Chemistry

JEE Advanced Revision Booklet

A Comprehensive Revision Program

Content

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IIT JEE | MEDICAL | FOUNDATION

JEE Advanced Revision Booklet	Stoichiometry-I & II

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. In the reaction : $CrO_5 + H_2SO_4 \longrightarrow Cr_2(SO_4)_3 + H_2O + O_2$
How many moles of O_2 are liberated by 1 mol of CrO_5 in above reaction?
(A) 5/2 **(B)** 5/4 **(C)** 9/2 **(D)** 7/4

2. A mixture of $Na_2C_2O_4$ and $KHC_2O_4.H_2C_2O_4$ required equal volumes of 0.2 M $KMnO_4$ and 0.2 M NaOH separately for complete titration. The mole ratio of $Na_2C_2O_4$ and $KHC_2O_4.H_2C_2O_4$ in the mixture is:
(A) 2/11 **(B)** 11/2 **(C)** 5/2 **(D)** 7/2

3. Following are given some of the unbalanced redox reactions showing all chemical speices participating during the reactions. Identify the redox reaction in which whole of reducing agent has not converted to one product?

(A) $Au + KCN + H_2O + O_2 \longrightarrow K[Au(CN)_4] + KOH$

(B) $V(OH)_4Cl + FeCl_2 + HCl \longrightarrow VOCl_2 + H_2O + FeCl_3$

(C) $KMnO_4 + KOH \longrightarrow K_2MnO_4 + O_2 + H_2O$

(D) $MnO + PbO_2 + HNO_3 \longrightarrow HMnO_4 + Pb(NO_3)_2 + H_2O$

4. A fluoride of Xenon reacts with excess of hydrogen to give 22.4 ml of Xenon at STP and liberated certain amount of HF, which is trapped in water. This hydrofluoric acid solution requires 60 ml of 0.1 M NaOH to neutralize it completely. The formula of Xenon fluoride will be:
(A) XeF_2 **(B)** XeF_4 **(C)** XeF_6 **(D)** XeF_8

5. 150 mL of solution of I_2 is divided into two unequal parts. 1st part reacts with 15 mL of 0.4 M Hypo solution in acidic medium. 2nd part was added to 100 mL of 0.3 M NaOH solution and residual base required 10 mL of 0.3 M H_2SO_4 solution for complete neutralization. What was the initial concentration of I_2?
(A) 0.08 M **(B)** 0.1 M **(C)** 0.2 M **(D)** 0.3 M

6. A sample of HCN yields potassium cyanide when titrated with 100 ml of 1 M KOH. The same HCN sample when titrated against 5 M $KMnO_4$ solution in acidic medium, the products formed are Mn^{2+}, NO_3^- and CO_2. The volume of $KMnO_4$ required would be:
(A) 400 ml **(B)** 120 ml **(C)** 200 ml **(D)** 40 ml

7. 1 mol of MnO_4^{2-} in alkaline aqueous medium disproportionates to:

(A) $\frac{2}{3}$ mol of MnO_4^- and $\frac{1}{3}$ mol of MnO_2 **(B)** $\frac{1}{3}$ mol of MnO_4^- and $\frac{2}{3}$ mol of MnO_2

(C) $\frac{1}{3}$ mol of Mn_2O_7 and $\frac{2}{3}$ mol of MnO_2 **(D)** $\frac{2}{3}$ mol of Mn_2O_7 and $\frac{1}{3}$ mol of MnO_2

8. RH_2 (ion exchange resin) can replace Ca^{2+} in hard water in a following way: $RH_2 + Ca^{2+} \longrightarrow RCa + 2H^{\oplus}$.

1 L of hard water after passing through RH_2 has pH = 2. Hence, hardness in ppm of Ca^{2+} is:

(A) 200 **(B)** 100 **(C)** 50 **(D)** 125

Paragraph for Questions 9 - 10

Air sample from an industrial area of Delhi, which is heavily polluted by CO_2, was collected and analysed. One such sample of 224 L of air measured at STP was passed through 500 mL of 0.1 M KOH solution, where $CO_2(g)$ was absorbed completely. 50 mL of the above solution was then treated with excess of $BaCl_2$ solution where all the carbonate was precipitated as $BaCO_3(s)$. The solution was filtered off and the filtrate required 30 mL of 0.1 M HCl solution for neutralisation.

9. The ppm strength of CO_2 (g) volume by volume (mL of CO_2 per 10^6 mL of air) is:

(A) 224 **(B)** 2240 **(C)** 100 **(D)** 1000

10. The weight of the precipitate of $BaCO_3(s)$ obtained from 50 mL of the above test solution is:
(Ba = 137, C = 12, O = 16, Mw($BaCO_3$) = 197g mol^{-1})

(A) 3.94 g **(B)** 0.394 g **(C)** 0.197 g **(D)** 1. 97 g

Paragraph for Questions 11 - 13

100 mL solution of ferric alum [$Fe_2(SO_4)_3.(NH_4)_2.SO_4.\ 24H_2O$](Mw = 964 g/$mol^{-1}$) containing 2.41g of salt was boiled with Fe when following reaction took place:

$Fe + Fe_2(SO_4)_3 \rightarrow 3\ FeSO_4$.

The unreacted iron was filtered off and the solution was titrated with M/60 $K_2Cr_2O_7$ solution in acidic medium.

11. Number of moles of $FeSO_4$ formed when Fe reacts with $Fe_2(SO_4)_3$ is :

(A) 0.0075 **(B)** 0.005 **(C)** 0.001 **(D)** 0.002

12. If instead of Fe, plate of Cu is put in $Fe_2(SO_4)_3$ then number of moles of $FeSO_4$ formed will be:

(A) 0.0075 **(B)** 0.005 **(C)** 0.001 **(D)** 0.002

13. Volume of $K_2Cr_2O_7$ reacted with $FeSO_4$ is:

(A) 25 mL **(B)** 50 mL **(C)** 75 mL **(D)** 100 mL

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

14. A solution containing Cu^{2+} and $C_2O_4^{2-}$ ions is titrated with 20 mL of M/4 $KMnO_4$ solution in acidic medium. The resulting solution is treated with excess of KI after neutralisation. The evolved I_2 is then absorbed is 25 mL of M/10 hypo solution. Which of the following statement(s) is/are correct?

(A) The difference in the number of mmol of Cu^{2+} and $C_2O_4^{2-}$ ions in the solution is 10 mmol

(B) The difference in the number of mmol of Cu^{2+} and $C_2O_4^{2-}$ ions in the solution is 12.5 mmol

(C) The equivalent weight of Cu^{2+} salt in the titration with KI is equal to the atomic weight of Cu^{2+}salt itself

(D) n_f of KI during reaction with Cu^{2+} salt is 1

15. 100 mL of M/10 $Ca(MnO_4)_2$ in acidic medium can be reduced completely with:

(A) 100 mL of 1 M $FeSO_4$ solution. **(B)** $\frac{100}{3}$ mL of 1 M FeC_2O_4 solution.

(C) 16.6 mL of 1 M $K_2Cr_2O_7$ solution. **(D)** 50 mL of 1 M $C_2O_4^{2-}$ solution.

16. Equivalent weight of Na_2HPO_4 can be:

(A) M/2 as base if H^+ is taken in excess. **(B)** M/1 as acid if OH^- is taken in excess

(C) M/1 as base if reacted with 1 equivalent of H^+ **(D)** Defined only as a base and not as an acid for this salt

17. (x) g of H_2O_2 requires 100 mL of M/5 $KMnO_4$ in a titration having pOH =1. Which of following statement(s) is(are) correct?

(A) The value of x is 1.7 g. **(B)** The value of x is 0.34 g.

(C) $MnO_4^{\ominus}$ changes to MnO_4^{2-} **(D)** H_2O_2 changes to O_2.

18. 20 mL of 6 M HCl is mixed with 50 mL of 2 M $Ba(OH)_2$ and 30 mL of water is added. Select the correct statement(s):

(A) $[OH^-]_{mix} = 0.8$ M **(B)** $[Cl^-]_{mix} = 1.2$ M

(C) $[Ba^{2+}]_{mix} = 0.2$ M **(D)** 40 mmol of OH^- are in excess.

19. A sample of oleum is labelled as 112% . Which of the following statement(s) is(are) correct for this sample?

(A) Addition of 9 g of water will leave 1/6 mole of SO_3 unreacted in it

(B) Addition of 9 g of water will make total mass of H_2SO_4 as 95.7 grams

(C) 53.3 g of H_2SO_4 is present in sample and rest is unreacted SO_3

(D) Addition of 12 g of water would react with 53.3 g of unreacted SO_3

20. The hardness of water due to HCO_3^- is 122 ppm. Select the correct statement(s).

(A) The hardness of water in terms of $CaCO_3$ is 200 ppm.

(B) The hardness of water in terms of $CaCO_3$ is 100 ppm.

(C) The hardness of water in terms of $CaCl_2$ is 222 ppm.

(D) The hardness of water in terms of $MgCl_2$ is 95 ppm.

21. One mole of Fe_2S_3 , 2 moles of H_2O and 3 moles of O_2 are allowed to react in following way:

$$2Fe_2S_3(s) + 6H_2O(l) + 3O_2(g) \longrightarrow 4Fe(OH)_3(s) + 6S(s)$$

Select the corect statement(s).

(A) H_2O would act as limiting reagent. **(B)** 1.33 moles of $Fe(OH)_3$ is formed.

(C) 6 moles of S is formed. **(D)** It is a non redox reaction.

22. Half litre each of three samples of H_2O_2 labelled as 10 volume , 15 volume , 20 volume are mixed and then solution is made 3 litre by addition of water. Select the correct statement(s).

(A) Final H_2O_2 solution would be labelled as 7.5 volume

(B) Normality of final H_2O_2 solution is 1.34

(C) Normality of final H_2O_2 solution is 1.5

(D) Final H_2O_2 solution would be labelled as 6.5 volume

23. Consider the following redox reaction: $KMnO_4 + Na_2S_2O_3 + H^+ \longrightarrow Mn^{2+} + SO_4^{2-} + K^+$

Which of the following is(are) true regarding the above reaction?

(A) $\frac{5}{8}$ mol of $Na_2S_2O_3$ is oxidised by 1 mole of $KMnO_4$

(B) Oxidation number of sulphur changes from $+4$ to $+12$

(C) Change of medium from acidic to basic will have no effect on the stoichiometry of reaction

(D) Change in medium from acidic to basic will change the nature of product

24. Which of the following can be oxidised further with a strong oxidising agent?

(A) SO_2 **(B)** MnO_2 **(C)** Al_2O_3 **(D)** CrO_3

25. A_2O_n is oxidised to AO_3^- by $KMnO_4$ solution in acidic medium. If 1.34 mmol of A_2O_n requires 32.2 mL of 0.05 M acidified $KMnO_4$ solution for complete oxidation, which of the following statement(s) is (are) correct?

(A) The value of n = 2

(B) Empirical formula of oxide of AO

(C) 1 mol of A_2O_n would require 1 mol of acidified $K_2Cr_2O_7$ solution

(D) 'A' can be metal belonging to Group-II of Periodic Table

26. 1.25 g of an acid is completely neutralised by 25 mL of a 0.25 M $Ba(OH)_2$ solution. Which of the following statement(s) is (are) correct?

(A) If the acid is dibasic, its molar mass would be 200

(B) If the acid is monobasic, its molar mass would be 400

(C) 0.50 g of the same acid would neutralize completely 12.5 mL of a 0.40 M NaOH solution

(D) 1 g of the same acid would neutralize completely 25 mL of a 0.40 M $Ca(OH)_2$ solution

27. 5 mmol of SO_2Cl_2 is hydrolysed completely to make a 100 mL solution. Which of the following statements is(are) correct? (Assume no gases were allowed to escape out of solution)

(A) The solution would be 0.05 M in H_2SO_4

(B) The solution would be 0.05 M in HCl

(C) If 10 mL of the stock solution is neutralised by 0.2 M NaOH, 10 mL of this base solution would be required

(D) If 10 mL of the solution is titrated with excess of $AgNO_3$, 1.5 mmol of AgCl would be formed

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

28. Given two mixtures: (A) NaOH and Na_2CO_3 (B) and $NaHCO_3$ and Na_2CO_3.

100 mL of mixture (A) required 'a' and 'b'mL of 1M HCl in separate titration using phenolphthalein and methyl orange indicators while 100 mL of mixture' (B) required 'x' and 'y' mL of same HCl solution is separate titration using the same indicators.

Column 1 [Mixture component]		**Column 2** [Milli moles]	
(P)	Na_2CO_3 in mixture (A)	**1.**	(2a - b)
(Q)	Na_2CO_3 in mixture (B)	**2.**	(y–2x)
(R)	NaOH in mixture (A)	**3.**	x
(S)	$NaHCO_3$ in mixture (B)	**4.**	(b – a)

Codes :

	P	Q	R	S		P	Q	R	S
(A)	2	3	4	1	**(B)**	1	3	2	4
(C)	4	3	1	2	**(D)**	2	1	3	4

29. MATCH THE FOLLOWING:

	Column 1 [Reaction]		**Column 2** [The value of x]
(P)	2.5 mol each of ferric oxalate and ferrous oxalate mixture will require *x* **mol** of $KMnO_4$ in acidic medium for complete oxidation.	**1.**	11.0
(Q)	2.5 mol each of ferric oxalate and ferrous oxalate mixture will require *x* **mol** of $K_2Cr_2O_7$ in acidic medium for complete oxidation.	**2.**	7.0
(R)	2.5 mol each of CuS and Cu_2S mixture will require *x* **mol** of $KMnO_4$ in acidic medium for complete oxidation.	**3.**	4.5
(S)	2 mol each of $KMnO_4$ and $K_2Cr_2O_7$ mixture will require *x* **mol** of H_2O_2 in acidic medium for complete reduction.	**4.**	3.75

Codes :

	P	**Q**	**R**	**S**		**P**	**Q**	**R**	**S**
(A)	2	3	4	1	**(B)**	3	4	2	1
(C)	4	2	1	3	**(D)**	3	1	2	4

30. MATCH THE FOLLOWING:

	Column 1 [Redox Reaction]		**Column 2** [Molar ratio of reducing agent to oxidising agent]
(P)	$Cr_2O_7^{2-} + FeC_2O_4 \rightarrow Cr^{3+} + CO_2 + Fe^{3+}$	**1.**	3 : 2
(Q)	$H_2O_2 + Cr(OH)_3 \rightarrow CrO_4^{2-} + H_2O$	**2.**	2 : 1
(R)	$N_2H_4 + Cu(OH)_2 \rightarrow N_2O + Cu$	**3.**	1 : 3
(S)	$MnO_4^{\ominus} + C_2O_4^{2-} \longrightarrow MnO_2 + CO_2$	**4.**	2 : 3

Codes :

	P	**Q**	**R**	**S**		**P**	**Q**	**R**	**S**
(A)	2	3	4	1	**(B)**	1	3	2	4
(C)	2	4	3	1	**(D)**	4	1	3	2

31. **MATCH THE FOLLOWING:**

	Column 1		Column 2 [Moles of product formed]
(P)	$N_2(g) + H_2(g) \rightarrow NH_3(g)$; (% yield = 80) 5 mol 9 mol ?	**1.**	3.5 mol
(Q)	$C(s) + H_2(g) \rightarrow C_2H_2(g)$; (% yield = 70) 12 mol 5 mol ?	**2.**	4 mol
(R)	$P_4(s) + O_2(g) \rightarrow P_2O_5(s)$; (% yield = 50) 5mol 20mol ?	**3.**	4.8 mol
(S)	$SO_2(g) + O_2(g) \rightarrow SO_3(g)$; (% yield = 75) 4 mol 3 mol ?	**4.**	3 mol

Codes :

	P	Q	R	S		P	Q	R	S
(A)	3	1	4	2	**(B)**	4	1	2	3
(C)	1	3	4	2	**(D)**	3	1	2	4

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

32. Number of moles of HCl used as reducing agent in the following reaction for per mole of $KMnO_4$ used is_____

$$KMnO_4 + HCl \longrightarrow KCl + MnCl_2 + Cl_2 + H_2O$$

33. 0.58 g of $CH_3(CH_2)_n COOH$ was burnt in excess of air and resulting gases (CO_2 and H_2O) were passed through excess NaOH. Then resulting solution was divided in two equal parts.

One part required 50 mL of 1.0 M HCl for complete neutralisation using phenolpthalein as indicator whereas another part required 80 ml of same HCl using methyl orange. Find the value of n.

34. $KIO_3 + KI + HCl \rightarrow KCl + I_2 + H_2O$

In the above reaction, if 1 mole of KIO_3 produces 0.27 mole of I_2, then what is percentage yield of reaction?

35. Moles of HNO_3 required as reducing agent to oxidise two moles of Mg in the following reaction is(are)_____

$$Mg + HNO_3 \longrightarrow Mg(NO_3) + N_2O + H_2O$$

36. A mixture is 0.04 M in Sn^{2+} and x M in Fe^{2+}. 15.0 mL of this mixture required 18.0 mL of 0.125 M $Cr_2O_7^{2-}$ solution to oxidise to Sn^{4+} and Fe^{3+} in acidic medium, $Sn^{2+} + Fe^{2+} + Cr_2O_7^{2-} \longrightarrow Cr^{3+} + Sn^{4+} + Fe^{3+}$. Thus, x is :

37. Amount of Mohr's salt $(FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O)$ having molar mass $392.0\,g\,mol^{-1}$ that must be dissolved in 250 mL solution to prepare an aqueous solution of density $1.00\,g\,mL^{-1}$ to have Fe^{2+} ion concentration 1 ppm by weight is $x \times 10^{-3}$ g. Find the numerical value of x.

38. RH_2 is an ion exchange resin used to purify water in RO. It can replace Ca^{2+} in hard water.

$$RH_2 + Ca^{2+} \longrightarrow RCa + 2H^+$$

Water coming out of ion exchange resin has $[H^+] = 0.01M$. The hardness of water in ppm of Ca^{2+} ion is _____.

39. In the Solvay process for producing sodium carbonate (Na_2CO_3), the following reactions occurs in sequence.

$$NH_3 + CO_2 + H_2O \longrightarrow NH_4HCO_3$$

$$NH_4HCO_3 + NaCl \longrightarrow NH_4Cl + NaHCO_3$$

$$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2$$

How much of Na_2CO_3 (in kg) would be produced per kg of NH_3 used if the process were 100% efficient?

40. In one reaction with a 95% yield, 225 mL of 1.50 M $Na_2CO_3(aq)$, 22.1 g NO and a large excess O_2 are allowed to react $2Na_2CO_3(aq) + 4NO(g) + O_2(g) \longrightarrow 4NaNO_2(aq) + 2CO_2(g)$

What mass of $NaNO_2$ (in g) is obtained based on experimental yield?

41. A solution contains 6.0 micromoles of Na_2SO_4 in 250 mL solution. Assuming no change in volume on dissolution, Na^+ in ppm present in solution is _____.

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. The Schrodinger wave equation for hydrogen atom is: $\psi_{2s} = \frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2-\frac{r}{a_0}\right)e^{-r/a_0}$

Where a_0 is Bohr's radius. If the radial node in 2s be at r_0, then r_0 would be equal to:

(A) $\frac{a_0}{2}$ **(B)** $2a_0$ **(C)** $\sqrt{2}a_0$ **(D)** $\frac{a_0}{\sqrt{2}}$

2. A hydrogen like species (atomic number *Z*) is present in a higher excited state of quantum number n. This excited atom can make a transition to the first excited state by successive emission of two photons of energies 10.20 eV and 17.0 eV respectively. Alternatively, the atom from the same excited state can make a transition to the second excited state by successive emission of two photons of energy 4.25 eV and 5.95 eV respectively. Determine the value of *Z*.

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

3. The frequency of first line of Balmer series in hydrogen atom is ν_0. The frequency of corresponding line emitted by singly ionized helium atom is:

(A) $2\nu_0$ **(B)** $4\nu_0$ **(C)** $\nu_0/2$ **(D)** $\nu_0/4$

4. The angular momentum of an electron in a Bohr's orbit of H-atom is 3.1652×10^{-34} kg-m^2/sec. Calculate the wavenumber in terms of Rydberg constant (R) of the spectral line emitted when an electron falls from this level to the ground state. [Use h = 6.6×10^{-34} Js]

(A) $R\left(\frac{8}{9}\right)$ **(B)** $R\left(\frac{5}{9}\right)$ **(C)** $R\left(\frac{7}{9}\right)$ **(D)** None of these

5. Electron present in H atom jumps from energy level 3 to 1. Emitted photons when passed through a sample containing excited He^+ ion causes further excitation to some higher energy level. Determine principal quantum number of initial excited level & higher energy level of He^+. (Given $E_n = -13.6\frac{Z^2}{n^2}$):

(A) $n_1 = 2,\ n_2 = 6$ **(B)** $n_1 = 2,\ n_2 = 3$ **(C)** $n_1 = 6,\ n_2 = 2$ **(D)** None of these

6. The frequency v of certain line of the Lyman series of the atomic spectrum of hydrogen satisfies the following conditions:

(i) It is the sum of the frequencies of another Lyman line and a Balmer line.

(ii) It is the sum of the frequencies of a certain line, a Balmer line and a Paschen line.

(iii) It is the sum of the frequencies of a Lyman and a Paschen line but no Brackett line.

To what transition does v correspond?

(A) $n_2 = 3$ to $n_1 = 1$ **(B)** $n_2 = 3$ to $n_1 = 2$ **(C)** $n_2 = 2$ to $n_1 = 1$ **(D)** $n_2 = 4$ to $n_1 = 1$

7. Radiation corresponding to the transition n = 4 to n = 2 in hydrogen atoms falls on a certain alkali metal (work function = 2.0 eV). Calculate maximum kinetic energy (in eV) of the photoelectrons.

(A) 0.55 **(B)** 5.5 **(C)** 55 **(D)** None of these

8. Photochemical dissociation produces a normal oxygen atom and a oxygen atom 2.5 eV more energetic than normal one. Also the average bond energy of O_2 into normal oxygen is 498 kJ/mol. Determine the longest wavelength required for photochemical decomposition of O_2.

(A) 126 nm **(B)** 140 nm **(C)** 163 nm **(D)** 178 nm

Paragraph for Questions 9 - 12

Paragraph # 1 : One of the fundamental laws of physics is that matter is most stable with the lowest possible energy. Thus, the electron in a hydrogen atom usually moves in the $n = 1$ orbit, the orbit in which it has the lowest energy. When the electron is in this lowest energy orbit, the atom is said to be in its ground electronic state. If the atom receives energy from an outside source, it is possible for the electron to move to an orbit with a higher n value, in which case the atoms is in an excited with a higher energy.

The law of conservation of energy says that we cannot create or destroy energy. Thus, if a certain amount of external energy is required to excite an electron from one energy level to another, then that same amount of energy will be liberated when the electron returns to its initial state.

Lyman series is formed when the electro returns to the lowest orbit while Balmer series is formed when the electron returns to second orbit. Similarly, Paschen, Brackett and Pfund series are formed when electrons returns to the third, fourth and fifth orbits from higher energy orbits respectively.

When an electron returns from n_2 to n_1 state, the number of lines in the spectrum will equal to $\frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

If the electron comes back from energy level having energy E_1, then the difference may be expressed in terms of energy of photon as : $E_2 - E_1 = \Delta E,\ \Delta E \Rightarrow \frac{hc}{\lambda}$

Since, h and c are constants, ΔE corresponds to definite energy; thus, each transition from one energy level to another will produce a radiation of definite wavelength. This is actually observed as a line in the spectrum of hydrogen atom.

Wave number of a spectral line is given by the formula $\overline{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ where R is a Rydberg's constant $\left(R = 1.1 \times 10^7\ m^{-1}\right)$.

Read the paragraph carefully and answer the following questions:

9. If the wavelength of series limit of Lyman series for He^+ ion is $x\,\mathring{A}$, then what will be the wavelength of series limit of Balmer series of Li^{2+} ion?

(A) $\frac{9x}{4}\mathring{A}$ **(B)** $\frac{16x}{9}\mathring{A}$ **(C)** $\frac{5x}{4}\mathring{A}$ **(D)** $\frac{4x}{7}\mathring{A}$

10. The emission spectra is observed by a consequence of transition of electron from higher energy state to ground state of He^+ ion. Six different photons are observed during the emission spectra, then what will be the minimum wavelength during the transition?

(A) $\frac{4}{27R_H}$ **(B)** $\frac{4}{15R_H}$ **(C)** $\frac{15}{16R_H}$ **(D)** $\frac{16}{15R_H}$

11. What transition in the hydrogen spectrum would have the same wavelength as Balmer transition, $n = 4$ to $n = 2$ in the He^+ spectrum?

(A) $n = 3$ to $n = 1$ **(B)** $n = 3$ to $n = 2$ **(C)** $n = 4$ to $n = 1$ **(D)** $n = 2$ to $n = 1$

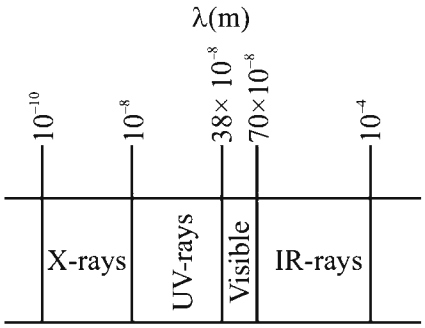
12. An electron in H-atom in M-shell on de-excitation to ground state gives .... spectrum lines.

(A) 10 **(B)** 6

(C) 3 **(D)** 1

Paragraph for Questions 13 - 16

Paragraph # 3 : The emission spectrum of H-atom and like species were studied by several scientists. All lines in UV region were studied by Lyman, all lines in visible region were studied by Balmer and the lines of longer wavelengths were studied by Paschen, Brackett and Pfund. The wavelength range of electromagnetic radiations are shown:



Read the paragraph carefully and answer the following questions:

13. For He^+, Lyman lines could be observed on spectrum when electron falls to:

(A) 1st Bohr orbit **(B)** 2nd Bohr orbit

(C) Either 1st or 2nd Bohr orbit **(D)** 1st, 2nd or 3rd Bohr orbit

14. For Li^{2+}, when an electron from a higher orbit falls to n^{th} Bohr orbit. Visible lines would be observed. Here n is:

(A) 1 **(B)** 2

(C) 4 **(D)** 3

15. For He^+, when an electron falls from a higher orbit to n^{th} orbit, all three types of lines i.e., UV, Visible and IR would be observed on the spectrum. Here, n could be:

(A) 1 **(B)** 2

(C) 3 **(D)** 4

16. Lines corresponding to which electronic transition in Li^{2+} ion would not be observed in the emission spectrum of H-atom?

(A) $6 \rightarrow 3$ **(B)** $8 \rightarrow 6$

(C) $9 \rightarrow 6$ **(D)** $12 \rightarrow 6$

Paragraph for Questions 17 - 19

Photon having wavelength 12.42 nm was allowed to strike a metal plate having work function 25 eV. Calculate the:

17. Maximum kinetic energy of photoelectrons emitted in eV.

(A) 76 Ev **(B)** 56 eV

(C) 7.6 eV **(D)** None of these

18. Wavelength of electron with maximum kinetic energy in Å.

(A) 14 Å **(B)** 1.4 Å

(C) 0.14 Å **(D)** None of these

19. Calculate the uncertainity in wavelength of emitted electron if the uncertainity in the momentum is 6.62×10^{-28} Kg m/sec. ($h = 6.62 \times 10^{-34}$ J- sec):

(A) 1.96×10^{-14} m **(B)** 0.96×10^{-14} m

(C) 19.6×10^{-14} m **(D)** None of these

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

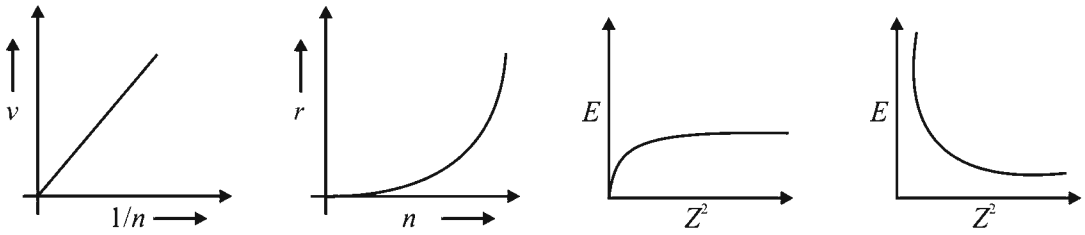
20. Select the correct curve (s):

If v = Velocity of electron in Bohr's orbit [Assume n to be continuous value]

r = Radius of electron in Bohr's orbit

P.E. = Potential energy of electron in Bohr's orbit

K.E. = Kinetic energy of electron in Bohr's orbit



(A) **(B)** **(C)** **(D)**

21. A sample of hydrogen atoms absorbs radiation of wavelength λ_0 and consequently emits radiations of six different wavelengths of which three wavelengths are shorter than λ_0. Choose the correct alternatives.

(A) The highest orbit occupied by the electron is the fourth orbit

(B) The initial orbit number of the electrons may be 2

(C) The initial orbit number of the electrons may be 3

(D) There are three transitions belonging to Lyman series

22. If the Binding energy of 2nd excited state of hypothetical H-like atom is 12 eV, then:

(A) Ist excitation potential = 81 V **(B)** II excitation energy = 96 eV

(C) Ionisation potential = 192 V **(D)** Binding energy of 2nd state = 27 eV

23. When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy $(K.E)_A$ and de-Broglie wavelength is λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.7 eV is $(KE)_B$, where $(KE)_B = (KE)_A - 1.5$ eV. If the de-Broglie wavelength of these photoelectrons is $\lambda_B (= 2\lambda_A)$, then:

(A) The work function of metal A is 2.25 eV **(B)** The work function of metal B is 4.20 eV

(C) $(KE)_A = 2$ eV **(D)** $(KE)_B = 2.75$ eV

24. Which of the following statements is/are INCORRECT:

(A) All spectral lines belonging to Balmer series in hydrogen spectrum lie in visible region

(B) If a light of frequency ν fall on a metal surface having work functional $h\nu$, photoelectric effect will take place only if $\nu \geq \nu_0$

(C) The number of photoelectrons ejected from a metal surface in photoelectric effect depends upon the intensity of intensity of incident radiations

(D) The series limit wavelength of Balmer series for H-atoms is $\frac{4}{R}$, where R is Rydber's constant

25. Which of the following statements are not correct about atomic orbital?

(A) Size of the atomic orbital depends on the azimuthal quantum number

(B) Shape of the atomic orbital depends on both principal and azimuthal quantum number

(C) Orientation of an atomic orbital depends on the spin quantum number

(D) Rotation of an electron in an atomic orbital depends on Heisenberg uncertainty principle

26. Which of the following statement(s) is/are not a part of Bohr's model of hydrogen atom?

(A) Splitting of spectral lines takes place in electric and magnetic field

(B) Energy of the electron in the orbit is not quantized

(C) Angular momentum of the electron in the orbit is quantized

(D) The radius and velocity of the electron in the orbit can be determined simultaneously

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

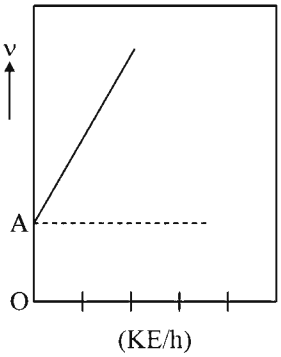
27. Calculate the number of waves made by a Bohr electron in one complete revolution in n^{th} orbit of H-atom, if ratio of de-Broglie wavelength associated with electron moving in nth orbit and 2^{nd} orbit is 3 : 1.

28. What is the total number of radial and angular nodes present in 5f orbital?

29. Given that, $r_{(n+1)} - r_n = r_{(n-1)}$, where r_n, r_{n-1} and r_{n+1} are Bohr's radius for H-atom in n^{th}, $(n-1)^{th}$ and $(n+1)^{th}$ shell respectively, then find the value of n.

30. The electron in the first excited state ($n_1 = 2$) of H-atom absorbs a photon and is further excited (n_2). The De-Broglie wavelength of the electron in this excited state is 1340 pm. Find the value of n_2.

31. Photoelectric effect can be expressed in terms of the following graph: [Given $h = 6.62\times10^{-34}$ Js]



Value of intercept $= 5\times10^{14}\,s^{-1}$

What is work function in kJ / mole for this photoelectric emission of electrons?

32. If the photon of wavelength 150 pm strikes an atom and one of its inner bound electrons is ejected out with a velocity of $1.5\times10^{7}\,ms^{-1}$, then binding energy by which electron is bound to nucleus is $x\times10^{-15}$ J. The numerical value of x is_____. Plank's constant $= 6.62\times10^{-34}$ Js, $C = 3\times10^{8}\,ms^{-1}$, $m_e = 9.11\times10^{-31}$kg)

33. The position of both, an electron and a helium atom is known within 1.0 mm.

Further more the momentum of the electron is known with $5.0\times10^{-26}\,kg\,ms^{-1}$.

The minimum uncertainly in the measurement of the momentum of the helium atom is $x\times10^{-26}\,kg\,ms^{-1}$. The numerical value of x is_____.

34. An electron in H-atom in its ground state absorbs 1.5 times as much as energy as the minimum required for its escape from the atom.

$$H(g)\longrightarrow H^{+}(g)+e^{-};\quad \Delta H = 13.6\,eV\,atom^{-1}$$

Thus, kinetic energy in eV of the emitted electron is_____.

35. Consider the following dissociation of O_2 (dissociation energy $498\,kJ\,mol^{-1}$)

$$O_2 \xrightarrow{hv} O+O^{*}$$

O* is more energetic than normal oxygen atom (O) by 1.967 eV. The maximum wavelength in nm for photochemical dissociation is _____. (Given: $N_A = 6.02\times10^{23}\,J\,mol^{-1}$, $h = 6.62\times10^{-34}\,Js$, $C = 3\times10^{8}\,ms^{-1}$)

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. In the reaction: $CO + \frac{1}{2}O_2 \rightarrow CO_2$; $N_2 + O_2 \rightarrow 2NO$

10 mL of mixture containing carbon monoxide and nitrogen required 7 mL of oxygen to form CO_2 and NO on combustion. The volume of N_2 in the mixture will be:

(A) 7/2 mL **(B)** 17/2 mL **(C)** 4 mL **(D)** 7 mL

2. Pay load is defined as, the difference between the mass of displaced air and the mass of the balloon. Calculate the pay load when a balloon of radius 10 m, mass 100 kg is filled with helium at 1.66 bar at 27°C. (Density of air = 1.2 kg m^{-3} and R = 0.083 bar dm^3K^{-1} mol^{-1}).

(A) 3602.35 kg **(B)** 3811.1 kg **(C)** 3204.89 kg **(D)** 3807.54 kg

Paragraph for Questions 3 - 4

Kinetic theory of gases is a generalization offered by Maxwell, Boltzman, Clausius, etc., to explain the behavior of ideal gases. This theory assumes that ideal gas molecules neither attract nor repel each other. Average kinetic energy of a gas molecules is directly proportional to the absolute temperature. A gas equation called kinetic gas equation was derived on the basis of kinetic theory.

$$PV = \frac{1}{3}mnv^2$$

3. The average kinetic energy per molecule of an ideal gas is equal to:

(A) 0.5 kJ **(B)** 0.5 RT **(C)** 1.5 KT **(D)** 1.5 RT^2

4. Which of the following do not pertain to the postulates of kinetic theory of gases?

(A) No loss in kinetic energy during collision.

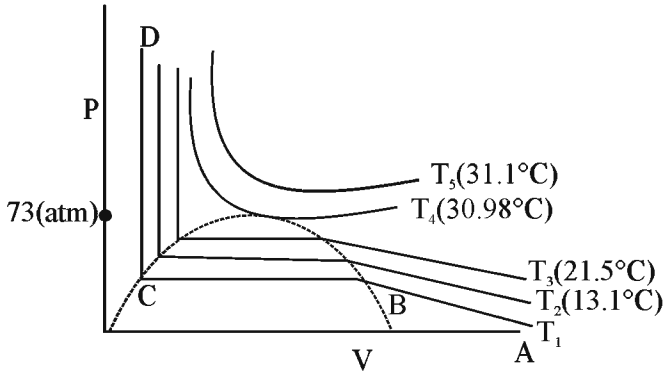
(B) Speed of gas molecules are ever changing.

(C) Pressure exerted by the gas is due to the collision of molecules with the walls of the container.

(D) Kinetic energy of a gas is given by the sum of 273 and temperature in Celsius scale.

Paragraph for Questions 5 - 7

For an ideal gas P, V curve is hyperbola but for any real gas the curves show variation. Andrew has observed the curve for CO_2 and concluded that other real gases also show similar curve. At high temperature real gas behaves similar to an ideal gas. Answer following questions on the given information.



5. The gas can't be liquefied when:

I. Pressure is greater than 73 at 30.98°C

II. Pressure is smaller than 73 at 30.98°C

III. Both P and T are greater than 73 and 30.98 respectively.

IV. At T_2 temperature pressure applied is 73

(A) TTTT **(B)** FTTF **(C)** TFTF **(D)** FFTT

6. For the curve ABCD. The vapour pressure is given by:

(A) Pressure corresponding to any point for AB **(B)** Pressure corresponding to any point for CD

(C) Pressure corresponding to any point for BC **(D)** Pressure corresponding to any point from A to D

7. The highest temperature at which the gas can be obtained in liquid state is:

(A) 31.1 **(B)** 30.98

(C) 13.1 **(D)** 21.5

8. 'a' and 'b' are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because:

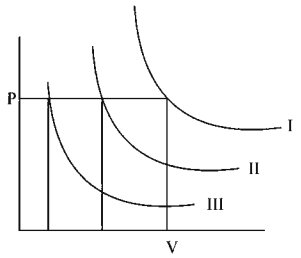
(A) a and b for Cl_2 > a and b for C_2H_6

(B) a and b for Cl_2 < a and b for C_2H_6

(C) a for Cl_2 < a for C_2H_6 but b for Cl_2 > b for C_2H_6

(D) a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6

9. I, II, III are three isotherms respectively at T_1, T_2 and T_3. Temperature will be in order:



(A) $T_1 = T_2 = T_3$

(B) $T_1 < T_2 < T_3$

(C) $T_1 > T_2 > T_3$

(D) $T_1 > T_2 = T_3$

10. A 0.5 dm^3 flask contains gas A and 1 dm^3 flask contains gas B at the same temperature. If density of A = 3.0 g dm^{-3} and that of B = 1.5 g dm^{-3} and the molar mass of A $= \frac{1}{2}$ of molar mass of B, then the ratio of pressure exerted by gases is:

(A) $\frac{P_A}{P_B} = 2$ **(B)** $\frac{P_A}{P_B} = 1$

(C) $\frac{P_A}{P_B} = 4$ **(D)** $\frac{P_A}{P_B} = 3$

11. The total kinetic energy of a sample of gas which contains N molecules at –123°C is E_K Joules. Another sample of gas at 27°C has total kinetic energy $2E_k$ Joules. The number of molecules in the second sample of gas is:

(A) N/2 **(B)** 2N **(C)** N **(D)** N^2

12. A solid P is kept in a sealed vessel containing He gas at 1 atm. at 27°C. The vessel is heated to 127°C such that all the solid P sublimes and the total pressure increases to 2atm. On further heating to 327°C, gaseous P further dissociates as per the reaction: $P(g) \longrightarrow Q(g) + R(g)$

Final pressure in the vessel will be:

(A) 2 atm **(B)** 3 atm **(C)** 3.33 atm **(D)** 4 atm

13. The compressibility factor of N_2 at 330K and 800 atm is 1.90 and at 570K and 200 atm is 1.10. A certain mass of N_2 occupies a volume of 1dm^3 at 330K and 800 atm. Calculate the volume of N_2 gas at 570K and 200 atm.

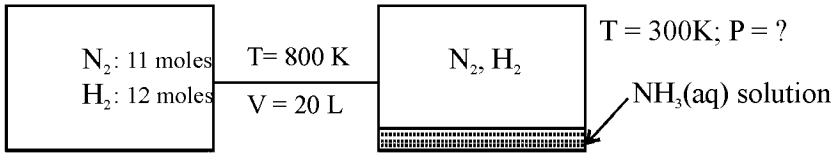
(A) 1 L **(B)** 2 L **(C)** 3 L **(D)** 4 L

14. The density of O_2 is maximum at:

(A) STP **(B)** 273 K and 2 atm

(C) 546K and 1 atm **(D)** 546 K and 2 atm

15. 11 moles N_2 and 12 moles of H_2 mixture reacted in 20 litre vessel at 800 K. After equilibrium was reached, 6 mole of H_2 was present. 3.58 litre of liquid water is injected in equilibrium mixture and resultant gaseous mixture suddenly cooled to 300 K. What is the final pressure of gaseous mixture? Neglect vapour pressure of liquid solution. Assume (i) all NH_3 dissolved in water (ii) no change in volume of liquid (iii) no reaction of N_2 and H_2 at 300 K.



Initial condition:

(A) 18.47 atm **(B)** 60 atm **(C)** 22.5 atm **(D)** 45 atm

16. Two closed vessel A and B of equal volume containing air at pressure P_1 and temperature T_1 are connected to each other through a narrow open tube. If the temperature of one is now maintained at T_1 and other at T_2 (where $T_1 > T_2$) then what will be the final pressure:

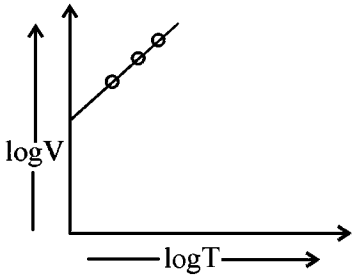
(A) $\frac{T_1}{2P_1T_2}$ **(B)** $\frac{2P_1T_2}{T_1+T_2}$ **(C)** $\frac{2P_1T_2}{T_1-T_2}$ **(D)** $\frac{2P_1}{T_1+T_2}$

MULTIPLE CORRECT ANSWERS TYPE

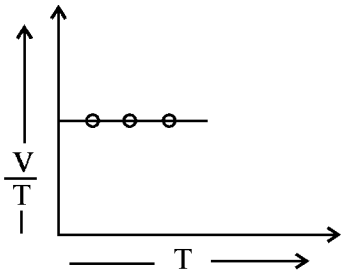
Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

17. Which of the following plots represents Charles' law?

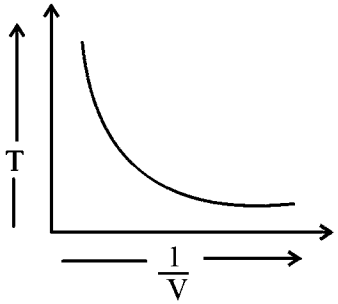
(A)



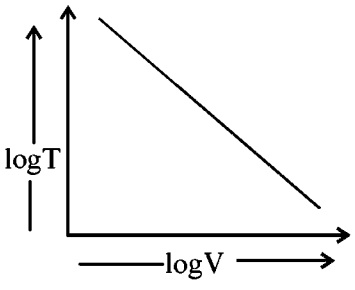
(B)



(C)



(D)



18. In a closed flask of 5L, 1.0 g of H_2 is heated from 300 K to 600 K. Which statements are correct:

(A) The rate of collision increases **(B)** The energy of gaseous molecules increases

(C) The number of moles of the gas increases **(D)** Pressure of the gas increases

19. The root mean square velocity of an ideal gas in a closed container of fixed volume is increased from 5×10^4 cm s^{-1} to 10×10^4 cm s^{-1}. Which of the following statements correctly explains how the change is accomplished?

(A) by heating the gas, the temperature is doubled

(B) by heating the gas, the pressure is quadrupled

(C) by heating the gas, the pressure is doubled

(D) by heating the gas, the temperature is quadrupled

20. Select the correct statement(s):

(A) At the limit of vanishing pressure, where all gases behave ideally, the volume tends to infinity and intermolecular distances becomes enormously large

(B) Gases with weak intermolecular forces obey the ideal gas law at relatively high pressures

(C) Gases with strong intermolecular forces obey the ideal gas law at relatively low pressures

(D) All the statements are incorrect

21. If temperature of a gas is raised, which of the following would be true?

(A) Fraction of the molecules possessing most probable velocity will increase

(B) Fraction of the molecules possessing most probable velocity will decrease

(C) Fraction possessing very low velocity will decrease

(D) Fraction possessing very high velocity will increase

22. Select the correct statement regarding the vander waal real gas:

(A) At low pressure $z = 1 + \dfrac{Pb}{RT}$

(B) More is the value of vander waal's constant 'a' easier will be the liquification of gas

(C) Boyle temperature is more than critical temperature

(D) $P_C = \dfrac{8a}{27Rb}$

23. Which of the following is(are) correct for a gas obeying vander waal's equation?

(A) A gas having negligible size and reasonable intermolecular force follow $\left(P + \dfrac{a}{V_m^2}\right)(V_m) = RT$

(B) A gas having negligible intermolecular force and reasonable size follow: $Z = 1 - \dfrac{Pb}{RT}$

(C) A gas having negligible size and negligible intermolecular force follow $PV_m = RT$

(D) At Boyle's temperature, gas follow $PV_m = RT$ at all pressure

24. Which of the following statement is correct about mean free path:

(A) λ remains unchanged on heating the gas in a closed container

(B) λ remains constant on heating the gas in a closed rigid container

(C) On increasing the T, λ increases (P and n constant)

(D) λ is inversely proportional to T

25. An open flask contains air at 27°C. Calculate the temperature at which it should be heated so that 2/3 rd of air measure at final temperature escapes out.

(A) 400 K **(B)** 450 K

(C) 500 K **(D)** 227°C

26. Which of the following equation can't be obtained from Vander Waal's equation for Z at proper conditions:

(A) $1+\frac{a}{RTV_m}$ **(B)** $1+\frac{Pb}{RT}$ **(C)** $1-\frac{a}{RTV_m}$ **(D)** $1-\frac{Pb}{RT}$

27. A gas at 250 K and 15 atm has a molar volume 12% smaller than that calculated from ideal gas low, find the correct option for the above condition:

(A) $Z = 0.90$ **(B)** $V_m = 1.2$ L

(C) 'b' is dominating **(D)** 'a' is dominating

28. Select the correct statement about Vander Waal's constant 'b':

I. It is excluded volume **II.** Its unit is L/mol

III. It depends on intermolecular force **IV.** Its value depends on molecular size

(A) II, III **(B)** I, II, IV

(C) II, III, IV **(D)** III, IV

29. Precisely 1 mole of Helium and 1 mole of Neon are placed in a container at same temperature. Indicate the correct statements about the system:

(A) Molecules of the two gases strike the wall of the container with same pressure

(B) Molecules of Helium & Neon have same average molecular speed

(C) Molecules of Helium has greater average molecular speed

(D) Helium exerts larger pressure as compared to Neon

30. If 10 gm of a gas at atmospheric pressure is cooled from 273°C to 0°C, keeping the volume constant, its pressure would become:

(A) $\frac{1}{273}$ atm **(B)** 2 atm

(C) $\frac{1}{2}$ atm **(D)** $5.05\times10^4\ N/m^2$

31. The compressibility of a gas is greater than unity at S.T.P. Therefore:

(A) $V_m > 22.4$ litres **(B)** $V_m < 22.4$ litres

(B) $V_m = 22.4$ litres **(D)** the gas will become less liquefiable

32. Select correct statements:

(A) Vapour may be condensed to liquid by the application of pressure

(B) To liquefy a gas one must lower the temperature below T_c and apply pressure

(C) At T_c there is no distinction between liquid and vapour state

(D) At T_c density of liquid is very high as compared to its gaseous state

33. Which of the following statement is/are correct?

(A) All real gases are less compressible than ideal gas at high pressure

(B) Hydrogen and Helium are more compressible than ideal gas for all values of pressure

(C) Except H_2 and He, the compressibility factor $Z=\left(\frac{PV}{nRT}\right)<1$ for all gases at low pressure

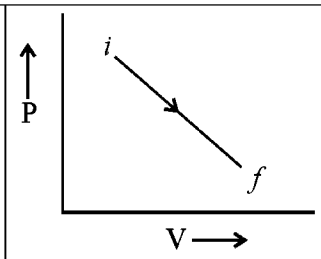
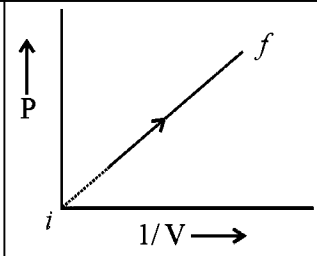
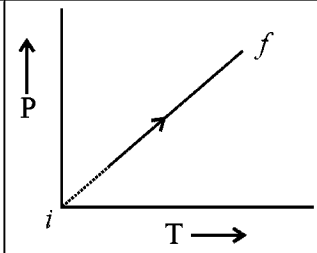
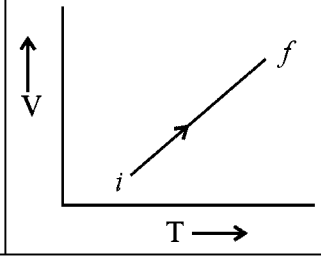
(D) The compressibility factor of real gases is independent of temperature

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

34. MATCH THE FOLLOWING:

A system is proceeding from initial state to final state by different ways column I shows diagrams for processes match it with column II (i.e. initial state, f = final state)

Column 1		Column 2	
(A)		(p)	Temperature will remain constant
(B)		(q)	Pressure will remain constant
(C)		(r)	Volume will be constant
(D)		(s)	Temperature may increase or decrease or may first increased and then decrease.

35. **MATCH THE FOLLOWING: (For an ideal gas)**

Column 1		Column 2	
(A)	If temperature of given gas is increased	**(p)**	Average speed of gas will increase
(B)	If pressure of a given gas is increased at constant temperature	**(q)**	Root mean square speed of gas molecules will increase
(C)	If the density of a given gas is lowered at constant temperature	**(r)**	Must probable speed of gas molecules will increase
(D)	If the volume of a given gas is increased at constant temperature	**(s)**	Speed of gas molecules will not change.

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

36. Consider 40 mL of a gaseous mixture of CO, CH_4 and Ne that was exploded with 10 mL O_2. On cooling, the gases occupied 36.5 mL. After treatment with KOH, the volume reduced by 9 mL and again on treatment with alkaline pyrogallol, the volume further reduced. Find the volume (in mL) of CH_4.

37. 16 mL of gaseous hydrocarbon when exploded with excess oxygen and then cooled, there was a contraction of 48 mL. On passing through KOH solution, there was a further contraction of 48 mL. Find the number of Carbon atoms in hydrocarbon.

38. Two vessels of volumes 16.4 L and 5 L contain two ideal gases of molecular existence at the respective temperature of 27°C and 227°C and exert 1.5 and 4.1 atmospheres respectively. The ratio of the number of molecules of the former to that of the later is _____.

39. The excluded volume of a molecule in motion is x times the actual volume of a molecule in rest. The value of x is _____.

40. If the ratio of masses of SO_3 and O_2 gases confined in a vessel is 1:1, then the sum of the ratio of their partial pressure would be _____.

41. Under identical condition of temperature and pressure, one litre of CH_4 weighed 1.2 g while 2 litre of another gaseous hydrocarbon C_nH_{2n-2} weighed 8.1 g. The value of n is _____.

42. The stopcock, connecting the two bulbs of volumes 5 litres and 10 litres containing an ideal gas at 9 atm and 6 atm respectively, is opened. The final pressure in the two bulbs if the temperature remained the same is _____.

43. At 400 K the root mean square (rms) speed of a gas x. (mol. wt. 40) is equal to the most probable speed of gas y at 60 K. The mol. wt. of the gas y is _____.

44. A sample of water gas has a composition by volume of 50% H_2, 45% CO and 5% CO_2. Calculate the volume in litre at S.T.P. of water gas which on treatment with excess of steam will produce 5 litre H_2. The equation for the reaction is:

$$CO + H_2O \longrightarrow CO_2 + H_2$$

45. The rate of diffusion of a sample of ozonised oxygen is 0.98 times than that of oxygen. Find the percentage (by volume) of ozone in the ozonised sample.

46. Consider the reaction

$$2X(g)+3Y(g)\longrightarrow Z(g)$$

Where gases X and Y are insoluble and inert to water and Z form a basic solution. In an experiment 3 mole each of X and Y are allowed to react in 15 lit flask at 500 K. When the reaction is complete, 5L of water is added to the flask and temperature is reduced to 300 K. The pressure in the flask is (neglect aqueous tension)_____atm. [Given: $R = 0.0821 L atm^{-1} mol^{-1} K^{-1}$]

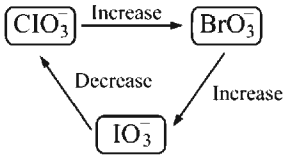
47. A mixture of carbon monoxide and carbon dioxide is found to have a density of 1.7 g/lit at S.T.P. The mole fraction of carbon monoxide is_____. [Given: $R = 0.0821 L\,atm\,mol^{-1} K^{-1}$]

SINGLE CORRECT ANSWER TYPE

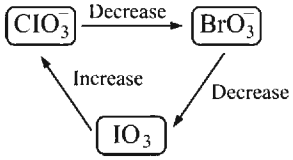
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Select diagram which represent the correct change in the bond angle of given ions.

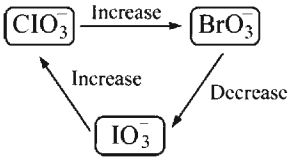
(A)



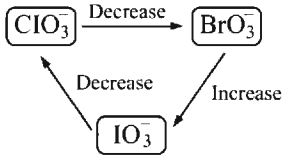
(B)



(C)

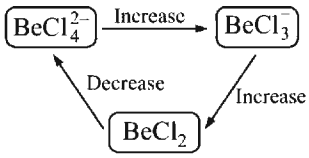


(D)

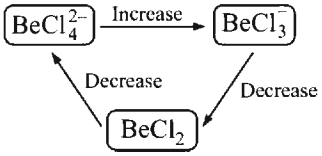


2. Select systematic diagram which represent the correct change in the % *s*-character in the hybrid orbital of beryllium.

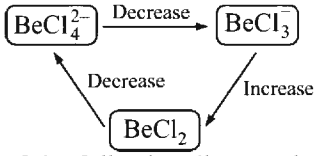
(A)



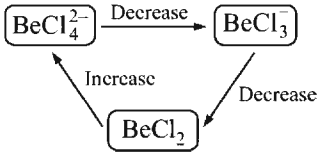
(B)



(C)

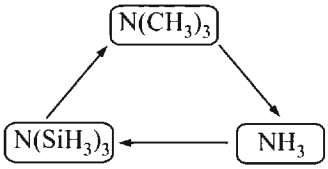


(D)

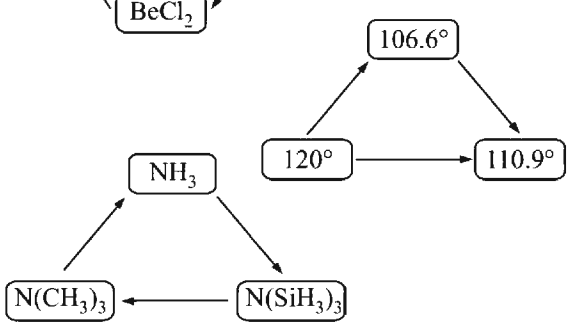


3. In which of the following diagram the change in the bond angle at nitrogen is observed as:

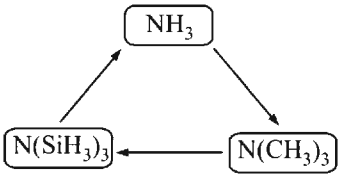
(A)



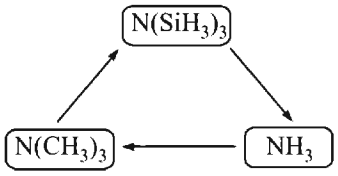
(B)



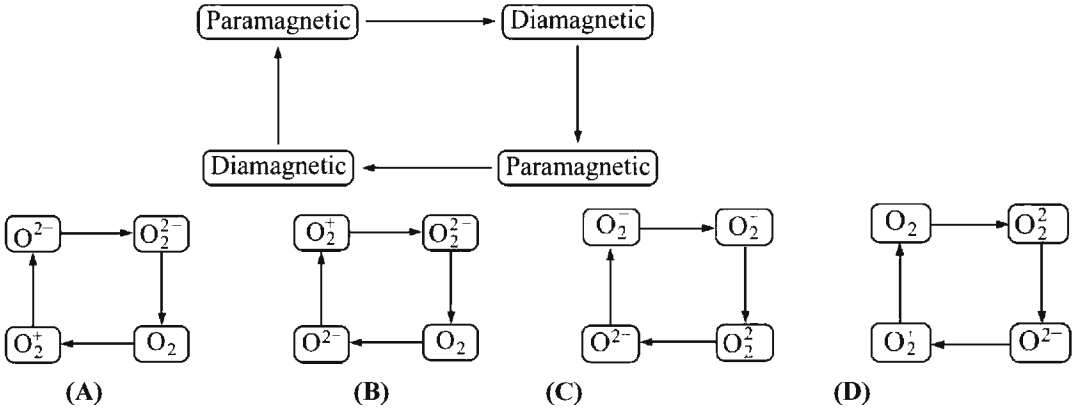
(C)



(D)



4. In which of the following diagram magnetic nature of species is changed as:



MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

5. In which pair first compound has more dipole moment than second compound?

(A) $P(CH_3)_2(CF_3)_3$, $P(CH_3)_3(CF_3)_2$ **(B)** CH_3Cl, CH_3F

(C) NH_3, NF_3 **(D)** Benzene, Borazine

6. In which of the following hybridisation lone pairs are not observed on opposite position?

(A) sp^3 **(B)** sp^3d **(C)** sp^3d^2 **(D)** sp^3d^3

7. Which of the following will result in zero overlap if molecular axis is x-axis?

(A) $1s - 2p_x$ **(B)** $2s - 2p_z$ **(C)** $2p_x - 2p_x$ **(D)** $1s - 2p_y$

8. If the molecular axis is z-axis, then which of the following sets of orbitals are not affected by s – p mixing for N_2 molecule?

(A) $\sigma 2s, \sigma 2p_z$ **(B)** $\pi 2p_x, \pi 2p_y$

(C) $\sigma 2s, \sigma^* 2s$ **(D)** $\pi^* 2p_x, \pi^* 2p_y$

9. Select correct statement for AB_nL_2 :

[A = central atom; L = lone pair of electron on A; n = number of monovalent atom B]

(A) Molecule will be planar and non polar when n = 4

(B) Molecule will be non planar and polar when n = 3

(C) Molecule will be planar and polar when n = 2

(D) Bond polarity is equal to molecular polarity when n =2

10. Which of the following has planar geometry in both monomeric and dimeric forms?

(A) ICl_3 **(B)** $AlCl_3$ **(C)** NO_2 **(D)** BH_3

11. In which case bond energy decreases from left to right?

(A) N_2, P_2, As_2, Sb_2 **(B)** F_2, Cl_2, Br_2, I_2

(C) O_2, S_2, Se_2, Te_2 **(D)** C_2, N_2, O_2, F_2

12. Select correctly matched.

(A) $Cr_2O_7^{2-} \Rightarrow$ two tetrahedral units are joined by their common corner

(B) $S_2O_6^{2-} \Rightarrow$ centre of one tetrahedral is the corner of other tetrahedral

(C) $S_2F_{10} \Rightarrow$ two octahedral joined together

(D) $S_2O_8^{2-} \Rightarrow$ two tetrahedral unit joined by their corners

13. In which of the following geometry of underlined atom is not changed on replacing all $-CH_3$ groups by $-SiH_3$?

(A) $(CH_3)_3\underline{N}$ **(B)** $H_3C\underline{N}CO$

(C) $H_3C\underline{O}CH_3$ **(D)** $(CH_3)_3\underline{P}$

14. $H_2N-\overset{\overset{O}{\|}}{C}-NH_2$ (urea), $HO-\overset{\overset{O}{\|}}{C}-OH$ (carbonic acid), $F-\overset{\overset{O}{\|}}{C}-F$ (carbonyl fluoride) have:

(A) different number of total lone pair **(B)** different number of total bond pairs

(C) same number of electrons **(D)** same number of σ - bond pairs

15. Which of the following is(are) iso-structural pairs?

(A) B_2H_6, C_2H_6 **(B)** Al_2Cl_6, C_2Cl_6

(C) B_2H_6, Al_2Cl_6 **(D)** C_2H_6, C_2Cl_6

16. Which is(are) not exist?

(A) B_2 **(B)** C_2 **(C)** Be_2 **(D)** Li_2

17. The bond order in O_2^+ is the same as in:

(A) N_2^+ **(B)** CN^- **(C)** CO **(D)** NO^+

18. The diamagnetic molecules are:

(A) B_2, C_2, N_2 **(B)** O_2, N_2, F_2 **(C)** C_2, N_2, F_2 **(D)** B_2, O_2^{2-}, N_2

19. The species having diamagnetic nature and bond order 1.0 is(are):

(A) O_2^{2-} **(B)** O_2^+ **(C)** O_2^{2+} **(D)** O_2

20. The species which does not show paramagnetism is(are):

(A) O_2 **(B)** O_2^+ **(C)** O_2^{2-} **(D)** H_2^+

21. Which of the following molecule has/have only σ type covalent bond between two non metallic atoms?

(A) CaC_2 **(B)** CsO_2 **(C)** Na_2O_2 **(D)** F_2

22. When N_2 is ionised to N_2^+, bond length ..... and if O_2 is ionised to O_2^+, bond length..... (Select correct option to fill the blank space respectively):

(A) Increases and decreases **(B)** Decreases and increases

(C) Increases and increases **(D)** Decreases and decreases

23. In which species the hybrid state of central atom is(are) sp^3d ?

(A) I_3^+ **(B)** SF_4 **(C)** PF_5 **(D)** IF_5

24. A molecule XY_2 contains two σ, two π-bonds and one lone pair of electron in the valence shell of X. The arrangement of lone pair and bond pairs is:

(A) Square pyramidal **(B)** Linear

(C) Trigonal planar **(D)** Unpredictable

25. Which of the following pairs of species have identical shapes?

(A) NO_2^+ and NO_2^- **(B)** PCl_5 and BrF_5 **(C)** XeF_4 and ICl_4^- **(D)** $TeCl_4$ and XeO_4

26. Indicate the wrong statement(s):

(A) A sigma bond has no free rotation along its axis

(B) p-orbitals always have only sidewise overlapping

(C) s-orbitals never form π-bonds

(D) There can be more than one sigma bond between two atoms

27. Which of the following molecules or ions is(are) linear?

(A) $BeCl_2$ **(B)** ICl_2^- **(C)** CS_2 **(D)** ICl_2^+

28. Assume that BrF_3 in liquid phase intermolecularly exchanges one F^- ion to give an ion pair, then which of the following statement(s) is(are) correct?

(A) Cation is sp^3 hybrid and anion is sp^3d^2 hybrid **(B)** Cation and anion both are planar

(C) Cation is non-planar and anion is planar **(D)** Cation is planar and anion is non-planar

29. Select correct statement(s).

(A) All $N-N$ bond length are same in N_3^- (Azide) ion

(B) All $N-N$ bond length are not identical in HN_3 (Hydrazoic acid)

(C) In HN_3 terminal $N-N$ bond length is shorter that the central $N-N$ bond length

(D) Azide ion and hydrazoic acid have same number of electron

Paragraph for Questions 30 - 32

Bond formation between two atoms is then envisaged as the progressive overlapping of an atomic orbital from each of the participating atoms, the greater the overlap achieved (the overlap integral), the stronger the bond so formed.

30. For σ bond formation the relative overlapping power of:

(A) s-orbital is greater than p-orbital because s-orbital are closer to nucleus

(B) p-orbitals is greater than s-orbital because p-orbitals are far away from nucleus

(C) s-orbital is greater than p-orbital because of spherical shape of s-orbital

(D) p-orbital is greater than s-orbital because electrons of p-orbitals are oriented on internuclear axis

31. In which of the following pair both have similarity in bond angle(s) between adjacent chlorine?

(A) PCl_3, $PCl_4^{\oplus}$ **(B)** $PCl_4^{\oplus}$, PCl_5 **(C)** PCl_5, $PCl_6^{\ominus}$ **(D)** $PCl_4^{\oplus}$, $PCl_6^{\ominus}$

32. In inorganic benzene ($B_3N_3H_6$):

(A) Only six $(sp^2-sp^2)\sigma$ bonds and three $p\pi-p\pi$ coordinate bond

(B) Twelve $(sp^2-sp^2)\sigma$ bonds and three $p\pi-p\pi$ coordinate bond

(C) Six $(sp^2-sp^2)\sigma$ bonds, six $(sp^2-s)\sigma$ bonds and three $p\pi-p\pi$ coordinate bond

(D) Six $(sp^2-sp^2)\sigma$ bonds, six (sp^2-sp^2) coordinate π-bond

Paragraph for Questions 33 - 34

The shape of a molecule is determined by the number of groups of electrons around the central atom. The 'groups' might be a non-bonding single electron, a non-bonding or bonding pair of electrons, a double pair of bonding electrons or triple pair of bonding electrons etc. The electron 'groupings' minimise the repulsion to decrease potential energy of the system i.e., to make the Q – X – Q angle as wide as possible. (X = central atom, Q = surrounding atom).

According to VSEPR theory repulsive interaction are summarized as lone pair – lone pair > lone pair – bond pair > bond pair – bond pair. So that as the lone pair – 'other pair repulsion increases, the angle between these pairs increases, so the Q – X – Q angle will be slightly reduced compared to what might be expected from the simple geometry or shape.

33. In which of the following pair both species have same Cl – X – Cl bond angle?

I. CCl_4, $SiCl_4$ **II.** $POCl_3$, SO_2Cl_2 **III.** BCl_3, $AlCl_3$ **IV.** $SOCl_2$, $COCl_2$

(A) I, II **(B)** III, II, I **(C)** I, III **(D)** II, IV

34. In which of the following species presence of L.P does not affect idealized bond angle?

I. PF_3 **II.** BrF_3 **III.** IF_5 **IV.** ICl_4^- **V.** XeF_2

(A) I, II, III **(B)** IV, V **(C)** II, V **(D)** None of these

Paragraph for Questions 35 - 37

The mixing or redistribution of energy among the atomic orbitals is known as hybridisation. In hybridisation each electron can be described by its wave function ψ.

35. Which of the following set of species has same electronic geometry?

(A) PCl_3, NH_3, SO_3 **(B)** CH_4, NH_3, H_2O **(C)** ClF_3, BF_3, NF_3 **(D)** CO_2, SiO_2, SO_2

36. In which of the following species lone pair-bond pair repulsion is maximum?

(A) NH_3 **(B)** NF_3 **(C)** SF_4 **(D)** NO_2^-

37. BF_3 form adduct with NH_3 as Lewis acid-base reaction, in which atom hybridisation will change?

(A) Both N and B **(B)** Only B not N **(C)** Only N not B **(D)** None of these

Paragraph for Questions 38 - 40

Xe reacts with F_2 at different ratio to give different types of xenon fluorides.

$$\underset{(2:1)}{Xe + F_2} \longrightarrow XeF_2 \quad ; \quad \underset{(1:5)}{Xe + F_2} \longrightarrow XeF_4 \quad ; \quad \underset{(1:20)}{Xe + F_2} \longrightarrow XeF_6$$

38. Which of the following option is correct regarding XeF_2?

(A) Two fluorine occupy equatorial position

(B) There are total two bond pair and two lone pair present in XeF_2

(C) Its structure is linear and it is isostructural with I_3^-

(D) Hybridisation of XeF_2 is sp^3

39. The shape and hybridisation of XeF_4 is:

(A) tetrahedral and sp^3 **(B)** square pyramidal and $sp^2 d$

(C) square planar and sp^3d **(D)** square planar and sp^3d^2

40. In XeF_6 the number of lone pair and bond pair is respectively and its hybridisation is:

(A) 0, 6 ; $sp^3 d^2$ **(B)** 1, 6; $sp^3 d^3$ **(C)** 0, 5; $sp^3 d$ **(D)** 1,5;sp^3d^2

Paragraph for Questions 41 - 43

Bond Length : Internuclear distance between two adjacent atoms in a species is known as bond length. Bond length depends on:

(i) Size of the atom involved in the bond formation

(ii) Size of the orbitals involved in the bond formation

(iii) Lone pair-lone pair repulsion **(iv)** Resonance **(v)** s-character of combining orbital

With the increasing size of the atoms and atomic orbitals bond length increase. Lone pair repulsion increases bond length (if atoms are small sized) whereas resonance can increase some bond lengths and decrease some other bond length. With increasing s-character bond length decreases, whereas with increasing multiplicity of bonds, bond length decreases. However, in some cases, bond lengths are also affected by relative position of bonds (between two similar atoms). Usually but not always with increasing bond length, bond strength (and hence bond dissociation energy) decreases.

41. The correct order B – F bond length follows the sequence:

(A) $BF_3 < BF_2OH < BF_2NH_2 < BF_4^-$ **(B)** $BF_2NH_2 < BF_2OH < BF_3 < BF_4^-$

(C) $BF_3 < BF_4^- < BF_2OH < BF_2NH_2$ **(D)** $BF_3 < BF_2NH_2 < BF_2OH < BF_4^-$

42. Consider the following statements:

I. Percentage of σ - bonding in $C-O$ bond follows the sequence $CO < CO_2 < CO_3^{2-}$

II. Relative strength of π – bonding in BX_3 $(X = F, Cl, Br, I)$ follows the sequence $BF_3 = BCl_3 > BBr_3 > BI_3$

III. The correct order of bond length $(S-O)$ follows the sequence $SO_3 < SO_4^{2-}$

IV. π - bond order follows the sequence $ClO_2^- > ClO_3^- > ClO_4^-$

Using 'T' for 'True' and 'F' for 'False' statement in the given sequence, pick the correct set of codes.

(A) TFTT **(B)** TFTF **(C)** TTFT **(D)** FTTF

43. In which of the following all bonds are not equivalent?

(A) N_2O **(B)** CN_2^{2-} **(C)** N_3^- **(D)** NO_2^-

Paragraph for Questions 44 - 46

There are some cases in which the number of available valency electrons is not sufficient to displays the normal electron pair bonds (i.e., 2 centre-2 electron, $2c-2e^-$) among all the constituent atoms. This type of compounds is generally referred to as electron deficient compounds. Here it is worth nothing that in a particular compound, all the bonds are not to be necessarily electron deficient. The occurrence of electron deficient covalent bonds is a common feature in some classes of compounds of group IIIA elements. For example, boron contains only three valence electron and it stands as a typical example of electron deficient atoms.

Retaining the valence bond concept of relationship between bond distance and bond order we encounter a problem on examining the known structure of some electron deficient compound like diborane. Satisfactory theories of bonding in electron deficient compounds introduce the concept of $3c-2$ electron bond. A simple extension to include $3c-2e$ bond explain many electron deficient compound.

44. Select correct statement about B_2H_6 (diborane) and C_2H_6 (ethane).

(A) B_2H_6 has total 12 valence electrons but C_2H_6 has total 18 valence electrons

(B) Each compound contains four identical $M-H$ bonds (M = B or C)

(C) Every sp^3 orbital of central atom in B_2H_6 is associated with H but not so in C_2H_6

(D) Free rotation around central atoms is possible in both

45. Molecule in which three centred two electron bond present is:

I.	Si_2H_6	**II.**	C_2H_4	**III.**	P_2H_4	**IV.**	Be_2H_4
(A)	III and IV	**(B)**	I, II and III	**(C)**	Only IV	**(D)**	I and IV

46. Select correct statement about solid BeH_2 and solid $BeCl_2$.

(A) Both have similar structure but different bonding

(B) Both have similar bonding but different structure

(C) Both have similar bonding and structure

(D) Both have different bonding and structure

Paragraph for Questions 47 - 49

47. Select incorrect statement about $Li[AlH_4]$.

(A) Hybridistation of Al is same as B in $Na[BH_4]$

(B) Geometry around Al is same as $AlCl_4^-$

(C) $AlH_4^-, BH_4^-, AlCl_4^-$ are iso-structural

(D) $AlH_4^-, AlCl_4^-, BH_4^-$ are iso-electric

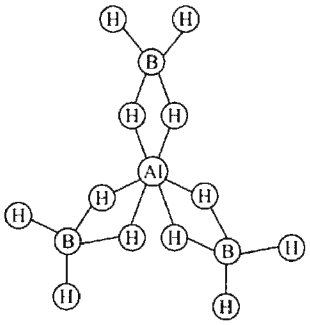
48. Select correct about $Al(BH_4)_3$:

(A) Each tetrahydride borate form two hydrogen bridges

(B) Two BH_4 form 2 hydrogen bridges and one BH_4^- form one hydrogen bridge

(C) One BH_4^- form 2 hydrogen bridge and two BH_4^- form one hydrogen bridge

(D) B form only $2c-2e$ bond



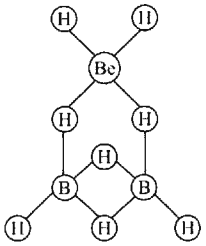
49. Total $2c-2e$ and $3c-2e$ bonds in $Be(BH_4)_2$ are respectively:

(A) 6, 4

(B) 4, 6

(C) 4, 4

(D) 4, 8



50. Which of the following is not correct?

(A) During N_2^+ formation, one electron is removed from the bonding molecular orbitals

(B) During O_2^+ formation, one electron is removed from the antibonding molecular orbital

(C) During O_2^- formation one electron is added to the bonding molecular orbital

(D) During CN^- formation one electron is added to the bonding molecular orbital

51. Which of the following pairs have identical bond order?

(A) N_2^+ and O_2^+ **(B)** F_2 and Ne_2 **(C)** O_2 and N_2 **(D)** C_2 and N_2

52. Among the following the incorrect statement:

(A) NO has one unpaired electron in the antibonding molecular orbital

(B) Bond length of $NO > NO^+$

(C) Magnetic moment of N_2^+ is $\sqrt{3}$ B. M.

(D) Magnetic moment of O_2 is zero

Paragraph for Questions 53 - 55

Hydrogen bonding is said to be formed, when slightly acidic hydrogen atom attached to a strongly, electronegative fluorine, oxygen or nitrogen atom, is held with weak electrostatic forces by the non-bonded pair of electrons of another atom. The co-ordination number of hydrogen in such cases is two. It acts as a bridge between two atoms, to one of which it is covalently bonded and to other attached through electrostatic forces, also called Hydrogen bond.

Though the hydrogen atoms in a methyl group are not polarised, if an electronegative group like chloro, carbonyl, nitro or cyano (in order to increase electronengativity) is attached to it, the $C-H$ bond gets polarised due to the inductive effect and the hydrogen atom becomes slightly acidic resulting in the formation of weak hydrogen bonds.

Though a weak bond, the H-bond effect a large number of the physical properties of compounds some of which are:

- Boiling point of liquids.
- Solubility of polar compounds in polar solvents (containing H attached with strong electronegative atom).
- Viscosity of liquids.
- Acidity

53. Which of the following combination can involve hydrogen bonding?

I. Mixture of KF and HF. **II.** Mixture of CH_3COCH_3 and $CHCl_3$

III. Mixture of NH_4Cl and H_2O **IV.** Mixture of CH_3OCH_3 and H_2O

(A) (I), (II) and (IV) **(B)** (I) and (II)

(C) (I), (II) and (III) **(D)** (I), (II), (III) and (IV)

54. For which of the following intramolecular H-bonding is not responsible?

(A) High value of pKa_2 for maleate acid ion $\begin{pmatrix} CHCOO^- \\ \| \\ CHCOOH \end{pmatrix}$ as compared to fumarate ion $\begin{pmatrix} CHCOO^- \\ \| \\ CHCOOH \end{pmatrix}$

(B) High viscosity of H_3PO_4 compared with $(CH_3)_3PO_4$

(C) High volatility of ortho-nitrophenol compared with para-isomer

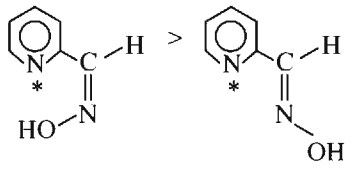
(D) Stability of chloral hydrate $[CCl_3CH(OH)_2]$ compared with $CH_3CH(OH)_2$

55. Which of the following is incorrectly matched?

(A) $H_2O > HF$ - (Enthalpy of vaporistaion)

(B) $SbH_3 > NH_3 > AsH_3 > PH_3$ - (Boiling point)

(C) $CH_2OHCHOHCH_2OH > CH_2OHCH_2OH$ - (Viscosity)

(D)  - (Basicity of starred nitrogen)

Paragraph for Questions 56 - 58

Boiling point of covalent compound depends on intermolecular force. Intermolecular forces are the force of attraction and repulsion between interacting particles (atoms and molecules). This term does not include the electronic forces that exist between the two oppositely charged ions and the forces that hold atoms of a molecule together i.e., covalent bonds.

56. Which of the following hydrogen bond is the strongest?

(A) $O-H\text{- - -}N$ **(B)** $F-H\text{- - -}F$ **(C)** $O-H\text{- - -}O$ **(D)** $O-H\text{- - -}F$

57. Liquidation of which gaseous substance will arise as a result of momentary imbalance in electronic distribution?

(A) $Ammonia_{(g)}$ **(B)** $Carbon\ monoxide_{(g)}$ **(C)** $Na^+_{(g)}\ Cl^-_{(g)}$ **(D)** $Xenon_{(g)}$

58. In which triad, first one has the highest boiling point?

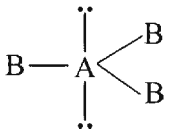
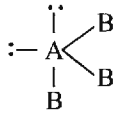
(A) PH_3, AsH_3, SbH_3 **(B)** HBr, HCl, HF

(C) $CH_3-O-CH_3, CH_3-S-CH_3, CH_3-Se-CH_3$ **(D)** AlF_3, SiF_4, PF_5

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labelled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

59. **MATCH THE FOLLOWING:**

Column 1		Column 2	
(A)	**Statement-1 :** In BCl_3, all Cl atoms are in same plane of B but in PCl_3 all Cl atoms are not in the plane of P. **Statement-2 :** In BCl_3, all Cl atoms are on corner of triangular plane but in PCl_3 all Cl atoms are on the base of the pyramid.	**(p)**	Statement-1 is correct.
(B)	**Statement-1 :** H_3PO_3 and H_3BO_3 increase H^+ ions concentration in water by different way. **Statement-2 :** In H_3PO_3 two hydrogens ionize in water but by H_3BO_3 only one hydrogen is lost in water.	**(q)**	Statement-2 is correct.
(C)	**Statement-1 :** AB_3E_2 type molecules have  type of arrangement rather than  (E = lone pair) **Statement-2 :** Structure have maximum symmetry and least valence shell electron pair repulsions out of all the hypothetical possibilities.	**(r)**	Statement-2 is correct explanation of Statement-1.
(D)	**Statement-1 :** In $H_2C=C=O\,(\text{ketene})$ all the π - electrons are in same plane but in $H_2C=C=CH_2\,(\text{allene})$ all π - electrons are not in same plane. **Statement-2 :** $H_2C=C=O$ is planar but $H_2C=C=CH_2$ is non-planar.	**(s)**	Statement-2 is incorrect.
		(t)	Statement-1 is incorrect

60. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	CsCl, CsBr, CsI	**(p)**	Increasing order of covalent character
(B)	LiOH, NaOH, KOH	**(q)**	Decreasing order of thermal stability
(C)	LiH, NaH, KH	**(r)**	Decreasing order of lattice energy
(D)	Mg_3N_2, Ca_3N_2, Sr_3N_2	**(s)**	Increasing order of thermal stability
		(t)	Increasing order of ionic character

61. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Only $p\pi - p\pi$ bond is present	**(p)**	S_3O_9
(B)	Only $p\pi - d\pi$ bond is present	**(q)**	$H_3P_3O_9$
(C)	Both $p\pi - d\pi$ and $p\pi - p\pi$ bonds are present	**(r)**	SO_3
(D)	$X - O - X$ bond is present	**(s)**	CO_3^{2-}
		(t)	P_4O_{10}

62. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	CN	**(p)**	B.O. of corresponding cation ≥ 2
(B)	N_2	**(q)**	B.O. increasing when converted to corresponding (monopositive) cation
(C)	O_2	**(r)**	B.O. decreases when converted to corresponding anion (mononegative)
(D)	NO	**(s)**	Paramagnetic in both cationic (monopositive) as well as anionic (mononegative) form

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

63. Out of given ten molecules total molecules which have dipole moment zero is:

IOF_5, H_2O_2, ClF_3, CO_2, SO_2, P_4S_8, $CH_2(CN)_2$, $C_2(CN)_4$, C_2N_2

64. In the following nine series select total number of series in which IInd member has high boiling point as compared to Ist member.

Series – CH_4, SiH_4, SnH_4

Series – NH_3, PH_3, AsH_3, SbH_3

Series – HF, HCl, HBr, HI

Series – He, Ne, Ar, Kr

Series – F_2, Cl_2 Br_2, I_2

Series – H_2O, H_2S, H_2Se, H_2Te

Series – BF_3, BCl_3, BBr_3

Series – o-dichlorobenzene, m-dichlorobenzene, p-dichlorobenzene

Series – o-hydroxybenzaldehyde, m-hydroxybenzaldehyde, p-hydroxybenzaldehyde

65. For the given species number of species which do/does not exist:

$BF_6^{3-}, BiCl, SH_2, HN_3, SI_6, CsXeF_5, PbI_2, ClF_7, NF_6^-, Li_2CO_3, KH_3$

66. Out of given 9 statements total number of statements which are correct for graphite.
Statement – Three dimenstional network like structure.
Statement – C is sp^2 hybridised
Statement – Lubricant use
Statement - π - bond(s) present
Statement –C – C bond length is almost same as C_2H_6
Statement – van der waals forces present
Statement – Used as a abrasive
Statement – C – C bond length is more than $H-C\equiv C-H$
Statement – It conducts electricity.

67. Total number of water molecule(s) consumed for complete hydrolysis of one molecule of P_4O_{10} is:

68. Total number of oxygen atom(s) which act as bridge between any two silicon atom in mineral with composition $MM'Si_3O_x$ (M = divalent metal ion and M' = tetravalent metal ion).

69. Find the number of molecules or ions in which d-orbitals is(are) not used in hybridisation.

$PCl_6^-, PCl_4^+, IF_4^-, IF_5, XeO_3F_2, ICl_2^+, SF_2, SF_6, AsF_4^+, SiF_4$

70. Find the total number of non-linear species out of given species:

$I_3^-, BeCl_2, NH_2^-, OH_2, XeF_2, N_2O, SO_2, SF_2$

71. Total number of molecules in which all the possible bond angles are identical:

$PF_3, CF_4, XeF_4, PF_5, IF_7, BeF_2, SF_6$

72. How many comparison(s) are INCORRECT among given?

(i)	H > Li (ionization energy)	(ii)	Li > Be (size)
(iii)	Na > Rb (size)	(iv)	O > N (size)
(v)	S > P (ionisation energy)	(vi)	C > O (size)
(vii)	B > Al (size)	(viii)	F > Cl (ionization energy)
(ix)	N > O (ionization energy)		

73. Observed dipole moment of LiF is 6.32 D. Calculate percentage ionic character of LiF if bond length (Li – F) is 0.156 nm.

74. P_4 is stable form of phosphorus. The percentage of p-character in the orbital forming (P – P) bond in P_4 is:

75. At 300K and 1.00 atm, density of gaseous HF is $3.17\,gL^{-1}$. How many HF molecules are associated by H-bonding?
[Given: R = $0.0821\,Latm\,mol^{-1}\,K^{-1}$, Atomic mass of H = 1, F = 9]

76. A total of $n\times10^{20}$ energy levels are present in 3s conduction band of single crystal of sodium weighing 26.8 mg. What is the value of n?

SINGLE CORRECT ANSWER TYPE

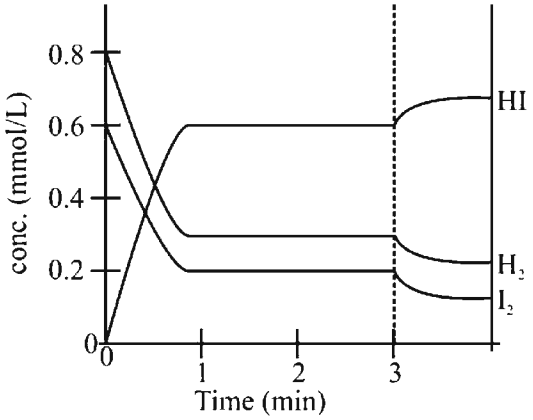
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. At a certain temperature the equilibrium constant K_c is 0.25 for the reaction: $A_2(g) + B_2(g) \rightleftharpoons C_2(g) + D_2(g)$

If we take 1 mole of each of the four gases in a 10 litre container, what would be equilibrium concentration of $A_2(g)$.

(A) 0.12 **(B)** 0.13 **(C)** 0.14 **(D)** 0.15

2. The equation for the reaction in the figure below is: $H_2(g) + I_2(g) + \text{Heat} \rightleftharpoons 2HI(g)$.



At the instant 3 min, what change was imposed into the equilibrium?

(A) Pressure was increased **(B)** Temperature was increased

(C) Iodine was added to the system **(D)** Hydrogen was added to the system

3. A flask containing 0.5 atm of $A_2(g)$ contains some solid AB which undergoes dissociation according to

$$2AB\,(s) \rightleftharpoons A_2(g) + B_2(g).\ K_p = 0.06\ atm^2$$

Calculate the total pressure (in atm) at equilibrium:

(A) 0.70 atm **(B)** 0.80 atm **(C)** 0.90 atm **(D)** 1.0 atm

4. If for $2A_2B(g) \rightleftharpoons 2A_2(g) + B_2(g)$, K_p = total pressure (at equilibrium) and starting the dissociation from 4 moles of A_2B, then:

(A) degree of dissociation of A_2B will be (2/3)

(B) total number of moles at equilibrium will be (14/3)

(C) at equilibrium the number of moles of A_2B are not equal to the number of moles of B_2

(D) at equilibrium the number of moles of A_2B are equal to the number of moles of A_2

5. 0.96 gm of HI was heated at 720 K till the equilibrium. The % dissociation of HI was found to be 21%. The volume and concentration of hypo required for the liberated I_2 is:

(A) 10 ml of 0.1 N $Na_2S_2O_3$

(B) 20 ml of 0.02 N $Na_2S_2O_3$

(C) 6 ml of 0.3 M $Na_2S_2O_3$

(D) None of these

6. The reaction $X_2 + Y_2 \rightleftharpoons 2XY$ was studied at a certain temperature. In the beginning 1.0 mole of X_2 was taken in a one litre flask and 2 moles of Y_2 was taken in another 2 L flask and both these containers are connected so equilibrium can be established. What is the equilibrium concentration of X_2 and Y_2? Given equilibrium concentration of [XY] = 0.6 mol/L.

(A) $\left(\frac{1}{3}-0.3\right), \left(\frac{2}{3}-0.3\right)$ **(B)** $\left(\frac{1}{3}-0.6\right), \left(\frac{2}{3}-0.6\right)$

(C) $(1-0.3), (2-0.3)$ **(D)** $(1-0.6), (2-0.6)$

7. Ammonia under a pressure of 15 atm at 27°C is heated to 347°C in a closed vessel in the presence of catalyst. Under these conditions, NH_3 partially decomposes to H_2 and N_2. The vessel is such that the volume remains effectively constant, whereas the pressure increases to 50 atm. Calculat the % of NH_3 actually decomposed at 347°C.

(A) 61.29% **(B)** 60.29% **(C)** 58.28% **(D)** 55.25%

8. Consider the reaction: $2NO_2(g) \rightleftharpoons N_2O_4(g)$ at 20°C.

If $\Delta G° = -5.39$ kJ and $K_p = 8.81$ for the reaction at 20°C, calculate the value of ΔG for the reaction when the partial pressures of NO_2 and N_2O_4 are 1.50 atm and 2.40 atm, respectively.

(A) –5.22 kJ **(B)** +4.71 kJ **(C)** –9.28 kJ **(D)** +154 kJ

9. PCl_5 dissociates into PCl_3 and Cl_2: $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

The total pressure of the system is P at a density ρ and temperature T. If the vapour density of the gas mixture at equilibrium has the value of 62 when the temperature is 230°C, what is the value of P/ρ.

(A) 0.3327 atm/gm/*l* **(B)** 33.27 atm/gm/*l* **(C)** 3.327 atm/gm/*l* **(D)** None of these

10. For the reaction: $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$; $K_p = 7.5$ at some temperature. If $p_{CO} = 0.100\,atm$, $p_{Cl_2} = 0.200\,atm$, and $P_{COCl_2} = 0.250\,atm$, which of the following statements is true?

(A) The reaction is at equilibrium **(B)** At equilibrium, $p_{COCl_2} > 0.250\,atm$

(C) At equilibrium, $p_{COCl_2} < 0.250\,atm$ **(D)** At equilibrium, $p_{CO} = p_{Cl_2}$

11. Hydrogen peroxide (H_2O_2) decomposes according to the equation: $2H_2O_2\,(\ell) \rightleftharpoons 2H_2O\,(\ell) + O_2(g)$

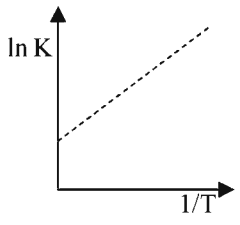
From the following data at 25°C, calculate the value of K_p at 400 K for the above reaction, $\Delta H° = -196.0$ kJ $\Delta S° = 125.65$ J/K.

(A) 1.44×10^{32} **(B)** 1.44×10^{-32} **(C)** 1.44×10^{3} **(D)** 1.3×10^{15}

12. What is the slope of the following line?

(A) $\frac{1}{T \ln K}$ **(B)** $\frac{T\Delta S°}{R}$

(C) $\frac{-\Delta H°}{R}$ **(D)** $\frac{\ln K}{T}$



13. The reaction $A(g) + B(g) \rightleftharpoons C(g) + D(g)$ is in equilibrium in a 1.0 L flask, and has 0.20 mol of A, 0.20 mole of B, 0.40 mole of C, and 0.40 mole of D. If 0.15 mole of A and 0.15 mole of B are then added to the system at equilibrium, what will be the concentration of A once a new equilibrium point is reached?

(A) 0.050 M **(B)** 0.10 M **(C)** 0.20 M **(D)** 0.25 M

14. For the reaction, $N_2O_4(g) \rightleftharpoons 2NO_2(g)$; if percentage dissociation of N_2O_4 varies as 25%, 50%, 75% and 100%, then the corresponding observed vapour densities of the reaction mixture are related as:

(A) $d_1 > d_2 > d_3 > d_4$ **(B)** $d_4 = d_3 > d_2 > d_1$ **(C)** $d_1 = d_2 = d_3 = d_4$ **(D)** $(d_1 = d_2) > (d_3 = d_4)$

15. 40% of a mixture of 0.2 mole of N_2 and 0.6 mole of H_2 react to give NH_3 according to the equation $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at given temperature and pressure. Then the ratio of the final volume to the initial volumes of gases are as:

(A) 4:5 **(B)** 5:4 **(C)** 7:10 **(D)** 8:5

16. The K_p for the reaction $N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$ is 640mm Hg at 775K. At what pressure the dissociation will be 50 %: [Give answer in mm Hg]

(A) 460 **(B)** 470 **(C)** 480 **(D)** 490

17. N_2O_4 dissociates as $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. At 50°C and 1 atm pressure, N_2O_4 dissociates 40%. The pressure at which mole ratio of N_2O_4 : NO_2 is 1 : 8, at same temperature is:

(A) 0.107 atm **(B)** 0.15 atm **(C)** 0.63 atm **(D)** 0.3 atm

18. N_2O_3 on decomposition gives NO and NO_2, they are found to be in equilibrium at 300 K. If the vapour density of such an equilibrium mixture is 23.75, then calculate percentage by mass of N_2O_3 in the equilibrium mixture?

(A) 80 % **(B)** 60 % **(C)** 40 % **(D)** 20 %

19. The pH of blood is maintained by the balance between H_2CO_3 and $NaHCO_3$. If the amount of CO_2 in the blood is increased, how will it effect the pH of blood?

(A) pH will increase **(B)** pH will decrease **(C)** pH will be 7 **(D)** pH will remain same at 7.4

Paragraph for Questions 20 - 21

Effect of temperature on the equilibrium process is analyzed by using the thermodynamics. From the thermodynamic relation

$\Delta G^\circ = -2.303\,RT\log K$ ... (i) ΔG° : Standard free energy change

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ ... (ii) ΔH° : Standard heat of the reaction

From (i) and (ii)

$-2.303RT\log K = \Delta H^\circ - T\Delta S^\circ$ ΔS° : Standard entropy change

$$\Rightarrow \quad \log K = -\frac{\Delta H^\circ}{2.303RT} + \frac{\Delta S^\circ}{2.303R} \quad \text{... (iii)}$$

If a plot of log K vs 1/T is made, then it is a straight line having slope $= \frac{-\Delta H^\circ}{2.303R}$ and Y intercept $= \frac{\Delta S^\circ}{2.303R}$

If at temperature T_1, equilibrium constant be K_1 and at temperature T_2, equilibrium constant be K_2 then the above equation reduces to:

$$\Rightarrow \quad \log K_1 = -\frac{\Delta H^\circ}{2.303RT_1} + \frac{\Delta S^\circ}{2.303R} \quad \text{... (iv)}$$

$$\Rightarrow \quad \log K_2 = -\frac{\Delta H^\circ}{2.303RT_2} + \frac{\Delta S^\circ}{2.303R} \quad \text{... (v)}$$

Subtracting (iv) from (v) we get, $\log\frac{K_2}{K_1} = \frac{\Delta H^\circ}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

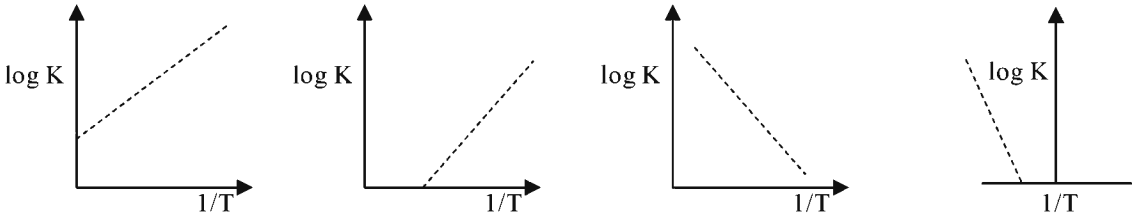
From the above relation we can conclude that the value of equilibrium constant increases with increase in temperature for an endothermic reaction and the same decreases with the increase in temperature of an exothermic reaction. Answer the following three questions based on the above information.

Read the paragraph carefully and answer the following questions:

20. If standard heat of dissociation of PCl_5 is 230 cal, then slope of the graph of $\log K$ vs 1/T is:

(A) +50 **(B)** –50 **(C)** 10 **(D)** None of these

21. For exothermic reaction if $\Delta S^\circ < 0$, then the sketch of log K vs 1/T may be:



(A) **(B)** **(C)** **(D)**

22. If for a particular reversible reaction: $K_c = 57$ at 355°C and $K_c = 69$ at 450°C, then:

(A) $\Delta H < 0$ **(B)** $\Delta H > 0$

(C) $\Delta H = 0$ **(D)** Sing of ΔH can't be determined

Paragraph for Questions 23 - 25

Paragraph : Two containers A and B of capacity 1 litre and 2 litre respectively is connected by tube of negligible volume. The tube is initially closed by stopcock and 'A' contains small amount of $H_2O(l)$ and B contain initially pure $COCl_2(g)$ at pressure of 100 torr. The gas $COCl_2$ partially dissociates at experimental condition into CO(g) and $Cl_2(g)$.

Now the stopcock connecting two container is opened and sufficient time is given to attain final equilibrium. The final pressure at equilibrium is found to be 100 torr in both containers.

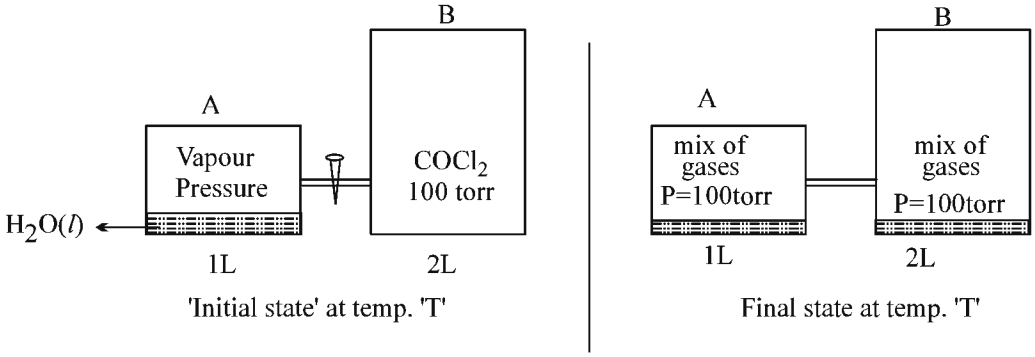
Using given data and taking following assumption calculate the mole fraction of CO(g) in final state.

Given : Vapour pressure of H_2O at experimental temperature 'T' is equal to 20 torr.

Assumption-1 : Volume of $H_2O(l)$ is small and can be neglected but sufficient to create vapour pressure in both container.

Assumption-2 : $COCl_2$, CO and Cl_2 gas do not dissolve in $H_2O(l)$.

Assumption-3 : Whole experiment is carried out under isothermal condition.



23. Pressure of $COCl_2(g)$ in the gaseous mixture in final state:

(A) 80 **(B)** 80/3 **(C)** 160/3 **(D)** 40/3

24. The ratio of number of moles of CO(g) to total number of moles of gases in the final state.

(A) 4/15 **(B)** 8/15 **(C)** 6/15 **(D)** 2/15

25. Ratio of the partial pressure of CO(g) and $COCl_2(g)$ in final state:

(A) 5 : 1 **(B)** 4 : 1 **(C)** 1 : 4 **(D)** 1 : 5

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

26. Consider the following reversible systems

$$N_2 + O_2 \overset{K_1}{\rightleftharpoons} 2NO\ ;\quad \frac{1}{2}N_2 + \frac{1}{2}O_2 \overset{K_2}{\rightleftharpoons} NO\ ;\quad 2NO \overset{K_3}{\rightleftharpoons} N_2 + O_2;$$

$$NO \overset{K_4}{\rightleftharpoons} \frac{1}{2}N_2 + \frac{1}{2}O_2;$$

Correct relation between K_1, K_2, K_3 and K_4 is:

(A) $K_1 \times K_3 = 1$ **(B)** $\sqrt{K_1} \times K_4 = 1$

(C) $\sqrt{K_3} \times K_2 = 1$ **(D)** None of these

27. Which of the following is/are correct for the reaction with equilibrium constant K?

$$A(g) + B(g) \underset{k_b}{\overset{k_f}{\rightleftharpoons}} C(g) + D(g)\ ;\ \Delta H = 20\ J$$

(A) K_{eq} will increase on increasing temperature

(B) k_f will increase on increasing temperature

(C) k_b will increase on increasing temperature

(D) k_b will decrease on increasing temperature

28. For the equilibrium reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $\Delta G° = -30$ kJ

In which of the following case, the reaction will move (spontaneous) in forward direction to achieve equilibrium? (Given: 2.303 RT = 5.705 kJ) (log 1.8 = 0.25).

(A) $p_{N_2} = 1$ atm, $p_{H_2} = 1$ atm and $p_{NH_3} = 1$ atm at 298 K.

(B) $p_{N_2} = 10$ atm, $p_{H_2} = 10$ atm and $p_{NH_3} = 0.01$ atm at 298 K.

(C) $p_{N_2} = 1$ atm, $p_{H_2} = 1$ atm and $p_{NH_3} = 0.001$ atm at 298 K.

(D) $p_{N_2} = 0.01$ atm, $p_{H_2} = 0.001$ atm and $p_{NH_3} = 0.01$ atm at 298 K.

29. Ammonia is manufactured by reaction of N_2 and H_2 by Haber's process. An equilibrium mixture obtained by mixing H_2 & N_2 contains 3.4 gm each of N_2, H_2 & NH_3.

Select the correct option(s).

(A) Mass of N_2 present initially was 6.2 gm

(B) Mass of H_2 present initially was 4 gm

(C) Maximum amount of NH_3 that can be produced is 22.66 gm if N_2 & H_2 reacts completely

(D) None of these

30. For which of the following reaction, does value of equilibrium constant independent of choice of standard state.

(A) $CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ **(B)** $COCl_2(g) \rightarrow CO(g) + Cl_2(g)$

(C) $NO(g) \rightarrow 1/2N_2(g) + 1/2O_2(g)$ **(D)** $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$

31. What is general criteria of choosing a suitable indicator for a given titration?

(A) The indicator should have a broad pH range

(B) pH at the end point of titration should be close to neutral point of indicator

(C) Indicator should have neutral point at pH = 7

(D) The indicator must show a sharp colour change near the equivalence point of titration point

32. When $AgNO_3$ is heated mildly in a closed vessel, oxygen is liberated and $AgNO_2$ is left behind. At equilibrium according to reaction $AgNO_3(s) \rightleftharpoons AgNO_2(s) + \frac{1}{2}O_2(g)$:

(A) Addition of $AgNO_2$ favours reverse reaction

(B) Addition of $AgNO_3$ favours forward reaction

(C) Increasing temperature favours forward reaction

(D) Increasing pressure favours reverse reaction

33. 1 mole each of $N_2(g)$ and $O_2(g)$ are introduced in a 1L evacuated vessel at 523 K and equilibrium concentrations:

(A) Change on changing pressure

(B) Change on changing temperature

(C) Change on changing volume of the vessel

(D) Remain same even when a platinum gauze is introduced to catalyse the reaction

34. For the reaction, $\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightleftharpoons HI(g)$

If pressure is increased by reducing the volume of the container, then:

(A) Total pressure at equilibrium will change

(B) Concentration of all the components at equilibrium change

(C) Concentration of all the components at equilibrium will remain same

(D) Equilibrium will shift in the forward direction

35. Which of the following is/are correct about the influence of positive catalyst on a chemical equilibrium?

(A) Equilibrium constant is unaffected

(B) Heat of reaction ΔH is unaffected

(C) Amount of product remains unaffected

(D) Larger amount of product is formed

36. An increase in temperature increase which of the following?

1. The rate constant of a reaction

2. The ionic product of water

3. The equilibrium constant of exothermic reactions

(A) 1 and 2 only **(B)** 1 and 3 only

(C) 2 and 3 only **(D)** 1, 2 and 3

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labelled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

37. **MATCH THE FOLLOWING:**

Column 1		Column 2	
(A)	For the equilibrium $NH_4I(s) \rightleftharpoons NH_3(g) + HI(g)$, if pressure is increased at equilibrium	**(p)**	Forward shift
(B)	For the reaction : $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at equilibrium, volume is increased at equilibrium	**(q)**	No change
(C)	For the reaction : $H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$ inert gas is added at constant pressure at equilibrium.	**(r)**	Backward shift
(D)	For the equilibrium : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, Cl_2 is removed at equilibrium	**(s)**	Final pressure is more than initial pressure

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

38. Consider the following reversible reaction: $NO(g) + NO_3(g) \rightleftharpoons 2NO_2(g)$

If 1.0 mol of NO is mixed with 3.0 mol of NO_3, 'x' mol of NO_2 is produced at equilibrium. If 2.0 mol of NO is added further, 'x' mol of NO_2 is further produced. What is the value of equilibrium constant?

39. Consider the following reversible reactions:

$$A + B \rightleftharpoons P \quad ; \qquad K_c = 6$$

$$2B + C \rightleftharpoons 2D \quad ; \qquad K_c = 4$$

Hence, equilibrium constant (K_c) for the reaction $A + D \rightleftharpoons P + \frac{C}{2}$ is _____ .

40. For a reversible reaction $A \rightleftharpoons P$, the equilibrium constant is expressed as : $\log K = 0.47 - \frac{2000}{T}$ (All values in SI unit) the standard entropy of reaction $\left(\Delta S^\circ_{rxn}\right)$ is closest to which integer (in) JK^{-1} unit)?

41. An equilibrium mixture containing both NO_2 and N_2O_4 at 2.0 atm is expanded at constant temperature till the equilibrium partial pressure of N_2O_4 decreases to 0.85 atm. By what factor the volume of equilibrium mixture were increased? (Approximate the answer to the nearest integer).

42. An equilibrium mixture contain equal moles (n) of each PCl_5, PCl_3 and Cl_2. If $\frac{20}{3}$ mol of $Cl_2(g)$ is added to equilibrium at constant temperature and pressure, volume of the system is doubled. What is approximate value of n?

43. Consider the following reversible system: $A(g) + 2B(g) \rightleftharpoons AB_2(g)$; $K_c = \frac{1}{2}$

The above equilibrium is established in a 1.0 L flask and at equilibrium 2 moles of each A and B are present. If 2.0 moles of B is added further, how many moles of AB_2 should be added so that moles of A does not change?

44. If for the reversible reaction $A \rightleftharpoons P$, $\Delta G^\circ = 0$. Therefore, the value of equilibrium constant is _____.

45. A reaction, $A(g) + 2B(g) \rightleftharpoons 2C(g) + D(g)$ was studied using an initial concentration of B which was 1.5 times that of A. But the equilibrium concentrations of A and B were found to be equal. The value of K_p for the equilibrium is _____.

46. For the reaction $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$ equilibrium pressure was found to be 3 atm at 1000 K, hence K_p in atm^3 is _____.

47. In the following reaction at equilibrium,

$$A(l) + B(g) \rightleftharpoons C(g) + D(g)$$

it was observed that vapour pressure of A is 2 atm and the pressure exerted by B, C and D are 1 atm, 2 atm and 3 atm respectively. What is the value of K_p?

48. In a basic aqueous solution chloromethane undergoes a substitution reaction in which Cl^- is replaced by OH^- as

$$CH_3Cl(aq) + OH^- \rightleftharpoons CH_3OH(aq) + Cl^-(aq)$$

The equilibrium constant of above reaction $K_c = 1 \times 10^{16}$. If a solution is prepared by mixing equal volumes of 0.1 M CH_3Cl and 0.2 M NaOH (100% dissociated) then $[OH^-]$ concentration at equilibrium in mixture will be_____M.

49. 10 lt box contain O_3 and O_2 at equilibrium at 2000 K. The $\Delta G^\circ = -534.52$ kJ at 8 atm equilibrium pressure. The following equilibrium is present in the container $2O_3(g) \rightleftharpoons 3O_2(g)$. The partial pressure of O_3 is $x \times 10^{-7}$ atm. The numerical value of x is_____. ($\ln 10 = 2.3$, $R = 8.3\ J\ mole^{-1}K^-$)

50. For the equilibrium, $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$ the value of K_p is $0.109\ atm^2$ at 300 K. The vapour pressure of NH_4HS at 300 K in atm would be_____.

51. The average person can see the red colour imparted by the complex $[Fe(SCN)]^{2+}$ to an aqueous solution if the concentration of the complex is 6×10^{-6} M or greater. What minimum concentration of KSCN would be required to make it possible to detect 1 ppm (part per million) of Fe (III) in a natural water sample?

The instability constant for $Fe(SCN)^{2+} \rightleftharpoons Fe^{3+} + SCN^-$ is 7.142×10^{-3}. [Given: Atomic mass Fe = 56]

52. Following two equilibria are established on mixing two gases A_2 and C.

(i) $3A_2(g) \rightleftharpoons A_6(g)$ $\quad K_p = 1.6\ atm^{-2}$

(ii) $A_2(g) + C(g) \rightleftharpoons A_2C(g)$

If A_2 and C are mixed in 2 : 1 molar ratio, calculate the K_p for the reaction (ii). Given that the total pressure to be 1.4 atm and partial pressure of A_6 to be 0.2 atm at equilibrium.

53. When equal volumes of 0.2 M $AgNO_3$ and 1 M KCN solutions were mixed then at equilibrium, concentration of Ag^+ was found to be 10^{-6} M. While when equal volumes of 0.2 M $Zn(NO_3)_2$ solution and of 1 M KCN solution were mixed then at equilibrium, concentration of Zn^{2+} ion was found to be 10^{-12} M. The equilibrium constant of reaction $2[Ag(CN)_2]^- + Zn^{2+} \rightleftharpoons [Zn(CN)_4]^{2-} + 2Ag^+$ is $x \times 10^{21}$. The numerical value of x is_____.

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. The pH of a solution obtained by mixing equal volume of solutions having pH = 3 and pH = 4. [log 5.5 = 0.7404]
(A) 3.38 **(B)** 3.5 **(C)** 3.26 **(D)** 4.0

2. 50 mL of 0.1M of H_3CCOOH is titrated against 0.1M NaOH solution. What will be the pH of the solution when 25 mL of NaOH is added? [Given: K_a of $H_3C–COOH = 2 \times 10^{-5}$; log 2 = 0.3]
(A) 3.50 **(B)** 7.00 **(C)** 4.70 **(D)** 5.30

3. The pH values of 1 M solutions of CH_3COOH (I), CH_3COONa (II), CH_3COONH_4 (III) and KOH (IV) will be in the order:
(A) IV > III > II > I **(B)** IV > II > III > I **(C)** I > III > II > IV **(D)** II > I > III > IV

4. Carbonic acid, H_2CO_3, is a diprotic acid for which $K_1 = 10^{-7}$ and $K_2 = 10^{-11}$. Which solution will produce a pH closest to 9?
(A) 0.1 M H_2CO_3 **(B)** 0.1 M Na_2CO_3
(C) 0.1 M $NaHCO_3$ **(D)** 0.1 M $NaHCO_3$ and 0.1 M Na_2CO_3

5. The ratio of degree of ionization of the two monobasic acids is 1 : 10 and the ratio of their ionization constants is 1 : 50. What would be the ratio of their concentrations?
(A) 1 : 2 **(B)** 2 : 1 **(C)** 1 : 1 **(D)** none of these

6. The solubility of $PbCl_2$ in water is 0.01 M at 25°C. The maximum concentration of Pb^{2+} in 0.1 M NaCl will be:
(A) 2×10^{-3} M **(B)** 1×10^{-4} M **(C)** 1.6×10^{-2} M **(D)** 4×10^{-4} M

7. The solubility of a saturated solution of calcium fluoride is 2×10^{-4} moles per litre. Its solubility product is:
(A) 32×10^{-10} **(B)** 32×10^{-8} **(C)** 32×10^{-14} **(D)** 32×10^{-12}

8. The ratio of dissociation constants of two weak acids HA and HB is 4. At what molar concentration ratio, the two acids will have same pH?
(A) 2 **(B)** 0.5 **(C)** 4 **(D)** 0.25

9. What will be the pH of a solution formed by mixing 40 cm^3 of 0.1 M HCl with 10 cm^3 of 0.45 M NaOH?
(A) 10 **(B)** 8 **(C)** 5 **(D)** 12

10. When 0.22 mole of CH_3NH_2 (ionization constant, $K_b = 10^{-6}$) is mixed with 0.02 mole HCl and the volume is made up to 1 litre, find the $[H^+]$ of resulting solution at 25°C.
(A) 10^{-5} M **(B)** 2×10^{-9} M **(C)** 2×10^{-5} M **(D)** 10^{-9} M

11. Which is the correct representation for the solubility product constant of Ag_2CrO_4?
(A) $[Ag^+]^2[CrO_4^{2-}]$ **(B)** $[Ag^+]\ [CrO_4^{2-}]$ **(C)** $[2Ag^+]\ [CrO_4^{2-}]$ **(D)** $[2Ag^+]^2[CrO_4^{2-}]$

12. Which of the following solution acts as a buffer?
(A) HCl + NaCl **(B)** NaOH + NaCl **(C)** $CH_3COOH + CH_3COONa$ **(D)** H_2SO_4 + NaOH

13. Buffer solution is prepared by mixing 10 ml of 1.0 M acetic acid and 20 ml of 0.5 M sodium acetate and then diluted to 100 ml with distilled water. If the pK_a of CH_3COOH is 4.76, what is the pH of the buffer solution prepared?
(A) 5.21 **(B)** 4.76 **(C)** 4.34 **(D)** 5.21

14. The pK_b value of ammonium hydroxide is 4.75. An aqueous solution of ammonium hydroxide is titrated with HCl. The pH of the solution at the point where half of ammonium hydroxide has been neutralised will be:

(A) 9.25 **(B)** 8.25 **(C)** 7.50 **(D)** 4.75

15. The solubility product of AgI at 25°C is 1.0×10^{-16} $mol^2 L^{-2}$. The solubility of AgI in 10^{-4} N solution of KI at 25°C is approximately: (in mol L^{-1})

(A) 1.0×10^{-12} **(B)** 1.0×10^{-10} **(C)** 1.0×10^{-8} **(D)** 1.0×10^{-16}

16. The self–ionisation constant of NH_3 at 50°C is given by $K_{NH_3} = [NH_4^+]\,[NH_2^-] = 10^{-30}$. How many NH_2^- ions are present per cm^3 of pure liquid NH_3? (Assume Avogadro's number = 6×10^{23})

(A) 6×10^{6} **(B)** 6×10^{5} **(C)** 6×10^{-5} **(D)** 6×10^{-6}

17. A buffer solution is to be made by using conjugate acid–base pair. Which of the following pair will be most suitable for preparing a buffer solution having pH = 7.1? (given: log 2 = 0.3)

	Acid	Conjugate base	K_a
(A)	H_2CO_3	HCO_3^-	8×10^{-7}
(B)	NH_4^+	NH_3	8×10^{-10}
(C)	$C_5H_5NH^+$	C_5H_5N	8×10^{-6}
(D)	NaH_2PO_4	Na_2HPO_4	8×10^{-8}

18. At 25°C, the dissociation constants of CH_3COOH and NH_4OH in aqueous solution are almost the same i.e., 10^{-5}. If pH of some acetic acid solution is 3, the pH of NH_4OH solution of same concentration at the same temperature would be:

(A) 3.0 **(B)** 4.0 **(C)** 10.0 **(D)** 11.0

19. The ionization constant of an acid-base indicator (a weak acid) is 1.0×10^{-6}. The ionized form of the indicator is red whereas the unionized form is blue. The pH change required to alter the colour of the indicator from 80% blue to 80% red is:

(A) 2.00 **(B)** 1.40 **(C)** 1.20 **(D)** 0.80

Paragraph for Questions 20 - 22

The solubility product of a soluble salt A_xB_y is given by: $K_{sp} = [A^{y+}]^x\,[B^{x-}]^y$. As soon as the product of concentration of A^{y+} and B^{x-} becomes more than its K_{sp}, the salt begins to precipitate. It may practically be noticed that AgCl is fairly soluble in water and its solubility decreases dramatically in 0.1 M NaCl or 0.1 M $AgNO_3$ solution. It may, therefore, be concluded that in presence of a common ion, the solubility of salt decreases.

Read the paragraph carefully and answer the following questions:

20. K_{sp} of SrF_2 in water is 8×10^{-10}. The solubility of SrF_2 in 0.1 M NaF aqueous solution is:

(A) 8×10^{-10} **(B)** 2×10^{-3}

(C) 2.7×10^{-10} **(D)** 8×10^{-8}

21. Equal volume of the following two solutions are mixed. The one in which $CaSO_4$ ($K_{sp} = 2.4 \times 10^{-5}$) is precipitated is:

(A) 0.02 M $CaCl_2$ + 0.0004 M Na_2SO_4 **(B)** 0.01 M $CaCl_2$ + 0.0004 M Na_2SO_4

(C) 0.02 M $CaCl_2$ + 0.0002 M Na_2SO_4 **(D)** 0.03 M $CaCl_2$ + 0.004 M Na_2SO_4

22. The pH of a saturated solution of $Mg(OH)_2$ is (K_{sp} $Mg(OH)_2 = 1 \times 10^{-11}$). $(\log 2.7 = 0.43)$

(A) 9 **(B)** 3.87 **(C)** 10.43 **(D)** 5

Paragraph for Questions 23 - 25

Acidity or alkalinity of a solution depend upon the concentration of hydrogen ion relative to that of hydroxyl ions. The product of hydrogen ion and hydroxyl ion concentration is given by $K_w = [H^+]\,[OH^-]$.

The value of K_w depends only on the temperature and not on the individual ionic concentration. If the concentration of hydrogen ion exceeds that of the hydroxyl ions, the solution is said to be acidic; whereas, if concentration of hydroxyl ion exceeds that of the hydrogen ions, the solution is said to be alkaline. The pH corresponding to the acidic and alkaline solutions at 25°C will be less than and greater than seven, respectively. We can confirm the above facts by taking 0.5 M CH_3COOH is taken for the experiments. (Given: K_a of acetic acid = 1.8×10^{-5})

Read the paragraph carefully and answer the following questions:

23. Degree of dissociation of acetic acid is:

(A) 66×10^{-2} **(B)** 6×10^{-3}

(C) 3×10^{-3} **(D)** 5×10^{-3}

24. pH of the solution will be:

(A) 2.52 **(B)** 2.22

(C) 5.04 **(D)** 2

25. If pH of the solution is doubled, what will be the concentration of acetic acid: [antilog 0.96 = 9.12]

(A) 1.8×10^{-5} M **(B)** 1.0 M

(C) 1.37×10^{-5} M **(D)** 1.25×10^{-3} M

Paragraph for Questions 26 - 28

Acid-base indicators are either weak organic acids or weak organic bases. Indicator change colour in dilute solution when the hydronium ion concentration reaches a particular value. For example, phenolphthalein is a colourless substance in any aqueous solution with a pH less than 8.3. In between the pH range 8.3 to 10, transition of colour (colourless to pink) takes place and if pH of solution is greater than 10 solution is dark pink. Considering an acid indicator HIn, the equilibrium involving it and it's conjugate base (In^-) can be represented as: $\underset{\text{acidic form}}{HIn} \rightleftharpoons H^+ + \underset{\text{basic form}}{In^-}$

pH of solution can be computed as: $pH = pK_{In} + \log\dfrac{[In^-]}{[HIn]}$

In general, transition of colour takes place in between the pH range, $pK_{In} \pm 1$.

26. An indicator is a weak acid and pH range is 4.0 to 6.0. If indicator in 50% ionized in a given solution, then what is the ionization constant of the acid?

(A) 10^{-4} **(B)** 10^{-5}

(C) 10^{-6} **(D)** None of these

27. Select the correct statement(s):

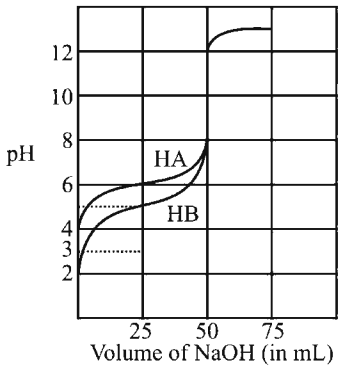
(A) At midway in the transition of an acidic indicator, $pH = pK_{In}$

(B) Methyl orange (3.1 to 4.4) is a suitable indicator for titration of weak acid and strong base

(C) Bromothymol blue (6.0 to 7.6) is not a good indicator for titration of HCl and NaOH

(D) Thymol blue (1.2 to 2.8) is a very good indicator for titration of 100 mL of 0.1 M NH_4OH (pK_b = 4.74) and 0.1 M HCl

28. Following is the titration curve of two acids HA and HB (5 milli-moles each) titrated against strong base NaOH(0.1 M)



What is pK_a for HB acid?

(A) 3 **(B)** 4 **(C)** 5 **(D)** 6

29. What is the equilibrium constant for the reaction: $HB(aq.) + NaA(aq.) \rightleftharpoons HA(aq.) + NaB(aq.)$?

(A) 10 **(B)** 0.1 **(C)** 10^{-7} **(D)** 10^{-11}

30. Calculate the pH at equivalent point when HB is titrated with NaOH.

(A) 8.75 **(B)** 8.85 **(C)** 9.0 **(D)** None of these

31. Which of the following indicator is most suitable for titration of HB with strong base:

(A) Phenolphthalein (8.3 – 10) **(B)** Bromothymol blue (6 – 7.6)

(C) Methyl red (4.2 – 6.3) **(D)** Malachite green (11.4 – 13)

Paragraph for Questions 32 - 35

In qualitative analysis, cations of group II as well as group IV both are precipitated as metal sulphides. Due to low value of Ksp of group II sulphides, Group reagent is H_2S in the presence of dil. HCl and due to high value of K_{sp} of group IV sulphides, Group reagent is H_2S in the presence of NH_4OH and NH_4Cl. In a solution containing 0.1 M each of Sn^{2+}, Cd^{2+} and Ni^{2+} ions, H_2S gas is passed.....

K_{sp} of $SnS = 8\times10^{-29}$, K_{sp} of $CdS = 1\times10^{-28}$, K_{sp} of $NiS = 3\times10^{-21}$, K_1 of $H_2S = 1\times10^{-7}$, K_2 of $H_2S = 1\times10^{-14}$

32. If H_2S is passed into the above mixture in the presence of HCl, which ion will be precipitated first?

(A) SnS **(B)** CdS

(C) NiS **(D)** SnS and CdS (both together)

33. At what value of pH, NiS will start to precipitate (saturated solution of H_2S is 0.1 M? (Given: $\log 5.77 = 0.76$)

(A) 12.76 **(B)** 7 **(C)** 1.24 **(D)** 4

34. Which of the following sulphide is more soluble in pure water?

(A) CdS **(B)** NiS **(C)** SnS **(D)** Equal solubility for all

35. If 0.1 M HCl is mixed in the solution containing only 0.1 M Cd^{2+} ions and saturated with H_2S, then $[Cd^{2+}]$ remaining in the solution after CdS stops to precipitate is:

(A) 10^{-8} **(B)** 8.2×10^{-9}

(C) 5.6×10^{-6} **(D)** 5.6×10^{-10}

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

36. Which of the following form conjugate acid-base pairs in the right order?

(A) NH_3, NH_2^- **(B)** OH^-, H_2O

(C) HCO_3^-, CO_3^{2-} **(D)** H_2S, HS^-

37. A weak acid HA has a pH = 4. Which of the following conditions satisfy the same?

(A) $C = 10^{-3}$, $\alpha = 10\%$ **(B)** $C = 10^{-2}$, $K_a = 10^{-6}$

(C) $[A^-] = 10^{-4}$ **(D)** $K_a = 10^{-2}$, $\alpha = 10\%$

38. Which among the following statements is(are) correct?

(A) pH of 10^{-8} M HCl is equal to 8

(B) Conjugate base of $H_2PO_4^-$ is HPO_4^{2-}

(C) pH of 0.1 M NaCl (aqueous solution) $= \frac{1}{2}pK_w$

(D) Ionization of water increases with decrease in temperature

39. In the following reaction:

$$[Cu(H_2O)_3(OH)]^+ + [Al(H_2O)_6]^{3+} \rightarrow [Cu(H_2O)_4]^{2+} + [Al(H_2O)_5(OH)]^{2+}$$

(A) (B) (C) (D)

(A) (A) is an acid and (B) is a base

(B) (A) is a base and (B) is an acid

(C) (C) is the conjugate acid of (A) and (D) is the conjugate base of (B)

(D) (C) is the conjugate base of (A) and (D) is the conjugate acid of (B)

40. In which of the following pairs of solutions is there no effect on the pH upon dilution?

(A) 0.1 M NH_3 and 0.1 M $(NH_4)_2SO_4$ **(B)** 0.1 M NaH_2PO_4 and 0.1 M Na_2HPO_4

(C) 0.1 M HCl and 0.01 M NaOH **(D)** 0.1 M KCl and 0.1 M HCl

41. Which of the following solution in water act as buffer?

(A) 0.1 mol of NaOH + 0.15 mol of CH_3COOH

(B) CH_3COONH_4

(C) 0.5 mol of pyridine + 0.5 mol of Pyridinium chloride

(D) 0.25 mol of NH_4Cl + 0.5 mol of NaOH

42. Pure AgCl(s) is added to (i) 0.01 M $AgNO_3$ solution (ii) 0.025 M KCl solution and both suspensions are shaken well. What is the approximate ratio of the $[Cl^-]$ in the first solution to the $[Ag^+]$ in the second solution?

(A) 2.5 **(B)** 2.0 **(C)** 3.0 **(D)** 1.5

43. If concentrations of two acids are same, their relative strengths can be compared by:

(A) α_1 / α_2 **(B)** K_1/K_2

(C) $[H^+]_1/[H^+]_2$ **(D)** $\sqrt{K_1 / K_2}$

44. Which can act as buffer?

(A) CH_3COOH + NaOH, if $[CH_3COOH] > [NaOH]$

(B) HCl + CH_3COONa, if $[CH_3COONa] > [HCl]$

(C) NH_4CN

(D) HCN + NaCN

45. Which is(are) wrong statement(s)?

(A) All Arrhenius acids are also Bronsted acid but all Arrhenius bases are not Bronsted bases

(B) All Bronsted bases are Lewis bases

(C) All Bronsted acids are Lewis acids

(D) Conjugate base of a strong acid is strong

46. Factor influencing the degree of dissociation of a weak electrolyte is:

(A) Dilution **(B)** Temperature **(C)** Presence of other ions **(D)** Nature of solvent

47. Dissociation of an indicator can be considered as $HIn \rightleftharpoons H^+ + In^-$. Colour of HIn is P and In^- is Q. Given that ratio of conc. of HIn to In^- rangers from 10 to 1/10, then which of the following statement is/are correct?

(A) Solution assumes P-colour, when $pH \le pK_{In} - 1$

(B) Solution assumes Q-colour, when $pH \ge pK_{In} + 1$

(C) Solution assumes P-colour, when $pH \ge pK_{In} + 1$

(D) Solution assumes Q-colour, when $pH \le pK_{In} - 1$

48. An acid indicator (HIn) has $K_a = 3 \times 10^{-5}$, the acid from is red and basic form is blue. Which is correct?

(A) pH = 5 when indicator is 75% red **(B)** pH = 4.05 when indicator is 75% red

(C) pH = 5 when indicator is 75% blue **(D)** pH = 4.05 when indicator is 75% blue

49. Which among the following statement is/are correct?

(A) $pH = -\log_{10}[H_3O^+]$

(B) pH of water decreases with increase of temperature

(C) pH cannot be zero, negative or more than 14

(D) If a solution is diluted ten times, its pH increases by 1

50. If concentrations of two weak acids are same, their relative strengths can be compared by:

(A) α_1 / α_2 **(B)** K_1 / K_2 **(C)** $[H^+]_1 / [H^+]_2$ **(D)** $\sqrt{K_1 / K_2}$

51. Which can act as buffer?

(A) $CH_3COOH + NaOH$, if $[CH_3COOH] > [NaOH]$ **(B)** $HCl + CH_3COONa$, if $[CH_3COONa] > [HCl]$

(C) NH_4CN **(D)** $HCN + NaCN$

52. Which is/are wrong statement(s)?

(A) Arrhenius acids are also Bronsted acid but not vice-versa

(B) All Bronsted bases are Lewis bases

(C) All Lewis acids are Bronsted acids

(D) Conjugate base of a strong acid is strong

53. Dissociation of an indicator can be considered as $Hln \rightleftharpoons H^+ + ln^-$. Colour of Hln is P and ln^- is Q. Given that ratio of conc. of Hln to ln^- ranges from 10 to $\frac{1}{10}$, then which of the following statements are correct?

(A) Solution assumes P-colour, when $pH \le pK_{In} - 1$

(B) Solution assumes Q-colour, when $pH \ge pK_{In} + 1$

(C) Solution assumes P-colour, when $pH \ge pK_{In} - 1$

(D) Solution assumes Q-colour, when $pH \le pK_{In} + 1$

54. Which of the following statements is (are) correct?

(A) A buffer solution contains a weak acid and its conjugate base

(B) A buffer solution show little changes in pH on the addition of a small amount of acid or base

(C) A buffer solution can be prepared by mixing a solution of sodium acetate and acetic acid

(D) The addition of solid potassium cyanide to water decrease the pH of water

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

55. **Match the Following:**

Column 1		Column 2	
(A)	$\underset{5\ ml\ 1N}{CH_3COOH} + \underset{5\ ml\ 1N}{NaOH}$	**(p)**	pH > 7
(B)	$\underset{15\ ml\ 1N}{CH_3COOH} + \underset{10\ ml\ 1N}{NaOH}$	**(q)**	pH < 7
(C)	$\underset{5\ ml\ 1N}{HCl} + \underset{15\ ml\ 1N}{NH_4OH}$	**(r)**	Buffer
(D)	$\underset{1\ ml\ 1N}{HCl} + \underset{1\ ml\ 2N}{NaOH}$	**(s)**	Hydrolysis occurs

56. **Match the Following:**

Column 1		Column 2	
(A)	50 ml of 0.1 M CH_3COOH + 25 ml of 0.1 M NaOH	**(p)**	Buffer solution
(B)	50 ml of 0.1 M NaOH + 50 ml of 0.1 M HCl	**(q)**	pH = 7 at 25°C
(C)	50 ml of 0.1 M NH_4OH + 25 ml of 0.1 M HCl	**(r)**	Basic solution
(D)	50 ml of 0.1 M CH_3COOH + 50 ml of 0.1 M NH_4OH ($K_a = K_b$)	**(s)**	Acidic solution

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

57. 500 ml of 0.150 M $AgNO_3$ solution is mixed with 500 ml of 1.09 M Fe^{2+} solution and the reaction is allowed to reach equilibrium at 25°C.

$$Ag^+(aq) + Fe^{2+}(aq) \rightleftharpoons Fe^{3+}(aq) + Ag(s)$$

For 25 ml of the equilibrium solution, 30 ml of 0.0833 M $KMnO_4$ were required for oxidation. Calculate the approximate equilibrium constant for the reaction at 25°C.

58. An unknown volume and unknown concentration of weak acid HX is titrated with NaOH of unknown concentration. After addition of 10.0 cm^3 of NaOH solution, pH of solution is 5.7 and after the addition of 20.0 cm^3 of NaOH solution, the pH is 6.3. Calculate the pK_a for the weak acid, HX. (Given: antilog of $0.6 \approx 4$)

59. Waste water resulting from metal processing often contains significant amounts of toxic heavy metal ions that must be removed before the water can be safely returned to the environment. One method uses sodium hydroxide solution to precipitate insoluble metal hydroxides. Suppose that 1.00×10^2 L of waste water containing 1.8×10^{-5} M Cd^{2+} is treated with 1.0 L of 6.0 M NaOH solution. The residual concentration of Cd^{2+} after treatment is $x \times 10^{-12}$ M and the mass of $Cd(OH)_2$ precipitates is y gm. Identify x and y. (K_{sp} $[Cd(OH)_2] = 2.5 \times 10^{-14}$) (atomic mass of Cd = 112)

60. A mixture of water and AgCl is shaken until a saturated solution is obtained. Now the solution is filtered and 100 mL of clear solution of filtrate is mixed with 100 mL of 0.03 M NaBr. Ionic product of AgBr is $x \times 10^{-y}$ M. Find value of x. K_{sp} of AgCl and AgBr are 1×10^{-10} and 5×10^{-13}.

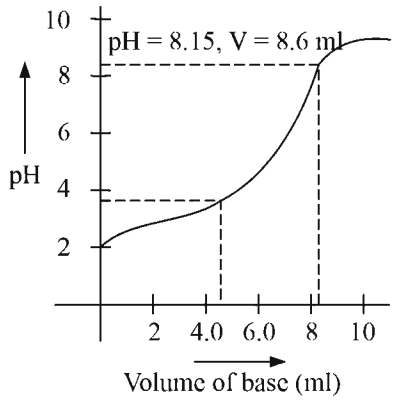
61. Given $Ag(NH_3)_2^+ \rightleftharpoons Ag^+ + 2NH_3$. $K_c = 6.2 \times 10^{-8} M^2$ and K_{sp} of AgCl = 1.8×10^{-10} M^2 at 298 K. If ammonia is added to a water solution containing excess of AgCl(s) only, the concentration of complex in 1.0 M aqueous ammonia is _____ M.

62. A solution is 0.1 M in Cl^-, 0.01 M in Br^-, 0.001 M in I^-. $AgNO_3(s)$ is added to the solution ($\Delta V_{mix} = 0$). The concentration of Ag^+ required to start precipitation of all three ions is 10^{-x} M. The numerical value of x is_____.

[Given, $K_{SP(AgCl)} = 10^{-10}$, $K_{SP(AgBr)} = 10^{-13}$, $K_{SP(AgI)} = 10^{-17}$]

63. The pH of glycine at the first half equivalence point is 2.34 and that at second half equivalence paint is 9.60. At the equivalence point (the first inflection point) the pH is_____.

64. Find the pK_a of a weak acid, if titration progress is monitored as follows:



65. The ionization constant of benzoic acid is 6.46×10^{-5} and K_{SP} for silver benzoate is 2.5×10^{-13}. How many times silver benzoate is more soluble in a buffer of pH = 3.19 as compared to its solubility in pure water?

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Based on the following thermochemical equations:

$H_2O(g) + C(s) \longrightarrow CO(g) + H_2(g)$; $\Delta H = 131$ kJ

$CO(g) + 1/2\ O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -282$ kJ

$H_2(g) + 1/2\ O_2(g) \longrightarrow H_2O(g)$; $\Delta H = -242$ kJ

$C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = X$ kJ

The value of X will be:

(A) –393 kJ **(B)** – 655 kJ **(C)** + 393 kJ **(D)** + 655 kJ

2. From the reaction, $P_{(white)} \longrightarrow P_{(red)}$; $\Delta H = -18.4$ kJ it follows that:

(A) Red P is readily formed from white P

(B) White P is readily formed from red P

(C) White P cannot be converted to red P

(D) White P can be converted into red P and red P is more stable

3. Find $\Delta_f H°$ for HCl(g) from the following data:

$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$; $\Delta_r H° = -176$ kJ/mole

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$; $\Delta_r H° = -92$ kJ/mole

$N_2(g) + 4H_2(g) + Cl_2(g) \longrightarrow 2NH_4Cl(g)$; $\Delta_r H° = -629$ kJ/mole

(A) 536.5 kJ/mol **(B)** –361 kJ/mol **(C)** –92.5 kJ/mol **(D)** +92.5 kJ / mol

4. Solid $CaSO_4 \cdot 2H_2O$ is taken in a container fitted with a frictionless piston initially containing no other gases. The external pressure is maintained at 1 atm and the container is heated till the equilibrium is achieved.

$CaSO_4 \cdot 2H_2O(s) \rightleftharpoons 2CaSO_4(s) + 2H_2O\ (g)$

If $\Delta H° = +30$ Kcal/mol and $\Delta S° = +40$ cal / K, at what temperature equilibrium will be establised in the container. (Ignore variation of ΔH_0 and ΔS_0 with temperature.)

(A) 600 K **(B)** 750 K **(C)** 700 K **(D)** 300 K

5. Calculate the work done in Joules when 1.0 mole of N_2H_4 decomposes against a pressure of 1.0 atm at 27°C

$3N_2H_4(l) \longrightarrow 4NH_3(g) + 2N_2(g)$

(A) –4988.4 **(B)** –9976.8 **(C)** 9976.8 **(D)** None

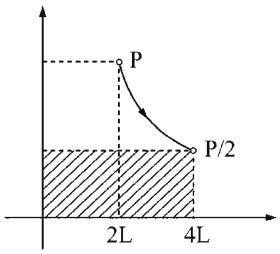
6. Calculate the heat produced ($|q|$) in kJ when 280 gm of CaO is completely converted to $CaCO_3$ by reaction with CO_2 at 27°C in a container of fixed volume. Given: ΔH_f^o $CaCO_3$ (s) = – 1207 kJ/mol ; ΔH_f^o CaO (s) = –635 kJ/mol ; ΔH_f^o CO_2 (g) = – 394 kJ/mol [Use R = 8.3 $JK^{-1}mol^{-1}$]

(A) 877.55 kJ **(B)** 87.755 kJ **(C)** 8775.5 kJ **(D)** None of these

7. 0.50 mol of an ideal gas initially at a temperature of 300 K and at a pressure of 2 atm is expanded isothermally in three steps. In each step, the pressure is dropped suddenly and held constant until equilibrium is reestablished. The pressure at each of the three stages of expansion are 1.6, 1.2 and 1 atm. Calculate the work done ($|w|$) (in atm-litre) in this process. [Use R = 0.08 atm-litre/mol.K]

(A) 7.4 atm litre **(B)** 4.7 atm litre **(C)** 6.2 atm litre **(D)** None of these

8. A student is calculating the work during a reversible isothermal process, shown by 2 moles of an ideal gas. He by mistake calculated the area as shown in the PV graph (Shaded area) equal to 49.26 litre atm. Calculate the correct value of work (in litre atm) during the process. (Given : R = 0.0821 litre atm/mol/K)



(A) 49.26 **(B)** – 34.14

(C) – 78.63 **(D)** – 98.52

9. If the ratio $C_p/C_v = \gamma$, the change in internal energy of the mass of a ideal gas, when volume changes from V to 2V at constant pressure, P, is:

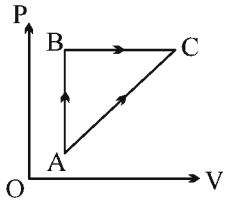
(A) $\frac{R}{\gamma-1}$ **(B)** PV **(C)** $\frac{PV}{\gamma-1}$ **(D)** $\frac{\gamma PV}{\gamma-1}$

10. Work done by a sample of an ideal gas in a process A is double of the work done in another process B. The temperature rises through the same amount in the two processes. If C_A and C_B be the molar heat capacities for the two processes:

(A) $C_A = C_B$ **(B)** $C_A > C_B$ **(C)** $C_A < C_B$ **(D)** None of these

11. A thermodynamic process is shown in the following figure. In the process AB, 600J of heat is added to the system and in BC, 200J of heat is added to the system. The change in internal energy of the system in the process AC would be:

Given: $P_A = 3 \times 10^4$ Pa, $P_B = 8 \times 10^4$ Pa, $V_A = 2 \times 10^{-3}$ m^3, $V_C = 5 \times 10^{-3}$ m^3.



(A) 560 J **(B)** 800 J **(C)** 600J **(D)** 640 J

12. A reaction that is spontaneous can be described as:

(A) releasing heat to the surroundings

(B) having the same rate in both the forward and reverse directions

(C) proceeding in both the forward and reverse directions

(D) proceeding without external influence once it has begun

13. Calculate the standard enthalpy of formation of acetylene from the following data:

$C(g) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H^\circ = -393.5$ kJ mol^{-1}

$H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$; $\Delta H^\circ = -285.8$ kJ mol^{-1}

$2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(l)$; $\Delta H^\circ = -2598.8$ kJ mol^{-1}

(A) 226.6 kJ mol^{-1} **(B)** 230.5 kJ mol^{-1} **(C)** 233.8 kJ mol^{-1} **(D)** -226.6 kJ / mol

14. Which of the following statement(s) is(are) correct:

Statement **1** : The entropy of isolated system is always maximized at equilibrium

Statement **2** : It is possible for the entropy of close system to decrease in an irreversible process.

Statement **3** : Entropy can be created but can not be destroyed.

Statement **4** : ΔS_{system} is always zero for reversible process in an isolated system.

(A) Statement 1, 2, 3 **(B)** Statement 2, 4 **(C)** Statement 1, 2, 4 **(D)** All

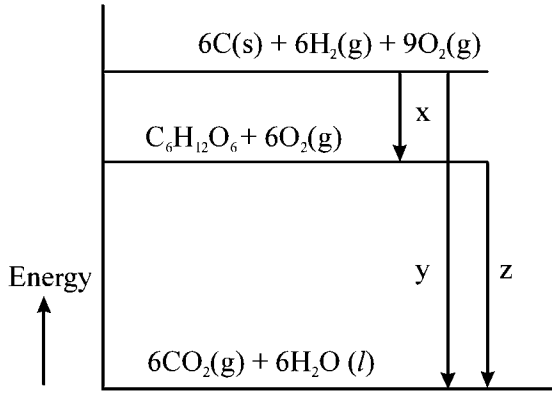
15. The C – Cl bond energy can be calculated from:

(A) ΔH_f° (CCl_4, l) only **(B)** ΔH_f° (CCl_4, l) and BE (Cl_2)

(C) ΔH_f° (CCl_4, l), BE (Cl_2) **(D)** ΔH_f° (CCl_4, l) BE (Cl_2), ΔH_f° (C, g) and $\Delta H^\circ_{vap}(CCl_4)$

Paragraph for Questions 16 - 18

Paragraph # 1 : Consider the following energy level diagram :



Answer the following questions on the basis of the given diagram:

16. The heat of formation of glucose is:

(A) –x **(B)** –y **(C)** x – y **(D)** –x + z

17. In the given diagram z refers to:

(A) $6 \times \Delta H^o_{fCO_2}$ **(B)** $\Delta H^o_{fC_6H_{12}O_6}$

(C) $\Delta H^o_{combustion\ C_6H_{12}O_6}$ **(D)** $\Delta H^o_{combustion\ C(s)} + \Delta H^o_{fH_2O(l)}$

18. The quantity y is equal to:

(A) $\Delta H_{combustion\ C(s)} + \Delta H_{combustion\ H_2(g)}$ **(B)** x + z

(C) x – z **(D)** $\Delta H_{fCO_2} + \Delta H_{H_2O}$

Paragraph for Questions 19 - 21

Heat capacity of a system is defined as the quantity of heat required to raise the temperature of the system by 1°C. If the mass of the system is one gm., the heat capacity is called the specific heat of the system. However, if the mass of the system is one mole, then the heat capacity is termed as molar heat capacity which is expressed by the differential equation $C = \frac{dQ}{dT}$

The molar heat capacity of a gaseous system, determined at constant volume (C_v) is different from that determined at constant pressure (C_p). In the former case, no external work is done by the system or on the system. Hence, from the first law equation

$dQ = dE \qquad \therefore \qquad C_v = \left(\frac{dE}{dT}\right)_v$

At constant pressure, there is change of volume and some work is done. Suppose, the volume increases by dV then

$dQ = dE - dW = dE - (-PdV) = dE + PdV = dH \qquad \therefore \qquad C_p = \left(\frac{dQ}{dT}\right)_P = \left(\frac{dH}{dT}\right)_P$

Let us consider a reaction occurring at constant pressure. Heat of reaction at constant pressure may be given as $\Delta H = H_P - H_R$

$$\frac{d\Delta H}{dT} = \frac{dH_P}{dT} - \frac{dH_R}{dT} = (C_P)_P - (C_P)_R = \Delta C_P$$

$$d\Delta H = \Delta C_P \, dT$$

Integrating above differential equation within proper limit we get: $\int_{T_1}^{T_2} d\Delta H = \Delta C_P \int_{T_1}^{T_2} dT$

$$\frac{\Delta H_{T_2} - \Delta H_{T_1}}{T_2 - T_1} = \Delta C_P$$ This equation is called Kirchhoff's equation.

Read the paragraph carefully and answer the following questions:

19. The ratio of molar heat capacity of a monoatomic gas at constant pressure to that at constant volume is:

(A) 1.66 **(B)** 1.4 **(C)** 1.33 **(D)** 1.24

20. The molar heat capacity of argon at constant volume is 5 cal at 27°C. How much heat is required to raise the temperature of 20 gm of argon at constant pressure by 1°C?

(A) 1.5 cal **(B)** 2.5 cal **(C)** 3.0 cal **(D)** 5.0 cal

21. Which one of the following expressions is equal to heat capacity of a monoatomic gas at constant volume?

(A) $\left[\frac{\partial E}{\partial T}\right]_P$ **(B)** $\left[\frac{\partial T}{\partial P}\right]_H$ **(C)** $\left[\frac{\partial E}{\partial T}\right]_V$ **(D)** $\left[\frac{\partial E}{\partial H}\right]_T$

Paragraph for Questions 22 - 24

Entropy is the measure of degree of randomness. Entropy is directly proportional to temperature. Every system tries to acquire maximum state of randomness or disorder. Entropy is measure of unavailable energy.

Unavailable energy = Entropy × Temperature.

The ratio of entropy of vapourisation and boiling point of most liquids remains almost constant.

Read the paragraph carefully and answer the following questions:

22. Which of the following process have $\Delta S = -ve$?

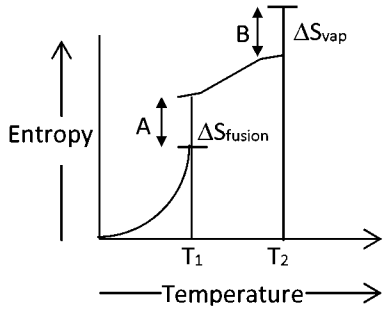
(A) Adsorption

(B) Dissolution of NH_4Cl in water

(C) $H_2 \rightarrow 2H$

(D) $2NaHCO_3(s) \xrightarrow{\Delta} Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$

23. Observe the graph and identify the correct statement(s):



(A) T_1 is melting point, T_2 is boiling point

(B) T_1 is boiling point, T_2 is melting point

(C) ΔS_{fusion} is more than ΔS_{vap}

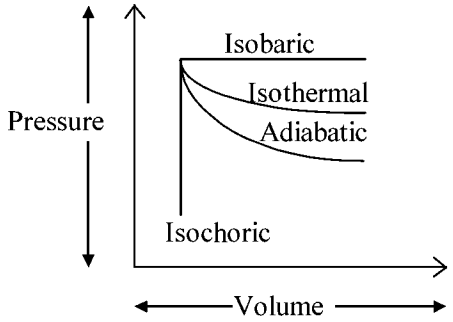
(D) T_2 is lower than T_1

24. The Law of thermodynamics invented by Nernst, which helps to determine absolute entropy, is:

(A) Zeroth law **(B)** 1st law **(C)** 2nd law **(D)** 3rd law

Paragraph for Questions 25 - 27

Observe the following graphic representation of four basic thermodynamic processes.



Read the paragraph carefully and answer the following questions:

25. Which of the following is true for isochoric process?

(A) $\Delta V = 0$ **(B)** $\Delta U = q + P\Delta V$ **(C)** $\Delta U = q_v$ **(D)** All of these

26. Which of the following is not true for isothermal process?

(A) $w_{exp} = -2.303nRT\log\frac{V_2}{V_1}$ **(B)** $w_{exp} = -2.303nRT\log\frac{P_1}{P_2}$

(C) $\Delta T = 0$ **(D)** $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

27. If the ratio $\frac{C_p}{C_v} = 1.30$ then the atomicity of gas will be:

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

28. For an isolated system, the wall/boundary separating the system from surrounding must have the following characteristics:

(A) Rigid **(B)** Impermeable **(C)** Adiabatic **(D)** Diathermic

29. $\Delta E = 0$ for which process, must be zero

(A) Cyclic process **(B)** Isothermal ideal gas expansion

(C) Isochoric process **(D)** Adiabatic process

30. Select the correct option if temperature of a real gas is doubled at constant low pressure.

(A) Volume will be less than doubled if both temperature are above Boyle's temperature.

(B) Volume will be more than doubled if both temperature are less than Critical temperature.

(C) Volume will be less than doubled if both temperature are less than Critical temperature.

(D) None of these

31. Select the correct option(s):

(A) Molar internal energy is an intensive property.

(B) Heat capacity at constant pressure is an extensive property

(C) Reversible process can be reversed at any point in the process by making infinitesimal change.

(D) Less heat is absorbed by the gas in the reversible isothermal expansion as compared to irreversible, when expanded to same final volume.

32. Pick out true statement among the following:

(A) Reversible adiabatic process is isoentropic process.

(B) ΔS_{system} for irreversible adiabatic compression is greater than zero.

(C) ΔS_{system} for free expansion is zero.

(D) ΔS_{surr} for irreversible isothermal compression is greater than zero.

33. Select the irreversible process(s)?

(A) Mixing of two gases by diffusion **(B)** Evaporation of water at 373 K and 0.1 atm pressure

(C) Free expansion of gases **(D)** None of these

34. Identify the incorrect statement regarding entropy:

(A) at absolute zero of temperature, the entropy of perfectly crystalline substance is +ve

(B) at absolute zero of temperature entropy of perfectly crystalline substance is taken to be zero

(C) at 0°C the entropy of a perfectly crystalline substance is taken to be zero

(D) at absolute zero of temperature, the entropy of all crystalline substances is taken to be zero

35. For which of the following substances, heat of formation in the standard state will not be zero?

(A) $Br_2(s)$ **(B)** $H^+(aq)$ **(C)** $Br_2(l)$ **(D)** $H_2O(l)$

36. For an isothermal irreversible expansion of 1 mole of a perfect gas, indicate the correct relation:

(A) $\Delta U = 0$ **(B)** $\Delta H = 0$ **(C)** $q = RT\left(1-\frac{P_2}{P_1}\right)$ **(D)** $w = RT \ln\left(\frac{P_2}{P_1}\right)$

37. $C_{(graphite)} + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -94.05$ kcal mol^{-1}

$C_{(diamond)} + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -94.5$ kcal mol^{-1}

Then which of the following is / are correct?

(A) $C_{(diamond)} \rightarrow C_{(graphite)}$; $\Delta H = 450$ cal mol^{-1} **(B)** $C_{(graphite)} \rightarrow C_{(diamond)}$; $\Delta H = 450$ cal mol^{-1}

(C) graphite is more stable than diamond **(D)** diamond is more stable allotrope than graphite

38. Enthalpy of atomization of $C_2H_6(g)$ and $C_3H_8(g)$ are 620 and 880 kJ mol^{-1} respectively. The C–C and C–H bond energies are respectively.

(A) 80 and 60 kJ mol^{-1} **(B)** 80 and 90 kJ mol^{-1}

(C) 70 and 90 kJ mol^{-1} **(D)** 100 and 80 kJ mol^{-1}

39. In a process involving 'n' moles of an ideal gas, the entropy change of the system is given by:

(A) $nC_v \ln\frac{T_2}{T_1} + nR \ln\frac{V_2}{V_1}$ **(B)** $n\,C_P \ln\frac{T_2}{T_1} + n\,R \ln\frac{P_1}{P_2}$

(C) $n\,C_V \ln\frac{T_2}{T_1} + n\,R \ln\frac{P_1}{P_2}$ **(D)** $n\,C_V \ln\frac{T_2}{T_1} + n\,R \ln\frac{V_1}{V_2}$

40. Calculate the resonance energy for CO_2 from the following $\Delta H_{C=O} = 339$ kJ mol^{-1}, $\Delta H_{O=O} = 498$ kJ mol^{-1}, $\Delta H\left(C_{(s)} \longrightarrow C_{(g)}\right) = 718$ kJ mol^{-1}, ΔH combustion $(carbon) = -393$ kJ mol^{-1}

(A) 913 kJ mol^{-1} **(B)** – 931 kJ mol^{-1} **(C)** 145 kJ mol^{-1} **(D)** – 145 kJ mol^{-1}

41. Which of the following conclusion at equilibrium is(are) true?

(A) If $\Delta G^\circ > 0$, $K_{eq} < 1$

(B) If ΔG° has a large negative value, the reaction will predominantly lie towards the product

(C) As the reaction proceeds towards equilibrium, Gibb's free energy change decreases and becomes zero finally

(D) As the reaction proceeds towards equilibrium, entropy of the system increases

42. Which of the following thermodynamic relations can be applied approximately to an ideal gas?

(A) $dE = dq + pdV$ **(B)** $dH = dq + Vdp$

(C) $dS_m = C_v \frac{dT}{T} + R\frac{dV}{V}$ **(D)** $dG = Vdp - SdT$

43. If an ideal gas in a piston fitted cylinder is allowed to expand isothermally against vacuum, then

(A) Expansion occur adiabatically **(B)** ΔS_{sys}, $\Delta S_{surr.}$, $\Delta S_{univ.}$ are all greater than zero

(C) $\Delta G < 0$ **(D)** $W_{sys.} = 0$

44. Which of the following statement(s) is(are) true?

(A) When $(\Delta G_{system})_{T,P} < 0$; the reaction must be exothermic

(B) $\Delta_f H^\circ$ (S, monoclinic) $\neq 0$

(C) If dissociation energy of $CH_4(g)$ is 1656 kJ/mole and C_2H_6 (g) is 2812 kJ/mole, then value of C–C bond energy will be 328 kJ/mole

(D) If $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$; $\Delta_r H^\circ = -56$ kJ/mol

$\Delta_f H^\circ(H_2O, g) = -242$ kJ/mole; Enthalpy of vaporization of liquid water = 44 kJ/mol then, $\Delta_f H^\circ(OH^-, aq)$ will be –142 kJ/mole

45. Which of the following conditions may lead to a non-spontaneous change?

(A) $\Delta H = +ve$; $\Delta S = -ve$ **(B)** $\Delta H = -ve$; $\Delta S = -ve$

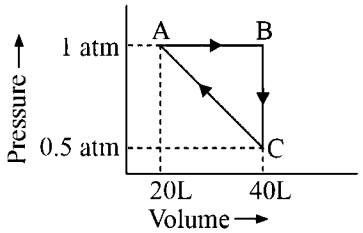
(C) $\Delta H = -ve$; $\Delta S = +ve$ **(D)** $\Delta H = +ve$; $\Delta S = +ve$

46. The work done during adiabatic expansion or compression of an ideal gas is given by:

(A) $nC_V\Delta T$ **(B)** $\frac{nR}{(\gamma-1)}(T_2 - T_1)$

(C) $-nR\ P_{ext}\left[\frac{T_2P_1 - T_1P_2}{P_1P_2}\right]$ **(D)** $-2.303\,RT\log\frac{V_2}{V_1}$

47. On the basis of following graph (P–V graph), choose the correct statements.



(A) Total work done W = q

(B) The entropy change for the overall process is zero

(C) For the overall process $\Delta H > \Delta U$

(D) Total work done w > q

48. In which of the reaction $\Delta H > \Delta U$?

(A) $H_2 + I_2 \longrightarrow 2HI$ **(B)** $PCl_5 \longrightarrow PCl_3 + Cl_2$

(C) $2H_2O_2 \longrightarrow 2H_2O + O_2$ **(D)** $C + O_2 \longrightarrow CO_2$

49. Which of the following affect the heat of reaction?

(A) Physical states of reactants and products

(B) Allotropic forms of elements

(C) Temperature

(D) Reaction carried out at constant pressure or constant temperature

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

50. **Match the following:**

Column 1		Column 2	
(A)	Isochoric process	**(p)**	$\Delta H = 0, \Delta E = 0, \Delta T = 0$
(B)	Isothermal reversible expansions	**(q)**	$w = 0, \Delta V = 0$
(C)	Adiabatic work done	**(r)**	$w = \frac{nR}{\gamma - 1}(T_2 - T_1)$
		(s)	$w = -nRT \ln V_2/V_1$

51. Match the solutions obtained by mixing different volumes of equimolar acid HA and base BOH given in column 1 with the rise in temperature given in column 2 if the solution obtained by mixing 10 ml each of the same acid and base shows an elevation in temperature of 5°C.

Column 1		Column 2	
(A)	100 ml of HA + 100 ml of BOH	**(p)**	5°C
(B)	10 ml of HA + 20 ml of BOH	**(q)**	4°C
(C)	20 ml of HA + 30 ml of BOH	**(r)**	3.3°C
(D)	50 ml of HA + 150 ml of BOH	**(s)**	0.66°C
		(t)	2.5°C

52. **Match the following:**

Column 1		Column 2	
(A)	$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$	**(p)**	heat of neutralization
(B)	$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$	**(q)**	heat of combustion
(C)	$C(s) + O_2(g) \longrightarrow CO_2(g)$	**(r)**	heat of formation
(D)	$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(\ell)$	**(s)**	fuel cell

53. **Column-1** and **column-2** contains **four** entries each. Entries of column-I are to be matched with some entries of column-II. One or more than one entries of column-I may be matched with the same entries of column-II and one entry of column-I may have one or more than one matching with entries of column-II.

Column 1		Column 2	
(A)	For the process $H_2O(l) \rightleftharpoons H_2O(s)$, ΔH & ΔS are	**(p)**	–ve, +ve
(B)	For the endothermic reaction $2A(s) + \frac{1}{2} O_2(g) \rightleftharpoons A_2O(s)$ at 298 K ΔS & ΔG are	**(q)**	+ve, –ve
(C)	C(diamond) $\rightleftharpoons$ C(graphite), favourable conditions for formation of diamond are high pressure and high temperature then ΔH for formation of diamond and ΔS for formation of graphite from diamond are	**(r)**	+ve, +ve
(D)	For the given reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, $Ea_{(forward)} = 57.2$ kJ and $E_{a(backward)} = 3.2$ kJ, ΔH for the given reaction & ΔS for the reverse reaction	**(s)**	–ve, –ve

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

54. If 2 kcal heat is given to a system and 6 kcal work is done on the system then the internal energy of system will increase by how many kcal?

55. Certain amount of a gas confined in a piston-filled cylinder is heated from 27°C to 127°C and the gas expanded against a constant pressure doing 4.157 kJ of work on surroundings. The number of moles of gas present in the cylinder is(are) _____.

56. Certain amount of a non-ideal gas is changed from state (500 K, 5 atm, 2 L) to (150 K, 2 atm, 1 L). If the change in internal energy is 14 L-atm, change in enthalpy in L-atm unit is _____.

57. Certain amount of an ideal gas confined in a 4.0 L piston at 20 K is allowed to expand adiabatically and reversibly to 25 L. If the ratio of heat capacities (molar heat capacity at constant pressure to molar heat capacity at constant volume) is 1.5, the final temperature (in Kelvin unit) of the gas would be _____.

58. Molar enthalpy of vaporization of a liquid is 3.6 kJ. If boiling point of this liquid is 177°C, the molar entropy of vaporization (in JK^{-1} unit) is _____.

59. When 1 mole of an ideal gas at 20 atm pressure and 15 L volume expands such that the final pressure becomes 10 atm and the final volume become 60 L. Calculate entropy change for the reaction ($C_{p.m} = 30.96$) in $JK^{-1}mol^{-1}$.

(Given : $R = 8.314\,J\,mol^{-1}\,K^{-1}$)

60. A certain mass of gas is expanded from (1L, 10 atm) to (4L, 5 atm) against a constant external pressure of 1 atm. If initial temperature of gas is 300 K and the heat capacity of process is 50 J/°C. Then the enthalpy change in kJ during the process is: (1L atm ≃ 100 J)

61. The given reaction

$$\underset{2\,\text{moles}}{2CO} + \underset{1\,\text{mole}}{O_2} \longrightarrow 2CO_2 \qquad \Delta H = -560\,\text{kJ}$$

is carried in one litre container, if the pressure in the container gets changes from 70 atm to 40 atm as reaction gets completed. Calculate ΔU in kJ of the reaction. [1L atm = 0.1 kJ]

62. Calculate the pH at which the following conversion (reaction) will be at equilibrium in basic medium $I_2(s) \rightleftharpoons I^-(aq) + IO_3^-(aq)$ when the equilibrium concentrations at 300 K are $[I^-] = 0.10\ M$ and $[IO_3^-] = 0.10\ M$

[Given that $\Delta G_f^0(I^-, aq) = -50\ kJ/mole$, $\Delta G_f^0(IO_3^-, aq) = -123.5\ kJ/mole$, $\Delta G_f^0(H_2O, \ell) = -233\ kJ/mole$,

$\Delta G_f^0(OH^-, aq) = -150\,kJ/mole$, Ideal gas constant $= R = \frac{25}{3}\,J\,mole^{-1}K^{-1}$, $\log e = 2.3$]

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SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. For the elementary reaction $M \rightarrow N$, the rate of disappearance of M increases by a factor of 8 upon doubling the concentration of M. The order of the reaction with respect to M is:

(A) 4 **(B)** 3 **(C)** 2 **(D)** 1

2. For first order reaction: $A \longrightarrow P$, the temperature (T) dependent rate constant 'k' was found to follow the equation $\log_{10} k = 6 - \frac{2000}{T}$. The pre-exponential factor 'A' and activation energy E_a, respectively:

(A) $1 \times 10^6\ s^{-1}$ and $9.2\ kJ\ mol^{-1}$ **(B)** $6.0 s^{-1}$ and $16.6\ kJ\ mol^{-1}$

(C) 1×0^6 and $16.6\ kJ\ mol^{-1}$ **(D)** $1 \times 10^6 s^{-1}$ and $38.3\ kJ\ mol^{-1}$

3. The overall rate $\frac{d[P]}{dt}$, for the reaction $2A \underset{}{\overset{K}{\rightleftharpoons}} B$; $B + C \xrightarrow{k_f} P$ is given by:

(A) $K\, k_f [A]^2 [C]$ **(B)** $K [A] [B]$ **(C)** $k_f [B]$ **(D)** $K\, k_f [A]^2 [B] [C]$

4. For a first order reaction, if the time taken for 50% completion of the reaction is t seconds, then time required for 99.9% completion of the reaction is:

(A) 10 t **(B)** 5 t **(C)** 100 t **(D)** 2 t

5. The decomposition of a gas on a surface follows the rate law : Rate $\propto \frac{kP}{1+kP}$. Where, P is pressure and k is a constant. the order of the reaction at high pressure is:

(A) Zero **(B)** 1/2 **(C)** 1 **(D)** 2

6. For a gaseous reaction, the rate of reaction is expressed in terms of $\frac{dP}{dt}$ instead of $\frac{dC}{dt}$ or $\frac{dn}{dt}$, where C is concentration and n is the number of moles. Hence, the relation between expression is:

(A) $\frac{dC}{dt} = \frac{dn}{dt} = \frac{V}{RT}\frac{dP}{dt}$ **(B)** $\frac{dC}{dt} = \frac{1}{V}\frac{dn}{dt} = \frac{1}{RT}\frac{dP}{dt}$

(C) $\frac{dP}{dt} = \frac{dn}{dt} = \frac{dC}{dt}$ **(D)** None of these

7. For the reaction, $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

$$-\frac{d[NH_3]}{dt} = k_1[NH_3];\ \frac{d[N_2]}{dt} = k_2[NH_3];\ \frac{d[H_2]}{dt} = k_3[NH_3]$$

The relation between k_1, k_2 and k_3 may be given by as:

(A) $1.5\ k_1 = 3k_2 = k_3$ **(B)** $2k_1 = k_2 = 3k_3$ **(C)** $k_1 = k_2 = k_3$ **(D)** $k_1 = 3k_2 = 2k_3$

8. Rate constant for the reaction is $1.5 \times 10^7\ sec^{-1}$ at 50°C and $4.5 \times 10^7\ sec^{-1}$ at 100°C. What is the value of activation energy?

(A) $220\ J\ mol^{-1}$ **(B)** $2300\ J\ mol^{-1}$ **(C)** $2.2 \times 10^3\ J\ mol^{-1}$ **(D)** $2.2 \times 10^4\ J\ mol^{-1}$

9. Which of the following is correct?

(A) Molecularity of a reaction can be fractional

(B) Zero order reaction never stops

(C) A first order reaction must be homogeneous

(D) The frequency factor 'A' in Arrhenius equation $\left(k = Ae^{-E_a/RT}\right)$ increases with increase in temperature

10. The order and molecularity of the chain reaction $H_2(g) + Cl_2(g) \xrightarrow{hv} 2HCl(g)$, are:

(A) 2, 0 **(B)** 0, 2 **(C)** 1, 1 **(D)** 3, 0

11. A reactant, A forms two products:

$A \xrightarrow{k_1} B$ Activation energy E_{a_1} ; $A \xrightarrow{k_2} C$ Activation energy E_{a_2}

If $E_{a_2} = 2E_{a_1}$, then k_1 and k_2 will be related as:

(A) $k_2 = k_1 e^{-E_{a_1}/RT}$ **(B)** $k_2 = k_1 e^{-E_{a_2}/RT}$ **(C)** $k_1 = k_2 e^{-E_{a_1}/RT}$ **(D)** $k_1 = 2k_2 e^{-E_{a_2}/RT}$

12. Collision theory is satisfactory for:

(A) First order reactions **(B)** Second order reactions

(C) Bimolecular reactions **(D)** Zeroth order reactions

13. Consider the following statements:

1. The rate of reaction is always proportional to the concentrations of reactants.

2. The order of an elementary chemical reaction step can be determined by examining its stoichiometry.

3. The first order reactions follows an exponential time course.

Of these statements:

(A) 1, 2 and 3 are correct **(B)** 1 and 2 are correct

(C) 2 and 3 are correct **(D)** 1 and 3 are correct

14. For a gaseous reaction, the following data were recorded:

Concentration in mol L^{-1}	0.1	0.05	0.025	0.0125
Half-life in sec	30	29.9	30.1	30

The order of reaction is:

(A) Second **(B)** First **(C)** Zero **(D)** Fractional

15. Consider the reaction: $2NO_2(g) + O_3(g) \longrightarrow N_2O_5(g) + O_2(g)$

The reaction of nitrogen dioxide and ozone represented is first order in $NO_2(g)$ and in $O_3(g)$. Which of these possible reaction mechanisms is consistent with the rate law?

Mechanism I: $NO_2(g) + O_3 \longrightarrow NO_3(g) + O_2(g)$ (slow)

$NO_3(g) + NO_2(g) \longrightarrow N_2O_5(g)$ (fast)

Mechanism II: $O_3(g) \rightleftharpoons O_2(g) + [O]$ (fast)

$NO_2(g) + [O] \longrightarrow NO_3$ (slow)

$NO_3(g) + NO_2(g) \longrightarrow N_2O_5$ (fast)

(A) I only **(B)** II only **(C)** Both I and II **(D)** Neither I nor II

16. In which of the following reactions, the increase in the rate of reaction will be maximum?

	E_a	Temperature rise
(A)	40 kJ/mol	200 – 210 K
(B)	90 kJ/mol	300 – 320K
(C)	80 kJ/mol	300 – 310 K
(D)	All will have same rate	

17. For nth order reaction $\frac{t_{1/2}}{t_{3/4}}$ depends on $(n \neq 1)$:

(A) Initial concentration only **(B)** 'n' only

(C) Initial concentration and 'n' both **(D)** Sometimes 'n' and sometimes initial concentration

18. Half-life of a reaction becomes half when *initial* concentration of reactants are made double. The order of reaction will be:

(A) 1 **(B)** 2 **(C)** 0 **(D)** 3

19. Decomposition of H_2O_2 is a first order reaction. A 16 volume solution of H_2O_2 of half life 30 min is present at start. When will the solution become one volume?

(A) After 120 min **(B)** After 90 min **(C)** After 60 min **(D)** After 150 min

20. What is the activation energy for the reverse of this reaction?

$$N_2O_4(g) \longrightarrow 2NO_2(g)$$

Data for the given reaction is $\Delta H = +54$ kJ and $E_a = +57.2$ kJ:

(A) −54 kJ **(B)** +3.2 kJ **(C)** +60.2 kJ **(D)** +111.2 kJ

21. Consider the reaction, $2H_2(g) + 2NO(g) \longrightarrow N_2(g) + 2H_2O(g)$

The rate law for this reaction is: Rate = k $[H_2]$ $[NO]^2$

Under what conditions could these steps represent the mechanism?

Step 1 : $2NO \rightleftharpoons N_2O_2$ **Step 2 :** $N_2O_2 + H_2 \longrightarrow N_2O + H_2O$

Step 3 : $N_2O + H_2 \longrightarrow N_2 + H_2O$

(A) These steps cannot be the mechanism under any circumstances

(B) These steps could be the mechanism if step 1 is the slow step

(C) These steps could be the mechanism if step 2 is the slow step

(D) These steps could be the mechanism if step 3 is the slow step

22. The acid catalysed ionisation of γ – hydroxy butyric acid proceeds as a reversible reaction, which is 1st order in both the forward and backward steps: $\underset{(\text{Acid})}{A} \underset{k_2}{\overset{k_1}{\rightleftharpoons}} \underset{(\text{Lactose})}{B}$

The rate $-\frac{d[A]}{dt}$ is given by:

(A) $k_1[A]$ **(B)** $-k_2[B]$ **(C)** $k_1[A] - k_2[B]$ **(D)** $\frac{k_1[A]}{k_2[B]}$

23. What is the slope of the straight line for the graph drawn between ln k and 1/T, where k is the rate constant of the reaction at temperature T?

(A) $\frac{-E_a}{2.303\,R}$ **(B)** $\frac{-E_a}{R}$ **(C)** $\frac{E_a}{R}$ **(D)** $\frac{R}{E_a}$

24. The correct statement regarding the functioning of a catalyst is that it:

I → alters the energy levels of the reactants and products.

II → provides an alternate path for climbing the activation energy barrier.

III → makes the reaction thermodynamically feasible.

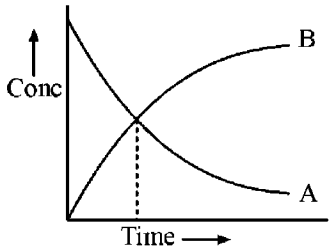
IV → provides a different mechanism of the reaction.

(A) I and II **(B)** I and III

(C) II and IV **(D)** III and IV

25. The following plot represents the variation of the concentration of a species A and B against time

Reaction: $A \longrightarrow B$.



The point of intersection of the two curves represents:

(A) $t_{1/2}$ **(B)** $t_{3/4}$

(C) $t_{2/3}$ **(D)** $t_{1/3}$

26. The specific rate constant of a first order reaction depends on the:

(A) Concentration of the reactant **(B)** Concentration of the product

(C) Time **(D)** Temperature

Reasoning Type - For Questions 27-29

(A) Statement-1 is True, Statement-2 is True and Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True and Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

27. **Statement : 1** In a multi-step reaction, the molecularity of overall reaction has no significance.
Statement : 2 Molecularity refers to the order of rate determining step.

28. **Statement : 1** Order of a reaction may be fractional.
Statement : 2 Sum of power of concentration terms involved in rate law expression gives the order of reaction.

29. **Statement : 1** Hydrolysis of ethyl acetate in acid medium is pseudo first order reaction.

Statement : 2 $CH_3COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3COOH + C_2H_5OH$. Water does not take part in this reaction.

Paragraph for Questions 30 - 32

The reaction rate is the increase in molar concentration of product of a reaction per unit time or the decrease in molar concentration of reactant per unit time. However, also because of stoichiometry of the balanced chemical reaction, rate of reactions in terms of individual reactants and products are related.

30. Consider the chemical reaction, $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

The rate of reaction may be expressed as:

(A) $\text{rate} = -\frac{d[N_2]}{dt} = -\frac{d[H_2]}{dt} = +\frac{d[NH_3]}{dt}$ **(B)** $\text{rate} = -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = +\frac{1}{2}\frac{d[NH_3]}{dt}$

(C) $\text{rate} = -\frac{d[N_2]}{dt} = +\frac{1}{3}\frac{d[H_2]}{dt} = -\frac{1}{2}\frac{d[NH_3]}{dt}$ **(D)** $\text{rate} = -\frac{d[N_2]}{dt} = -3\frac{d[H_2]}{dt} = +2\frac{d[NH_3]}{dt}$

31. For a chemical reaction, $m_1A + m_2B \longrightarrow n_1C + n_2D$. The ratio of rate of disappearance of A to that of appearance of C is:

(A) m_1/m_2 **(B)** m_2/n_1 **(C)** n_1/m_1 **(D)** m_1/n_1

32. In the following reaction: $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$

The rate of formation of SO_3 is 100 g min^{-1}. Hence, the rate of disappearance of O_2 is:

(A) 50 g min^{-1} **(B)** 20g min^{-1} **(C)** 100 g min^{-1} **(D)** 200 g min^{-1}

Paragraph for Questions 33 - 36

The reactions occurring in two or more steps are called complex reactions. Each step however is a simple reaction, i.e., an elementary reaction. The rates of the various elementary reactions generally differ from one another. The rate of the reaction is determined from slowest step. The chemical species present in rate law expression, must also be present in overall reaction.

33. The reaction, $2O_3(g) \longrightarrow 3O_2(g)$, proceeds as follows:

$O_3(g) \rightleftharpoons O_2 + [O]$ (fast) ; $[O] + O_3 \longrightarrow 2O_2$ (slow)

The rate law expression should be:

(A) $r = k[O_3]^2$ **(B)** $r = k[O_3]^2[O_2]^{-1}$ **(C)** $r = k[O_2]^2$ **(D)** $r = k[O_3][O_2]$

34. The reaction, $2NO(g) + Br_2(g) \longrightarrow 2NOBr(g)$, follows the mechanism given ahead:

Step 1 : $NO + Br_2 \rightleftharpoons NOBr_2$ (fast) **Step 2 :** $NOBr_2 + NO \longrightarrow 2NOBr$ (slow)

The overall order of this reaction is:

(A) 2 **(B)** 1 **(C)** 3 **(D)** None of these

35. A reaction, $A_2 + B_2 \longrightarrow 2AB$, occurs in following steps:

Step 1 : $A_2 \longrightarrow A + A$ (slow) **Step 2 :** $A + B_2 \longrightarrow AB + B$ (fast)

Step 3 : $A + B \longrightarrow AB$ (fast)

The order of reaction would be:

(A) 3/2 **(B)** zero **(C)** 2 **(D)** 1

36. In the following consecutive reactions, $A \xrightarrow{k = 2\times10^{-4}\ min^{-1}} B \xrightarrow{k = 6\times10^{-6}\ min^{-1}} C \xrightarrow{k = 3\times10^{-3}\ min^{-1}} D$

Which of the following steps is the rate determining step?

(A) $A \rightarrow B$ **(B)** $B \rightarrow C$ **(C)** $C \rightarrow D$ **(D)** $A \rightarrow D$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

37. For a first order reaction:

(A) The degree of dissociation is equal to $\left(1-e^{-kt}\right)$

(B) A plot of reciprocal concentration of the reactant vs time gives a straight line

(C) The time taken for the completion of 75% reaction is thrice the $t_{1/2}$ of the reaction

(D) The pre-exponential factor in the Arrhenius equation has the dimension of time, T^{-1}

38. The rate law for the reaction, $RCl+NaOH(aq)\rightarrow ROH+NaCl$ is given by Rate = $k_1[RCl]$. The rate of the reaction will be:

(A) Doubled on doubling the concentration of sodium hydroxide

(B) Halved on reducing the concentration of alkyl halide to one half

(C) Increased on increasing the temperature of the reaction

(D) Unaffected by increasing the temperature of the reaction

39. For the first order reaction: $2N_2O_5(g)\longrightarrow 4NO_2(g)+O_2(g)$

(A) The concentration of the reactant decreases exponentially with time.

(B) The half-life of the reaction decreases with increasing temperature.

(C) The half-life of the reaction depends on the initial concentration of the reactant.

(D) The reaction proceeds to 99.6% completion in eight half-life duration.

40. Which of the following statements are correct about the reaction in presence of catalyst?

(A) Catalyst does not alter the heat of reaction

(B) Catalyst alters the equilibrium constant of the reaction

(C) Catalyst does not alter the ΔG° of the reaction

(D) Catalyst changes the rate constant of forward and backward reaction to the same extent.

41. In the Arrhenius equation, $k=Ae^{-E_a/RT}$, the Arrhenius constant A will be equal to the rate constant when

(A) $E_a=0$ **(B)** $T=\infty$ **(C)** $T=0$ **(D)** $E_a=\infty$

42. Rate law expression of a reaction is: Rate = $k\,[A]^{2/3}[B]$

Which of the following are correct about the corresponding reaction?

(A) Order of reaction $=\frac{2}{3}+1=\frac{5}{3}$ **(B)** Unit of rate constant = $L^{2/3}\,mol^{-2/3}\,sec^{-1}$

(C) Unit of rate constant = $L^{-2/3}\,mol^{2/3}\,sec^{-1}$ **(D)** Unit of rate of reaction = $mol\,L^{-1}\,sec^{-1}$

43. Which of the following are correct expression for Arrhenius equation?

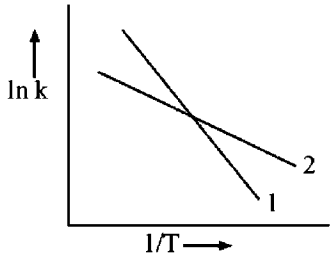
(A) $A=ke^{-E_a/RT}$ **(B)** $\ln k=\ln A+\frac{E_a}{RT}$

(C) $\log_{10}k=\log_{10}A-\frac{E_a}{2.303RT}$ **(D)** $\ln A=\ln k+\frac{E_a}{RT}$

44. A substance 'A' may react to give different products in two different path:

(1) $A \xrightarrow{k_1} B + C$ (2) $A \xrightarrow{k_2} D + E$

Both these reactions paths are of first order and have identical frequency factor. If k is plotted against 1/T for (1) and (2):



Select the correct statements among following:

(A) Activation energy of reaction (1) is greater than that of (2)

(B) Activation energy of reaction (2) is greater than that of (1)

(C) B and C are favourable product

(D) D and E are favourable products

45. Which of the following are true for the first order reaction?

(A) $t_{3/4} = 2t_{1/2}$ **(B)** $t_{15/16} = 4t_{1/2}$ **(C)** $t_{15/16} = 3t_{3/4}$ **(D)** $t_{7/8} = 2t_{3/4}$

46. Activation energy of forward and backward process of a reaction are 60 kJ and 40 kJ mol^{-1} respectively. Which of the following are true for the reaction?

(A) It is endothermic reaction **(B)** It is exothermic reaction

(C) Heat of reaction is +20 $kJ\,mol^{-1}$ **(D)** Threshold energy of reaction is 100 $kJ\,mol^{-1}$

47. Select the correct statement(s) among following:

(A) Increase in concentration of reactant increases the rate of a zero order reaction

(B) Rate constant k is equal to collision frequency A, if $E_a = 0$

(C) Rate constant k is equal to collision frequency A if $E_a = \infty$

(D) $\log_{10} k$ vs $1/T$ is a straight line

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

48. **Match the following:**

Column 1 (Half – life)		Column 2 (Order of reaction)	
(A)	$t_{1/2}$ = constant	**(p)**	First order
(B)	$t_{1/2} \propto a$	**(q)**	Pseudo first order
(C)	$t_{1/2} \propto \frac{1}{a}$	**(r)**	Second order
(D)	$t_{1/2} \propto \frac{1}{p}$	**(s)**	Zero order

a = Initial concentration of reactant ; p = Initial pressure of gaseous reactant

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

49. For the reaction, $A_2 + B_2 \longrightarrow 2AB$

$[A_2]$	$[B_2]$	Rate of reaction (mol L^{-1} sec^{-1})
0.2 M	0.2 M	0.04
0.1 M	0.4 M	0.04
0.2 M	0.4 M	0.08

Order of reaction will be _____ .

50. An organic compound undergoes first-order decomposition. The time taken for its decomposition to 1/8 and 1/10 of its initial concentration are $t_{1/8}$ and $t_{1/10}$ respectively. What is the value of $\frac{[t_{1/8}]}{[t_{1/10}]} \times 10$? (take $\log_{10} = 2.3$)

51. In a reaction, the time required to complete half of the reaction was found to increase 16 times when the initial concentration of the reactant was reduced to $1/4^{th}$. What is the order of the reaction?

52. If the $t_{1/2}$ for a first order reaction is 0.4 min, the time after 99.9% completion of the reaction is _____ min.

53. A reaction $X_2(g) \longrightarrow Z(g) + \frac{1}{2}Y(g)$ exhibits an increase in pressure from 150 mm to 170 mm in 10 min. The rate of disappearance of X_2 in mm per min is _____.

54. Rate constant of reaction increases (2^n) times. Temperature coefficient of this reaction is '2'. Initial and final temperature of the reaction is 25°C and 115°C respectively. What will be the value of 'n'?

55. The rate of reaction, $3A + 2B \longrightarrow$ Products is given by rate expression, rate $= k[A][B]^2$. If 'A' is taken in excess, the order of the reaction would be_____.

56. In a catalytic conversion of N_2 to NH_3 by Haber's process, the rate of reaction expressed as change in the concentration of ammonia per unit time is 40×10^{-3} mol L^{-1} s^{-1}. If there are no side reaction, the rate of the reaction as expressed in terms of hydrogen is $y \times 10^{-3}$ mol L^{-1} s^{-1}. Find value of y.

57. In the reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$, initial pressure is 500 atm and rate constant k is 3.38×10^{-5} sec^{-1}. After 10 minutes the final pressure (in atm) of N_2O_5 is_____.

58. The rate constant for an isomerization reaction, $A \rightarrow B$ is 4.5×10^{-3} min^{-1}. If the initial concentration of A is 1M. The rate of the reaction after 1h is $y \times 10^{-3}$ M min^{-1}. Find value of y.

59. A first order gas reaction has $k = 1.5 \times 10^{-6}$ per second at 200°C. If the reaction is allowed to run for 10h, what percentage of the initial concentration would have change into the product?

60. The rate constant for a second order reaction is 8.0×10^{-5} M^{-1} min^{-1}. How many minutes will it take a 1M solution to be reduced to 0.5M ?

61. 0.1 g atom of radioactive isotope ${}_{Z}X^{A}$ (half-life 5 days) is taken. The number of atoms that will decay during eleventh day are $y\times10^{21}$ atoms. Find value of y.

62. A certain nuclide has a half-life period of 30 minutes. If a sample containing 600 atoms is allowed to decay for 90 minutes, how many atoms will remain.

63. A sample of rock from moon contains equal number of atoms of uranium and lead ($t_{1/2}$ for U = 4.5×10^{9} years). The age of the rock would be $y\times10^{9}$ years. Find value of y.

64. For reaction $A \rightarrow B$, $\Delta H = -10\,kJ\,mol^{-1}$, $E_a = 50\,kJ\,mol^{-1}$, then E_a in kJ/mol of $B \rightarrow A$ will be_____.

65. Radioactivity of a radioactive element remains $\frac{1}{10}$ of the original radioactivity after 2.303 seconds. The half life period in second is _____.

66. In the Lindemann theory of unimolecular reactions, it is shown that the apparent rate constant for such a reaction is $k_{app} = \frac{k_1 C}{1+\alpha C}$ here C is the concentration of the reactant, k_1 and α are constants. The value of C for which k_{app} has 90% of its limiting value at C tending to infinitely large values, given $\alpha = 9\times10^{5}$ is 10^{-x} mol L^{-1}. Find value of x.

67. With the help of following information

Rate (forward) = $(1.45\times10^{13})[Fe^{2+}][diPy]^3$

Rate (backward) = $(1.22\times10^{-4})\left[Fe(dipy)_3^{2+}\right]$

and $Fe^{2+} + 3\,dipy \rightarrow Fe(dipy)_3^{2+}$ the stability constant for the complex will be $y\times10^{17}\ M^{-2}$. Find value of y.

68. Biochemists often define Q_{10} for a reaction as the ratio of the rate constant at 37°C to the rate constant at 27°C. What must be the energy of activation in $kJ\,mol^{-1}$ for a reaction that has $Q_{10} = 2.5$?

69. A drop of solution (Volume 0.05 ml) contains 3.0×10^{-6} mole of H^+. If the rate constant of disappearance of H^+ is 1.0×10^{7} mol lt^{-1} sec^{-1}. It takes $y\times10^{-9}$ sec for H^+ drop to disappear. Find value of y.

70. The following kinetic data are provided for a reaction between A and B:

Concentration of A/(M)	**Concentration of B/(M)**	**Rate of reaction ($M\ min^{-1}$)**
0.50	0.02	1.15×10^{-4}
0.50	0.04	2.30×10^{-4}
0.01	1.00	2.30×10^{-6}
0.02	1.00	0.92×10^{-5}

Then value of the rate constant for the above reaction is equal to $y\times10^{-2}\ L^2\ mol^{-2}\ min^{-1}$. Find value of y.

71. 99% of first order reaction was completed in 32 min. Find time in min for 99.9% completion of reaction.

72. The rate of the reaction: $A + B + C \longrightarrow$ Product is given by:

$$\text{rate} = -\frac{d[A]}{dt} = k[A]^{1/2}[B]^{1/4}[C]^{0}$$

The order of reaction is_____.

73. The reaction $A \longrightarrow B$ follows first order reaction. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1 hour. What is the time in hour taken for conversion of 0.9 mole of A to produce 0.675 moles of B:

74. The rate constant for the forward and backward reactions of hydrolysis of ester are 1.1×10^{-2} and 1.5×10^{-3} per minute respectively. The equilibrium constant of the reaction is _____.

75. For a reaction the activation energy $Ea = 0$ and the rate constant $k = 3.2\times10^{6}s^{-1}$ at 300 K. The value of rate constant at 310 K is found to be $y\times10^{6}s^{-1}$. What is value of y?

76. The conversion of $A \rightarrow B$ follows second order reaction. Doubling the concentration of A will increase the rate of reaction by _____ times.

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. An azeotropic solution of two liquids has boiling point lower than either of them when it:

(A) Shows negative deviation from the Raoult's law

(B) Shows no deviation from the Raoult's law

(C) Shows positive deviation from the Raoult's law

(D) Is saturated

2. Which of the following 0.1 M aqueous solutions will have the lowest freezing point?

(A) K_2SO_4 **(B)** NaCl **(C)** Glucose **(D)** Urea

3. When mercury (II) iodide is added is added to an aqueous solution of potassium iodide, the:

(A) Freezing point is lowered **(B)** Freezing point is raised

(C) Freezing point does not change **(D)** Boiling point does not change

4. The vapour pressure of a solution of 5 g of non-electrolyte in 100 g of water at a particular temperature is $2985\ N/m^2$. The vapour pressure of water is $3000\ N/m^2$. The molecular mass of the solute is:

(A) 60 **(B)** 120 **(C)** 180 **(D)** 380

5. Increasing in temperature of an aqueous solution will cause:

(A) Decrease in molality **(B)** Decrease in molarity

(C) Decrease in mole fraction **(D)** Decrease in % W/W

6. A 0.2 molal aqueous solution of a weak acid (HX) is 20% ionised. The freezing point of the solution is:

(A) $-0.45°C$ **(B)** $0.90°C$ **(C)** $-0.31°C$ **(D)** $-0.53°C$

7. During depression of freezing point in a solution, the following are in equilibrium:

(A) Liquid solvent, solid solvent **(B)** Liquid solvent, solid solute

(C) Liquid solute, solid solute **(D)** Liquid solute, solid solvent

8. 0.004 M Na_2SO_4 is isotonic with 0.01 M glucose. Degree of dissociation of Na_2SO_4 is:

(A) 75% **(B)** 50% **(C)** 25% **(D)** 85%

9. The van't Hoff factor of 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is:

(A) 91.3% **(B)** 87% **(C)** 100% **(D)** 74%

10. When 20 g of naphthoic acid $(C_{11}H_8O_2)$ is dissolved in 50 g of benzene ($K_f = 1.72\ K\,kg,\ mol^{-1}$), a freezing point depression of 2K is observed. The van't Hoff factor (i) is:

(A) 0.5 **(B)** 1 **(C)** 2 **(D)** 3

11. 0.5 M aqueous solution of glucose is isotonic with:

(A) 0.5 M KCl solution **(B)** 0.5 M $CaCl_2$ solution

(C) 0.5 M urea solution **(D)** 1 M solution of sucrose

12. The degree of ionization (α) of a weak electrolyte A_xB_y is related to van't Hoff factor by expression:

(A) $\alpha = \dfrac{i-1}{x+y+1}$ **(B)** $\alpha = \dfrac{i-1}{x+y-1}$ **(C)** $\alpha = \dfrac{x+y-1}{i-1}$ **(D)** $\alpha = \dfrac{x+y+1}{i-1}$

13. The relationship between osmotic pressure at 273 K when 10 g of glucose (P_1); 10 g of urea (P_2) and 10 g of sucrose(P_3) are dissolved in 250 mL of water is:

(A) $P_1 > P_2 > P_3$ **(B)** $P_3 > P_1 > P_2$ **(C)** $P_2 > P_1 > P_3$ **(D)** $P_2 > P_3 > P_1$

14. When acetone and Chloroform are mixed together, H-bonding takes place between them. Such a liquid pair shows:

(A) +ve deviation from Raoult's law **(B)** −ve deviation from Raoult's law

(C) No deviation from Raoult's law **(D)** Slight increase in volume

15. Compound $PdCl_4 \cdot 6H_2O$ is a hydrated complex. 1 molal aqueous solution of it has freezing point 269.28k. Assuming 100% ionization of complex, calculate the molecular formula of the complex (k_f for water $= 1.86\,k\ kg\ mol^{-1}$):

(A) $[Pd(H_2O)_6]Cl_4$ **(B)** $[Pd(H_2O)_4Cl_2]Cl_2 \cdot H_2O$

(C) $[Pd(H_2O)_3Cl_3]Cl \cdot 3H_2O$ **(D)** $[Pd(H_2O)_2Cl_4] \cdot 4H_2O$

16. The mass of glucose that should be dissolved in 100 g of water and in order to produce same lowering of vapour pressures as is produced by 1 g of urea (mol. mass = 60) on 50 g of water is:

(A) 1g **(B)** 2g **(C)** 6g **(D)** 12g

17. 50 g of antifreeze (ethylene glycol) is added to 200 g water. What amount of ice will separate out at $-9.3°C$? $(K_f = 1.86)$

(A) 42mg **(B)** 42g **(C)** 38.71g **(D)** 38.71mg

18. Which of the following graphs represent the behaviour of ideal binary liquid mixture?

(A) Plot of $1/P_{Total}$ against y_A is linear **(B)** Plot of $1/P_{Total}$ against y_B is non-linear

(C) Plot of P_{Total} against y_A is linear **(D)** Plot of P_{Total} against y_B is linear

(Here, y_A and y_B are the mole fraction of components A and B in vapour).

19. Which of the following solution will have the lowest freezing point depression?

(A) 0.2 M urea and 0.2 M glucose **(B)** $0.1\,M\ Al_2(SO_4)_3$ and $0.1\,M\ Na_2SO_4$

(C) $0.1\,M\ KNO_3$ and $0.2\,M\ Ba(NO_3)_2$ **(D)** $0.1\,M\ Ca(NO_3)_2$ and $0.1\,M\ Ba(NO_3)_2$

20. Mixture of volatile components A and B has total vapour pressure (in torr): $P = 254 - 119\,X_A$

Where, X_A is mole fraction of A in mixture, Hence, P_A^0 and P_B^0 are (in torr):

(A) 254, 119 **(B)** 119, 254 **(C)** 135, 254 **(D)** 154, 119

21. A compound MX_2 has observed and normal molar masses 65.6 and 164 respectively. Calculate the apparent degree of ionization of MX_2:

(A) 75% **(B)** 85% **(C)** 65% **(D)** 25%

22. Total vapour pressure of mixture of 1 mol A ($P_A^0 = 150$ torr) and 2 mol B ($P_B^0 = 240$ torr) is 200 torr. In this case:

(A) There is positive deviation from Raoult's law

(B) There is negative deviation from the Raoult's law

(C) There is no deviation from Raoult's law

(D) Molecular masses of A and B are also required from calculating the deviation

23. If liquids A and B form an ideal solution:

(A) The free energy of mixing is zero **(B)** The free energy as well as entropy of mixing are zero

(C) Enthalpy of mixing is zero **(D)** The entropy of mixing is zero

24. Which statement about the composition of vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume the temperature is constant at 25°C.

Vapour pressure data (25°C):

Benzene 75 mm Hg

Toluene 22 mm Hg

(A) The vapour will contain higher percentage of benzene

(B) The vapour will contain higher percentage of toluene

(C) The vapour will contain equal amount of benzene and toluene

(D) Not enough information is given to make a prediction

25. A solution containing 0.1 g of a non-volatile organic substance P(molecular mass 100) in 100 g of benzene raises the boiling point of benzene by 0.2°C, while a solution containing 0.1 g of another non-volatile substance Q in the same amount of benzene raises the boiling point of benzene by 0.4°C. What is the ratio of molecular masses of P and Q?

(A) 1:2 **(B)** 2:1 **(C)** 1:4 **(D)** 4:1

26. Consider 0.1 M solution of two solutes X and Y. The solute X behaves as an univalent electrolyte while the solute Y dimerises in solution. Which of the following statements are correct regarding these solutions?

1. The boiling point of solution of X will be higher than that of Y

2. The osmotic pressure of solution of Y will be lower than that of X

3 The freezing point of the solution of X will be lower than that of Y

4. The relative lowering of vapour pressure of both the solutions will be the same

Select the correct answer from the codes given below:

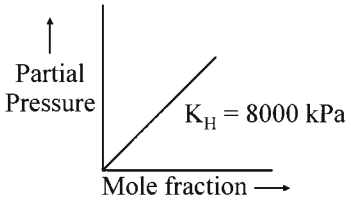
(A) 1, 2, 3 **(B)** 2, 3, 4 **(C)** 1, 2, 4 **(D)** 1, 3, 4

27. At 300 K, solubility of a gas in a liquid was measured at different partial pressure.

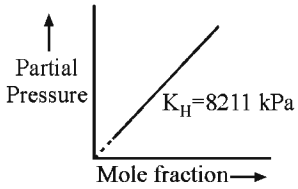
Mole fraction of Gas	0.010	0.015	0.020
Partial pressure of Gas (kPa)	82	122	166

Which of the following graph is correct in accordance with the Henry's law?

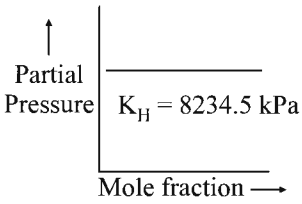
(A)



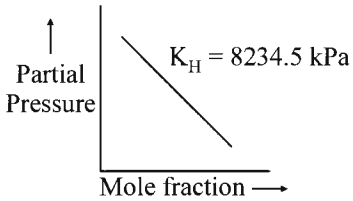
(B)



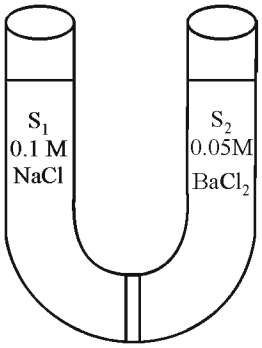
(C)



(D)



28. Two solutions S_1 and S_2 containing 0.1 M NaCl(aq) and 0.05 M $BaCl_2$ (aq) are separated by semipermeable membrane. Which among the following statement(s) is/are correct? (Assume complete dissociation of both the electrolytes).



(A) S_1 and S_2 are isotonic

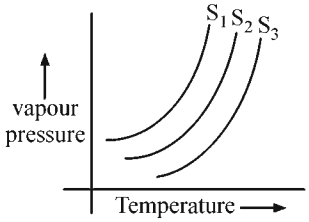
(B) S_1 is hypertonic while S_2 is hypotonic

(C) S_1 is hypotonic while S_2 is hypertonic

(D) Osmosis will take place from S_1 to S_2

29. The vapour pressure of three aqueous solutions S_1, S_2 and S_3 of same solute at different concentration are plotted against temperature in Kelvin.

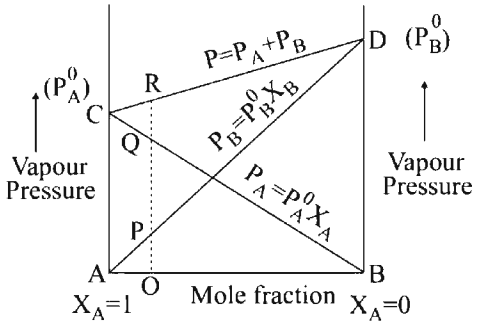
The concentrations of these solution will be in the order:



(A) $S_1 = S_2 = S_3$ **(B)** $S_1 < S_2 < S_3$

(C) $S_3 < S_2 < S_1$ **(D)** $S_1 < S_3 < S_2$

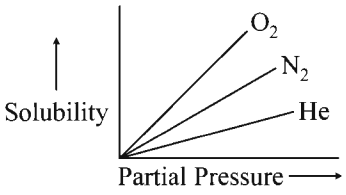
30. Two volatile liquids A and B form ideal solution. Considering the following vapour-pressure composition graph



OR will be equal to:

(A) OP + OQ **(B)** OP + PR **(C)** OQ + QR **(D)** OQ + PQ

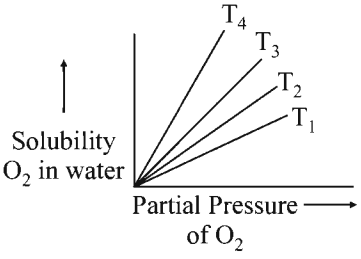
31. Molar solubility of helium, nitrogen and oxygen are plotted against partial pressure of the gas at constant temperature. Henry's law constant for these gases will lie in following sequence?



(A) $O_2 > N_2 > He$ **(B)** $O_2 < N_2 < He$

(C) $O_2 = N_2 = He$ **(D)** $O_2 > N_2 < He$

32. Solubility of oxygen gas in water follows Henry's law. When the solubility is plotted against partial pressure at a definite temperature we get following plots. Which of the following sequence of temperatures is correct?



(A) $T_1 = T_2 = T_3 = T_4$ **(B)** $T_1 > T_2 > T_3 > T_4$

(C) $T_1 < T_2 < T_3 < T_4$ **(D)** $T_1 > T_2 < T_3 > T_4$

Paragraph for Questions 33 - 36

The colligative properties of electrolytes require a slightly different approach that the one used for the colligative properties of non-electrolytes. The electrolytes dissociate into ions in a solution. It is the number of solute particles that determines the colligative properties of a solution. The electrolyte solutions, therefore, show abnormal colligative properties. To account for this effect we define a quantity called the van't Hoff factor, given by

$$i = \frac{\text{Actual number of particles in solution after dissociation}}{\text{Number of formula units initially dissolved in solution}}$$

$i = 1$ (for non-electrolytes);

$i > 1$ (for electrolytes, undergoing dissociation)

$i < 1$(for solutes, undergoing association).

33. Benzoic acid undergoes dimerisation in benzene solution. The van't Hoff factor 'i' is related to the degree of association 'α' of the acid as:

(A) $i = 1-\alpha$ **(B)** $i = 1+\alpha$ **(C)** $i = 1-\frac{\alpha}{2}$ **(D)** $i = 1+\frac{\alpha}{2}$

34. A substance trimerises when dissolved in a solvent A. the van't Hoff factor 'i' for the solution is:

(A) 1 **(B)** $1/3$ **(C)** 3 **(D)** Unpredictable

35. For a solution of non-electrolyte in water, the van't Hoff factor is:

(A) Always equal to 0 **(B)** ≤ 1

(C) Always equal to 1 **(D)** $>1 \text{ but } <2$

36. 0.1 M $K_4\left[Fe(CN)_6\right]$ is 60% ionized. What will be its van't Hoff factor?

(A) 1.4 **(B)** 2.4 **(C)** 3.4 **(D)** 4.4

Paragraph for Questions 37 - 40

The boiling point elevation and the freezing point depression of solutions have a number of practical applications. Ethylene glycol $(CH_2OH \cdot CH_2OH)$ is used in automobile radiators as an antifreeze because it lowers the freezing point of the coolant. The same substance also helps to prevent the radiator coolant from boiling away by elevating the boiling point. Ethylene glycol has low vapour pressure. We can also use glycerol as antifreeze. For boiling point elevation to occur, the solute must be non-volatile, but no such restriction applies to freezing point depression. For example, methanol (CH_3OH), a fairly volatile liquid that boils only at 65°C is sometimes used as antifreeze in automobile radiators.

37. Which of the following is a better reagent for depression in freezing point but not for elevation in boiling point?

(A) CH_3OH **(B)** $\begin{array}{l} CH_2OH \\ | \\ CH_2OH \end{array}$ **(C)** $\begin{array}{l} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \end{array}$ **(D)** $C_6H_{12}O_6$

38. 124 g each of the two reagents glycol and glycerol are added in 5 kg water of the radiators in the two cars. Which of the following statements is wrong?

(A) Both will act as antifreeze

(B) Glycol will be better

(C) Glycerol is better because its molar mass is greater than glycol

(D) Glycol is more volatile than glycerol

39. 620 g glycol is added to 4 kg water in the radiator of a car. What amount of ice will separate out at $-6°C$? $K_f = 1.86\,K\,kg\,mol^{-1}$:

(A) 800 g **(B)** 900 g **(C)** 600 g **(D)** 1000 g

40. If cost of glycerol, glycol and methanol are same, then the sequence of economy to use these compounds as antifreeze will be:

(A) glycerol > glycol > methanol **(B)** methanol > glycol > glycerol

(C) methanol = glycol = glycerol **(D)** methanol > glycol < glycerol

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

41. For accurate measurement of molecular mass of solute using colligative properties:

(A) Solution must be very dilute **(B)** Solute should not dissociate or associate

(C) Solute should be non-volatile **(D)** Solute and solvent should react with each other

42. Which of the following statements is/are correct about azeotropic mixture?

(A) Azeotropic mixture are non-ideal solutions

(B) The components of azeotropic mixture cannot be separated by fractional distillation

(C) Azeotropes obey Raoult's law

(D) Solutions with positive deviation from Raoult's law, forms minimum boiling azeotrope

43. Solution of two liquids A and B showing negative deviation from Raoult's law, will show:

(A) $\Delta H_{mix} < 0$ **(B)** $\Delta V_{mix} < 0$ **(C)** $P < P_A^0 X_A + P_B^0 X_B$ **(D)** $\Delta S_{mix} < 0$

44. Which of the following solutions exhibit positive deviation from Raoult's law?

(A) $H_2O + C_2H_5OH$ **(B)** $C_6H_6 + C_2H_5OH$

(C) $H_2O + HCl$ **(D)** $CHCl_3 + (CH_3)_2\,CO$

MATRIX MATCH TYPE

Given question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labelled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

45. Match the Column-1 with Column-2:

Column-1		Column-2	
(A)	Elevation in boiling point	**(p)**	Used in molecular mass determination of Polymers
(B)	Depression in freezing point	**(q)**	Proportional to the molality of solution
(C)	Osmotic pressure	**(r)**	Colligative property
(D)	Vapour pressure of a liquid	**(s)**	Depends on the intermolecular force

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

46. The vapour pressure of pure benzene at a certain temperature is 640 mm Hg. A non-volatile, non-electrolyte solid weighing 2.175 g is added to 39.0 g of benzene (to form an ideal solution). The vapour pressure of the solution is 600 mm Hg. What is the molecular weight of the solid substance?

47. The vapour pressure of pure water at 37°C is 47.1 torr. What is the vapour pressure in torr of an aqueous solution at 37°C containing 20 g of glucose dissolved in 500 gm of water.

48. The vapour pressure of ethyl alcohol at 25°C is 59.2 torr. The vapour pressure of a solution of urea in ethyl alcohol is 51.3 torr. What is the molality of the solution?

49. An aqueous solution containing 1g of urea boils at 100.25°C. The aqueous solution containing 3g of glucose in the same volume will boil at (Molecular mass of urea and glucose are 60 and 180 respectively)_____°C.

50. A solution of sucrose (Molar mass = 342 g/mol) is prepared by dissolving 68.4 g of it per litre of the solution, what is its osmotic pressure in atm? (R = 0.082 lit.atm / mol - K) at 273K

51. A solution has a 1 : 4 mole ratio of pentane to hexane. The vapour pressure of the pure hydrocarbons at 20°C are 440 mm Hg for pentane and 120 mm Hg for hexane. The mole fraction of pentane in the vapour phase would be:

52. The boiling point elevation constant for benzene is 2.57°C/m. The boiling point of benzene is 80.1°C. Determine the boiling point of a solution formed when 5.0 gm of $C_{14}H_{12}$ is dissolved in 15 gm of benzene.

53. What mass of sugar, $C_{12}H_{22}O_{11}(M_0 = 342)$ must be dissolved in 4.0 kg of H_2O to yield a solution that will freeze at $-3.72°C$. (Take $K_f = 1.86°C/m$)

54. The values of observed and calculated molecular weights of silver nitrate are 92.64 and 170 respectively. The percent dissociation of silver nitrate is_____.

55. Henry's constant of oxygen is 1.4×10^{-3} mol L^{-1} atm^{-1} at 298 K. How much of oxygen (in mg) is dissolved in 100 mL at 298 K when the partial pressure of oxygen is 0.5 atm?

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. The standard reduction potential values of $Cr^{3+}|Cr^{2+}$ and $Cr^{3+}|Cr$ half cells are –0.41 V and –0.74V respectively. The standard electrode potential of $Cr^{2+}|Cr$ half-cell is:

(A) +1.81 V **(B)** –1.81V **(C)** +0.9 V **(D)** – 0.9 V

2. Beryllium occurs naturally in the form of beryl. The metal is produced from its ore by electrolysis after the ore has been converted to the oxide and then to the chloride. How many grams of Be(s) is deposited from a $BeCl_2$ solution by a current of 5.0 A that flows for 1.0 h? (Atomic weight: Be = 9)

(A) 0.840 **(B)** 1.68 **(C)** 1.42 **(D)** 1.08

3. The element indium is to be obtained by electrolysis of a molten halide of the element. Passage of a current of 3.20 A for a period of 40.0 min results in formation of 3.05 g of In. What is the oxidation state of indium in the halide melt? (Atomic weight : In = 114.8)

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

4. How may grams of Cr are deposited in the electrolysis of solution of $Cr(NO_3)_3$ in the same time that it takes to deposit 0.54 g of Ag in a silver coulometer arranged in series with the $Cr(NO_3)_3$ cell? (Atomic weight : Cr = 52.0; Ag = 108)

(A) 0.0866 **(B)** 0.0288 **(C)** 0.173 g **(D)** 0.220

5. When a solution of $AgNO_3$ (1 M) is electrolyzed using platinum anode and copper cathode. What are the reaction occurring at two electrodes?

Given: $E^{o}_{Cu^{2+}|Cu} = +0.34$ volt; $E^{o}_{O_2,H^+|H_2O} = +1.23$ volt; $E^{o}_{H^+|H_2} = +0.0$ volt;

$E^{o}_{Ag^+|Ag} = +0.8$volt

(A) $Cu \rightarrow Cu^{2+} + 2e^-$ at anode; $Ag^+ + e^- \longrightarrow Ag$ at cathode

(B) $H_2O \rightarrow \frac{1}{2} O_2 + 2H^+ + 2e^-$ at anode; $Cu^{2+} + 2e^- \longrightarrow Cu$ at cathode

(C) $H_2O \rightarrow \frac{1}{2} O_2 + 2H^+ + 2e^-$ at anode; $Ag^+ + e^- \longrightarrow Ag$ at cathode

(D) $e^- + 2H^+ + NO_3^- \rightarrow NO_2 + H_2O$ at anode; $Ag^+ + e^- \longrightarrow Ag$ at cathode

6. The E^o at 25° C for the following reaction at the indicated concentrations is 1.50 V. Calculate the ΔG in kJ at 25° C for the given reaction: $Cr(s) + 3Ag^+(aq, 0.1M) \longrightarrow 3Ag(s) + Cr^{3+}(aq, 0.1M)$

(A) −140.94 **(B)** −295 **(C)** −212 **(D)** −422.96 kJ

7. Copper reduces HNO_3 into NO_2 depending upon concentration of HNO_3 in solution. Assuming $[Cu(NO_3)_2] = 0.1M$ and $P_{NO_2} = 10^{-3}$ bar, at which concentration of HNO_3, thermodynamic tendency for reduction of HNO_3 into NO_2 by copper is feasible? [Given $E^{o}_{Cu^{2+}|Cu} = +0.34$ volt, $E^{o}_{HNO_3|NO_2} = +0.79$ volt]

(A) 2.71×10^{-5} M **(B)** 2.82×10^{-6} M **(C)** 2×10^{-7} M **(D)** 2.71×10^{-8} M

8. Molar conductivity of a solution of an electrolyte AB_3 is 150 $Scm^2\ mol^{-1}$. If it ionisesas : $AB_3 \longrightarrow A^{3+} + 3B^-$, its equivalent conductivity will be:

(A) 150 (in $Scm^2\ eq^{-1}$) **(B)** 75 (in $Scm^2\ eq^{-1}$)

(C) 50 (in $Scm^2\ eq^{-1}$) **(D)** 80 (in $Scm^2\ eq^{-1}$)

9. A galvanic cell is composed of two hydrogen electrodes, of which cathode is a standard hydrogen electrode. In which of the following solutions, should the other electrode be immersed to get maximum e.m.f.?

(A) 0.1 M HCl **(B)** 0.1 M H_2SO_4

(C) 0.1 M HCO_2H **(D)** 0.01 M HCOOH

10. The EMF of the following cell is 0.265 V at 25°C and 0.2595 V at 35°C.

$$Pt(H_2)/HCl(aq)\,||\,AgCl/Ag.$$

The heat of reaction taking place at 25°C is:

(A) – 90.8 kJ **(B)** – 80.8 kJ

(C) –82.76 kJ **(D)** –41.38 kJ

11. The electrolytic conductivity of a saturated solution of AgCl in water at 25°C is $1.26\times10^{-6}\Omega^{-1}$ cm^{-1}greater than that for the water used. Calculate the solubility of AgCl in water if the molar ionic conductivities of Ag^+ and $Cl^- = 53.9\,\Omega^{-1}$ $cm^{-2}\,mol^{-1}$, and $72.1\,\Omega^{-1}cm^2mol^{-1}$ respectively.

(A) 0.95×10^{-5} g/L **(B)** 1×10^{-5}mol/L

(C) 0.95×10^{-2}mol/L **(D)** 0.95×10^{-2} g/L

12. Molar conductivities of AgCl, $BaSO_4$, $AlPO_4$ and $Ba_3(PO_4)_2$ are 200, 300, 500 and 700 S $cm^2\ mol^{-1}$. Which of the following solution has greater conducting ability?

(A) $Ba_3(PO_4)_2$ **(B)** $AlPO_4$ **(C)** $BaSO_4$ **(D)** AgCl

13. The molar conductivity of a weak acid (HA) at infinite dilution is 275 S $cm^2\ mol^{-1}$ and that of 0.1 M solution of HA is 5.5 S $cm^2\ mol^{-1}$ at 25°C. What is the dissociation constant of HA at the given temperature?

(A) 1×10^{-4} **(B)** 4.08×10^{-4}

(C) 4.08×10^{-5} **(D)** 1×10^{-5}

14. Which of the following is(are) correct for a lead acid battery supplying electrical energy?

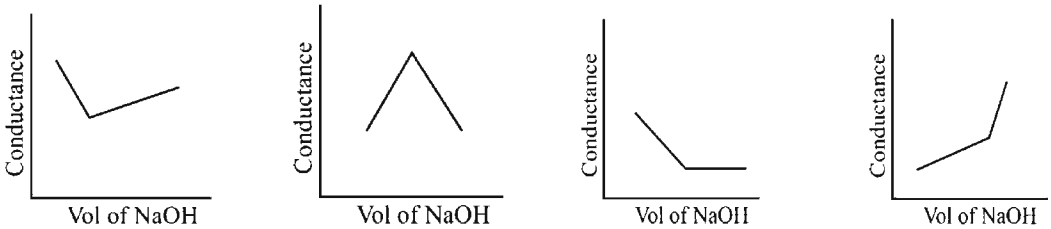
(A) $PbSO_4$ is formed at one electrode only

(B) $Pb + H_2SO_4 \rightarrow PbSO_4 + H_2$

(C) Weight of electrolyte decreases

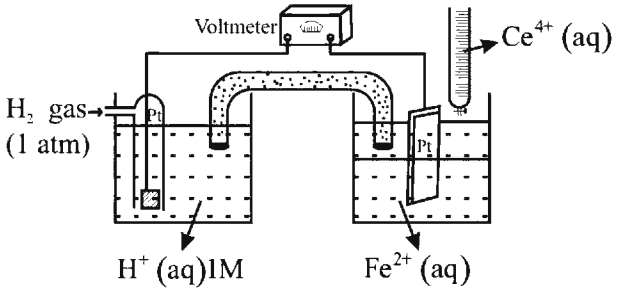
(D) PbO_2 accepts electrons only

15. HNO_3 (aq) is titrated with NaOH(aq) conductometrically, graphical representation of the titration is:



(A) **(B)** **(C)** **(D)**

Paragraph for Questions16- 18



The given electrochemical cell setup has standard hydrogen electrode as anode and Fe^{3+}/Fe^{2+} half-cell as cathode. Ce^{4+} (cerric) ion is added from the burette to beaker containing Fe^{2+} ion, when following reaction occurs.

$$Fe^{2+}(aq) + Ce^{4+}(aq) \rightleftharpoons Fe^{3+}(aq) + Ce^{3+}(aq)$$

With the addition of Ce^{4+} ion, the half – cell potential changes, and is measured directly by the voltmeter. Given; $E^{\circ}_{Ce^{4+}/Ce^{3+}} = 1.64V$, $E^{\circ}_{Fe^{2+}/Fe^{3+}} = -0.80V$. The concentration of Fe^{2+} solution is 0.1 M and its volume is 600 ml. The concentration of Ce^{4+} solution added from burette is 0.1 M.

16. The potential of the cell after 1/3rd of the ferrous ion has been titrated will be:

(A) 1.64 V **(B)** 0.782 V **(C)** 1.522 V **(D)** 0.682 V

17. The potential of the cell at equivalence point in the titration of Ce^{4+} and Fe^{2+}, will be:

(A) 1.22 V **(B)** 0.42 V **(C)** 1.64 V **(D)** 0.8 V

18. The equilibrium constant for the reaction in cathode half-cell is:

(A) $10^{1.68/0.059}$ **(B)** $10^{0.84/0.059}$ **(C)** $10^{1.64/0.059}$ **(D)** $10^{0.8/0.059}$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

19. If $Sn^{+2} + 2e^- \rightarrow Sn;\ E^{\circ} = -0.14V$

$Sn^{+4} + 2e^- \rightarrow Sn^{+2};\ E^{\circ} = -0.13V$

Then:

(A) Sn^{+2} is unstable and disproportionates to Sn^{+4} and Sn

(B) Sn^{+2} is stable and disproportionation reaction is not spontaneous

(C) Sn^{+4} is easily reduced to Sn in aqueous solution

(D) $Sn^{+4} + Sn \rightarrow 2Sn^{+2}$ is spontaneous

20.

Electrolyte	KCl	KNO_3	HCl	NaOAc	NaCl
$\Lambda_m^{\infty}\left(Scm^2mol^{-1}\right)$	149.9	145	426.2	91	126.5

Which of the following is/are correct?

(A) Λ^{∞}_{HOAc} is 517.2 **(B)** $\Lambda^{\infty}_{HNO_3}$ is 450

(C) Λ^{∞}_{AcOH} is 390.7 **(D)** $\Lambda^{\infty}_{HNO_3}$ is 421.3

21. Perdisulphuric acid ($H_2S_2O_8$) can be prepared by electrolytic oxidation of H_2SO_4 as:

$$2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$$

Which of the following statement(s) is(are) correct for this electrolysis?

(A) Oxygen and hydrogen gases are formed as other products at anode and cathode respectively.

(B) Concentrated H_2SO_4 solution can be used during this electrolysis to get $H_2S_2O_8$.

(C) Equivalents of $H_2S_2O_8$ formed is the difference between equivalents of H_2 and O_2 formed.

(D) Equivalents of $H_2S_2O_8$ formed is the sum of equivalents of H_2 and O_2 formed.

22. Which of the following cell reaction is spontaneous?

(A) $Pt\,|\,H_2(1\text{ atm})\,|\,HCl(0.01M)\,||\,H_2SO_4(0.01M)\,|\,H_2(1\text{ atm})\,|\,Pt$

(B) $Pt\,|\,H_2(1\text{ atm})\,|\,HCl(0.1M)\,||\,HCl(0.1M)\,|\,H_2(0.1\text{ atm})\,|\,Pt$

(C) $Ag\,|\,AgNO_3(0.01M)\,||\,AgCl(\text{saturated})\,|\,Ag$ $(K_{sp}\text{ of AgCl} = 1\times10^{-10})$

(D) $Ag\,|\,AgBr(\text{saturated})\,||\,AgCl(\text{saturated})\,|\,Ag$ $(K_{sp}\text{ of AgCl} = 1\times10^{-10})$

$\left(K_{sp}\text{ of AgBr} = 1\times10^{-13}\right)$

23. Which of the following represents correct relation(s)?

(A) $\Delta G = -nFE$ under non-standard conditions

(B) $\Delta G = -RT\ln K_{eq}$

(C) $\Delta G = \Delta G^\circ + RT\ln Q$

(D) $E^\circ_{Cl^-/AgCl/Ag} = E^\circ_{Ag^+/Ag} + \dfrac{RT}{F}\ln K_{Sp}(AgCl)$

24. When an aqueous solution of NaCl is electrolysed using Pt electrodes, the correct statement(s) is(are):

(A) H_2O is reduced at cathode to liberate H_2 gas

(B) Na^+ reduced at cathode.

(C) Cl^- is oxidized at anode to liberate Cl_2 gas

(D) There is no change in pH of solution.

25. Which of the following is true about the given cell, Ag | Saturated AgCl || Saturated Ag_2CrO_4|Ag?

$\left(K_{sp}\text{ AgCl} = 10^{-10}M^2\right)$ $\left(K_{sp}\,Ag_2CrO_4 = 3.2\times10^{-11}M^3\right)$

(A) It is an electrolyte concentration cell

(B) It is a non-spontaneous concentration cell.

(C) The net reaction is $Ag^+_c \longrightarrow Ag^+_A$

(D) The EMF of cell is 0.0944V

26. Consider the cell: $Ag\,|\,AgCl\,|\,KCl(0.1M)\,|\,Hg_2Cl_2\,|\,Hg$, the cell potential:

(A) increases on increasing concentration of Cl^- ions

(B) decreases on decreasing concentration of Cl^- ions

(C) is independent of concentration of Cl^- ions

(D) is independent of amounts of AgCl and Hg_2Cl_2

27. From the solution of an electrolyte, one mole of electron will deposit at cathode:

(A) 63.5g of Cu **(B)** 12 g of Mg **(C)** 11.5 g of Na **(D)** 9.0g of Al.

28. An aqueous solution containing 1M $NiSO_4$ and 1M $S_2O_8^{2-}$ is electrolysed using palladium electrodes at 25°C.

$Ni^{2+} + 2e^- \rightarrow Ni \quad E^\circ = -0.25V$

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O \quad E^\circ = 1.23V$

$Pd^{2+} + 2e^- \rightarrow Pd \quad E^\circ = 0.92V$

$S_2O_8^{2-} + 2e^- \rightarrow 2SO_4^{2-} \quad E^\circ = 2.0V$

pH of solution is assumed as 7.

Select the correct statement(s) on the basis of above given information (Ignore over-voltage)

(A) Anode reaction : $Pd \rightarrow Pd^{2+} + 2e^-$ **(B)** Anode reaction : $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

(C) Cathode reaction : $Ni^{2+} + 2e^- \rightarrow Ni$ **(D)** Cathode reaction : $2H^+ + 2e^- \rightarrow H_2$

29. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox reaction. Some half-cell reactions and their standard potential are given below:

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l) \quad E^\circ = 1.5\ V$

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l) \quad E^\circ = 1.38\ V$

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq) \quad E^\circ = 0.77\ V$

$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq) \quad E^\circ = 1.40\ V$

Identify the correct statement(s) regarding the quantitative estimation of aqueous ferrous nitrate insolution.

(A) MnO_4^- can be used in aqueous H_2SO_4 **(B)** $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

(C) MnO_4^- can be used in aqueous HCl **(D)** $Cr_2O_7^{2-}$ can be used in aqueous HCl

30. For the given half-cell, Ag | AgCl | Cl^- (M)

The reaction is : $Ag(s) \rightarrow Ag^+(aq) + e^- - (i)$

$$Ag^+(aq) + Cl^-(aq) \rightleftharpoons AgCl(s) - (ii)$$

$$Ag(s) + Cl^-(aq) \rightarrow AgCl(s) + e^- - (iii)$$

Which of the following is(are) true about this half cell?

(A) E° of reaction (i) and E° of reaction (iii) are same

(B) E of reaction (ii) is zero

(C) E of reaction (i) is same as E of reaction (iii)

(D) Moles of AgCl precipitated is same as moles of Ag used

31. Which of the following statement(s) is/are correct with respect to given standard electrode potentials?

$E^\circ_{Cu^{2+}/Cu} = 0.34V$, $E^\circ_{Sn^{2+}/Sn} = -0.136V$ and $E^\circ_{H^+/H_2} = 0.0V$.

(A) Cu^{2+} ions can be reduced by $H_2(g)$ **(B)** Sn^{2+} ions can be reduced by $H_2(g)$

(C) Sn can be oxidized by Cu^{2+} ions **(D)** Cu can be oxidized by Sn^{2+} ions

32. Which of the following electrolytic arrangement(s) will produce oxygen at anode during electrolysis?

(A) Fused NaOH with inert electrodes **(B)** Dilute H_2SO_4 with Cu electrodes

(C) Dilute H_2SO_4 with Pt electrodes **(D)** Concentrated NaCl with Pt electrodes

33. Which of the following represents a redox half-cell?

(A) $Pt \mid Fe^{2+}(0.1M), Fe^{3+}(0.01M)$ **(B)** $Pt \mid H_2(1\ atm) \mid H^+(0.05M)$

(C) $Pt \mid Mn^{2+}(0.1M),\ MnO_4^-(0.1M), H^+(0.8M)$ **(D)** $Pt \mid Cr^{3+}(0.2M), Cr_2O_7^{2-}(0.1M), H^+(1.4M)$

34. Which of the following represents a feasible reaction?

(A) $F_2 + 2Br^- \longrightarrow Br_2 + 2F^-$ **(B)** $Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2$

(C) $Br_2 + 2Cl^- \longrightarrow Cl_2 + 2Br^-$ **(D)** $Br_2 + 2I^- \longrightarrow I_2 + 2Br^-$

35. Which of the following is(are) true about lead storage battery?

(A) Concentration of H_2SO_4 decreases during discharging of lead storage battery.

(B) Amount of Pb increases during charging of lead storage battery.

(C) Lead storage battery in a car does not take ignition on a cold winter morning due to increase in viscosity of H_2SO_4.

(D) Moles of $PbSO_4$ formed during discharging is same as that of Pb used.

36. Which of the following represents a spontaneous electrolyte concentration cell?

(A) $Pt \mid H_2(0.1atm) \mid HCl(0.1M) \parallel H_2SO_4(0.05M) \mid H_2(0.05atm) \mid Pt$

(B) $Pt \mid H_2(0.1\ atm) \mid HCl(0.2M) \parallel H_2SO_4(0.1M) \mid H_2(0.2\ atm) \mid Pt$

(C) $Ag \mid \underset{K_{sp}=1\times10^{-13}}{AgBr} \mid Br^-(0.1M) \parallel Cl^-(0.1M) \mid \underset{K_{sp}=1\times10^{-10}}{AgCl} \mid Ag$

(D) $Zn \mid Zn^{2+}(0.2M) \parallel Zn^{2+}(0.1M) \mid Zn$

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

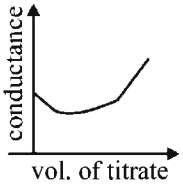
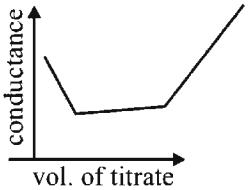
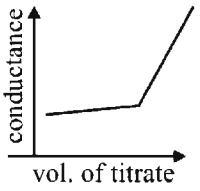
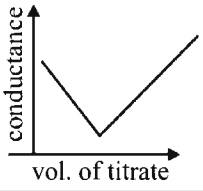
37. Match the following:

Column 1		Column 2	
(A)	$Cu \mid Cu^{2+} \mid (c_1M) \parallel Cu^{2+}(c_2M) \mid Cu$ $c_2 > c_1$	**(p)**	Concentration cell
(B)	$Al \mid Al^{3+} \parallel Zn^{2+} \mid Zn$	**(q)**	Gas-gas ion electrode
(C)	$Pt \mid O_2(P_1atm) \mid OH^-(cM) \parallel OH^-(cM) \mid O_2(P_2atm) \mid Pt$ $P_1 > P_2$	**(r)**	pH measurement
(D)	$Mg \mid Mg^{2+} \parallel H^+ \mid H_2 \mid Pt$	**(s)**	Galvanic cell

38. Match the following:

Column 1		Column 2	
(A)	Electrolysis of aqueous $CuSO_4$ using Cu electrodes	**(p)**	Density of H_2SO_4 increases
(B)	Electrolysis of dil. H_2SO_4 using Pt electrodes	**(q)**	Molarity of solution remains same.
(C)	Electrolysis of aqueous NaF using Pt electrodes	**(r)**	H_2 is liberated at cathode.
(D)	Recharging of lead storage battery	**(s)**	Positive electrode is anode and negative electrode is cathode
		(t)	O_2 is liberated at anode.

39. Match the titrations of titrant and titrand in column1 with appropriate conductometric titration curves in column 2 and select the correct answer among the code given below the columns.

Column 1		Column 2	
(1)	Titration of HCl v/s NaOH	**(p)**	
(2)	Titration of CH_3CO_2H v/s NaOH	**(q)**	
(3)	Titration of ($HCl+CH_3CO_2H$) v/s NaOH	**(r)**	
(4)	Titration of $AgNO_3$ v/s KCl	**(s)**	

Codes :

	P	Q	R	S		P	Q	R	S
(A)	4	1	2	3	**(B)**	4	2	1	3
(C)	4	3	2	1	**(D)**	4	3	1	2

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

40. The EMF of the cell $M|M^{n+}(0.02M)||\ H^+\ (1M)|H_2(g)(1\ atm)|Pt$ at 25°C is 0.81V. The valency of the metal if the standard oxidation potential of the metal is 0.76V, is_____.

41. Consider the cell, $Ag|AgBr|Br^-||Cl^-|AgCl|Ag$ at 25°C. The K_{sp} of AgBr and AgCl are 5×10^{-13} and 1×10^{-10}. The concentration ratio of $\frac{[Cl^-]}{[Br^-]}$ ions when the emf of the cell is 0.118V, will be_____.

42. The electrolysis of a metal salt was carried out by passing a current of 4 amp for 45 minutes. It resulted in the deposition of 2.977 g metal. If atomic mass of the metal is 106.4 g mol^{-1}, then calculate the charge on metal cation.

43. The emf of the given cell $Pt|H_2(g)|Buffer||$ Normal std. calomel electrode is 0.68 V at 25°C, when barometric pressure is 760 mm. What is the pH of the buffer solution?

E^0 calomel = 0.28 V. (Take $\frac{2.303RT}{F}=0.06$)

44. The conductivity of a saturated solution of CaF_2 at 18°C was found to be 5.2×10^{-5} S cm^{-1} and the conductivity of water used for making the solution was 2×10^{-6} S cm^{-1}. The molar ionic conductivities at infinite dilution of Ca^{2+} and F^- ions are 120 & 65 S cm^2 mol^{-1} respectively. The solubility product of $CaF_2$is $4x\times10^{-12}M^3$. The value of x is _____.

45. When 0.5 L of 16 M $SnSO_4$ is electrolysed for a period of 100 minutes using a current of 96.5 A and inert electrodes, the final concentration of Sn^{2+} in the solution will be _____.

($E^\circ\ Sn^{2+}/Sn = -0.14$ V, $E^\circ\ Sn^{2+}/Sn^{4+}$ = -0.13 V, $E^\circ OH^-/O_2=-0.4V$, $E^0{so_4}^{2-}/{s_2o_8}^{2-}=-2.0V$).

46. In the Hall-Heroult process, molten Al_2O_3 is electrolysed using 9650 A current for a period of 100 s. How many Al cans can be made from the Al produced if each can uses 10 g?

47. Aluminium displaces hydrogen from dilute HCl whereas silver does not. The EMF of a cell prepared by combining Al/Al^{3+} and Ag/Ag^+ is 2.46 V. The reduction potential of silver electrode is +0.80 V. The reduction potential of aluminium electrode is _____.

48. A 100 W, 110 V lamp is connected in series with an electrolytic cell containing $CdSO_4$ solution. What mass of Cd will be deposited by the current flowing for 10 hours? (Use : A_{Cd} = 112 gm/mole)

49. During the electrolysis of water, a total volume of 33.6 mL of hydrogen and oxygen gas was collected at STP. Find the amount of electricity in coulomb that passed during electrolysis.

50. The standard reduction potentials of Cu^{2+}/Cu and Cu^{2+}/Cu^+ are 0.337 V and 0.153 V respectively. The standard electrode potential of Cu^+/Cu half-cell is _____.

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. There are three cubic unit cells A, B and C. A is FCC and all of its tetrahedral voids are also occupied. B is also FCC and all of its octahedral voids are also occupied. C is simple cubic and all of its cubic voids are also occupied. If voids in all unit cells are occupied by the spheres exactly at their limiting radius, then the order of packing efficiency would be:

(A) $A < B < C$ **(B)** $C < A < B$ **(C)** $C < B < A$ **(D)** $A < C < B$

2. If 'a' stands for the edge length of the cubic systems: simple cubic, body centered cubic and face centred cubic, then the ratio of radii of the spheres in these systems will be respectively:

(A) $\frac{a}{2} : \frac{a\sqrt{3}}{2} : \frac{a\sqrt{2}}{2}$ **(B)** $a : \sqrt{3}a : \sqrt{2}a$ **(C)** $\frac{a}{2} : \frac{a\sqrt{3}}{4} : \frac{a}{2\sqrt{2}}$ **(D)** $\frac{a}{2} : \sqrt{3}\,a : \frac{a}{\sqrt{2}}$

3. First three nearest neighbour distance for body centered cubic lattice are:

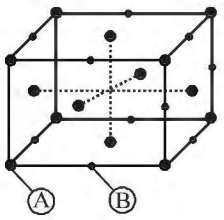
(A) $\sqrt{2}a, a, \sqrt{3}a$ **(B)** $\frac{a}{\sqrt{2}}, a\sqrt{3}, a$ **(C)** $\frac{\sqrt{3}a}{2}, a, \sqrt{2}a$ **(D)** $\frac{\sqrt{3}a}{2}, a, \sqrt{3}a$

4. At very low temperature oxygen (O_2) freezes and forms a crystal. Which term best describes the formed solid:

(A) Covalent network crystal **(B)** Molecular crystal

(C) Metallic crystal **(D)** Ionic crystal

5. For solid with following structure, the coordination number of the point B is:



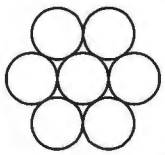
(A) 3

(B) 4

(C) 5

(D) 6

6. In FCC crystal, which of the following shaded planes contains the following type of arrangement of atoms:



(A)  **(B)**  **(C)**  **(D)** 

7. Distance between tetrahedral void and octahedral void in the FCC lattice will be (a = edge length of unit cell)

(A) $\frac{\sqrt{3}a}{4}$ **(B)** $\sqrt{3}a$ **(C)** $\frac{\sqrt{3}a}{2}$ **(D)** $\frac{\sqrt{3}a}{3}$

8. A non-stoichiometric compound $Cu_{1.8}$ S is formed due to incorporation of Cu^{2+} ions in the lattice of cuprous sulphide. What percentage of Cu^{2+} ions out of the total copper content is present in the compound:

(A) 88.88 **(B)** 11.11 **(C)** 99.8 **(D)** 89.8

9. CsBr has BCC structure with edge length 4.3 Å. The shortest inter ionic distance in between Cs^{+1} and Br^{-} in Å is:

(A) 3.72 **(B)** 1.86 **(C)** 7.44 **(D)** 4.3

10. When NaCl is doped with 1×10^{-4} mole of $SrCl_2$, the no. of cation vacancies produced are:

(A) 6.023×10^{18} **(B)** 6.023×10^{19} **(C)** 6.023×10^{20} **(D)** 3.011×10^{20}

11. A mineral having formula AB crystallizes in CCP lattice with 'A' atoms occupying the lattice points. Pick out the correct statement from the following:

(A) 100% occupancy of tetrahedral voids by B, co-ordination no. of B = 4

(B) 100% occupancy of octahedral voids by B, co-ordination no. of B = 4

(C) 50% occupancy of tetrahedral voids by B, co-ordination no. of A = 4

(D) 100% occupancy of octahedral voids by B, co-ordination no. of A = 4

12. Zinc oxide which is white when cold, becomes yellow when heated. It is due to the development of:

(A) Frenkel defect **(B)** Metal excess defect

(C) Schottky defect **(D)** Metal deficiency defect

13. A metal crystallizes into two crystal unit cells like face centered cubic (FCC) and body centre cubic (BCC) at different temperatures. Ratio of densities of FCC and BCC crystals will be (Assuming same edge length):

(A) 1.09 **(B)** 1.21 **(C)** 1.25 **(D)** 1.3

14. In a face centred cubic packed structure of mixed oxide, the lattice is made up of oxide ions, $1/5^{th}$ of tetrahedral voids are occupied by divalent ions (X^{2+}), while ½ of the octahedral voids occupied by trivalent (Y^{3+}) ions, then the formula of the oxide is:

(A) XY_2O_4 **(B)** X_2YO_4 **(C)** $X_4Y_5O_{10}$ **(D)** $X_5Y_4O_{10}$

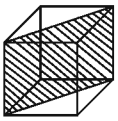
15. A crystal is made of particles X, Y and Z. X forms cubic close packing. Y occupies all the octahedral voids of X and Z occupies all the tetrahedral voids of X. If all the particles along one body diagonal of unit cell are removed then the formula of the crystal would be:

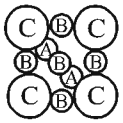
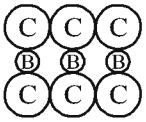
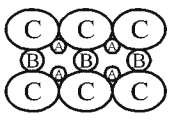
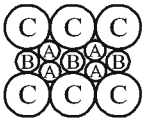
(A) XYZ_2 **(B)** X_2YZ_2 **(C)** $X_8Y_4Z_5$ **(D)** $X_5Y_4Z_8$

16. A certain solid mixed oxide crystallizing in the cubic system contains cations M_1 and M_2 and the oxide ion O^{2-}. Each M_1 ion is surrounded by 12 equidistant nearest neighbour oxide ions. If the oxide ions occupy face centers of cubic unit cell, where are the M_1 ions situated?

(A) At the center of the unit cell **(B)** At the corners of the cube

(C) At the edge centers **(D)** Occupying half the number of edge centres

17.  In a hypothetical solid C atoms are found to form cubic close packed lattice, A atoms occupy all tetrahedral voids B atoms occupy all octahedral voids. A and B atoms are of appropriate size, so that there is no distortion in CCP lattice of C atoms. Now if a plane as shown in the following figure is cut, then the cross section of this plane will look like.

(A)  **(B)**  **(C)**  **(D)** 

18. What is the distance between two nearest tetrahedral voids in FCC, given the edge length is 'a'

(A) $a/2$ **(B)** $\sqrt{3}/2a$ **(C)** $\sqrt{2}a$ **(D)** $a/\sqrt{2}$

19. Which of the following expressions is correct for a CsCl unit cell with lattice parameter, a?

(A) $r_{Cs^+} + r_{Cl^-} = 2a$ **(B)** $r_{Cs^+} + r_{Cl^-} = \frac{a}{\sqrt{2}}$ **(C)** $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}a}{2}$ **(D)** $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

Paragraph for Questions 20 - 22

Packing referes to the arrangement of constituent units in such a way that the forces of attraction among the constituent particles is maximum and the constituents occupy the maximum available space and the remaining is the void space. Different voids are present in close packing viz trigonal, tetrahedral, octahedral and cubic void. In three dimensions there are hexagonal close packing and cubic close pacing. HCP has AB AB AB ..... layer arrangement and CCP has ABC ABC ABC ..... layer arrangement of constituent spheres.

20. The volume of HCP unit cell is (r is radius of constituent spheres):

(A) $24\sqrt{2}\,r^3$ **(B)** $16\sqrt{2}\,r^3$ **(C)** $12\sqrt{2}\,r^3$ **(D)** $\frac{64}{3\sqrt{3}}r^3$

21. Which of the following is not common between HCP and CCP arrangements?

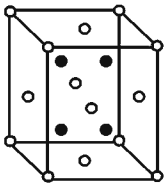
(A) Both have same packing efficiency
(B) Both have same coordination number
(C) Both contain octahedral voids
(D) Both contain same number of tetrahedral voids per unit cell

22. Distance between two adjacent most closely packed layers in CCP will be equal to (r = radius of atom)

(A) $\sqrt{2}\,r$ **(B)** $\sqrt{\frac{2}{3}}\,r$ **(C)** $2\sqrt{\frac{2}{3}}\,r$ **(D)** $2\sqrt{\frac{3}{2}}\,r$

For Questions 23 - 25

Answer the following questions for the given unit cell:



o ⟶ A (corner and face centre)
● ⟶ B (tetrahedral void)

23. If the molar mass of AB is 100g mol^{-1} and 'a' is edge length then the density of the crystal will be:

(A) $\frac{4N_A}{a^3 \times 100}$ **(B)** $\frac{4\times100}{a^3N_A}$ **(C)** $\frac{2N_A}{a^3100}$ **(D)** $\frac{2\times100}{a^3N_A}$

24. The given unit cell belongs to:

(A) CsCl type **(B)** TiCl type **(C)** Rock salt type **(D)** Zinc blende type

25. The coordination number of 'B' will be:

(A) 8 **(B)** 6 **(C)** 4 **(D)** 12

Paragraph for Questions 26 - 28

A site in a closest-packed lattice can be generated by placing four spheres of radius R at alternate corners of a cube, such that the spheres are in contact.

26. The site created is:

(A) Octahedral **(B)** Spherical **(C)** Tetrahedral **(D)** Square planar

27. The length of body diagonal of this cube is:

(A) Greater than 3R **(B)** Less than $\sqrt{2}$ R **(C)** Equal to $\sqrt{6}$ R **(D)** Greater than $\sqrt{6}$ R

28. The radius of tetrahedral hole is:

(A) $\frac{\sqrt{3}}{2}R$ **(B)** $\left(\sqrt{\frac{3}{2}}-1\right)R$ **(C)** $\sqrt{3}$ R **(D)** $\left(\frac{\sqrt{3}-1}{2}\right)R$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

29. If the three interaxial angles of the unit cell are all equal in magnitude, the crystal cannot belong to the:

(A) monoclinic system **(B)** cubic system
(C) hexagonal system **(D)** triclinic system

30. The two types of holes which occur in any close-packed structure are:

(A) tetrahedral, octahedral **(B)** trigonal, octahedral
(C) trigonal, tetrahedral **(D)** octahedral, cubic

31. Which of the following statements are correct?

(A) The co-ordination number of each type of ions in CsCl crystals is 8
(B) A metal which crystallizes in bcc structure has co-ordination number of 12
(C) The edge length of a unit cell in NaCl is 552 pm. $\left(r_{Na^+} = 95 \text{ pm}, r_{C\ell^-} = 181 \text{ pm}\right)$
(D) A unit cell of an ionic crystal shares some of its ions with other unit cells.

32. Which of the following statements are false:

(A) The radius of a metal atom is taken as half of the nearest metal-metal distance in a metallic crystal
(B) One tetrahedral void per atom is present in hcp structure
(C) In the fluorite structure (CaF_2), the Ca^{2+} ions are located at the lattice points and the fluoride ions fill all the tetrahedral holes in the ccp crystal.
(D) In the antifluorite structure (Li_2O, Rb_2S) the cations are located at the lattice points and anions fill the tetrahedral holes in the ccp structure.

33. In the unit cell of NaCl, which of the following statements are correct?

(A) Na^+ ions have six Cl^- ions in its nearest neighbourhood
(B) Cl^- ions have six Na^+ ions in its nearest neighbourhood
(C) Second nearest neighbour of Na^+ ion are twelve Na^+ ions
(D) NaCl has 68% of occupied space

34. The correct statement(s) regarding defects in solids is(are):

(A) Schottky defect is usually favoured by a very small difference in the sizes of cation and anion
(B) Frenkel defect increases exponentially with temperature
(C) Trapping of an electron in the lattice leads to the formation of F-center
(D) Solids with F – centre act as semi – conductors

35. Which of the following is expected in case of crystal exhibiting schottky defect?

(A) Crystal has intrinsic semi conduction **(B)** Density of crystal is less than expected
(C) Stoichiometry remains same **(D)** Crystal exhibit colour

36. Select the correct statements if NaCl is doped by $CaCl_2$, then the formed solid solution results in:

(A) Substitutional cation vacancy **(B)** Frenkel's defect

(C) Schottky defect **(D)** Decrease of density

37. Select the correct statement(s):

(A) Schottky defect is shown by CsCl

(B) Frenkel defect is shown by ZnS

(C) Hexagonal close packing (HCP) and Cubic close packing (CCP) structure has same coordination no.12

(D) At high pressure, the co-ordination number increases.

38. In which of the following crystalline systems $\alpha = \beta = \gamma$ is followed

(A) Cubic **(B)** Tetragonal **(C)** Orthorhombic **(D)** Rhombohedral

39. In diamond, the lattice is FCC with C atoms occupying lattice points as well as some of the void positions and resemble zinc blend structure. Which of the following statements are correct about the diamond structure?

(A) In the lattice half of the tetrahedral positions are vacant

(B) Packing efficiency of the crystal is 74 %

(C) In the lattice, all octahedral positions are vacant

(D) Coordination number of carbon atoms is 4

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Set 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Set 2 can be matched with Set 1.

40. MATCH THE FOLLOWING:

	Set – 1(Type of ionic crystal)		**Set – 2(Related information)**
(1)	NaCl type of crystal	**(P)**	Coordination number of cation = 8
(2)	CsCl type of crystal	**(Q)**	Coordination number of anion = 4
(3)	ZnS type of crystal	**(R)**	$r_c + r_a = a/2$ (lattice parameter)
(4)	CaF_2 type of crystal	**(S)**	Anions occupy CCP position

(r_c and r_a are radius of cation and anion respectively)

(A) 1 – R, 2 – P, 3 – Q, 4 – S **(B)** 1 – R, 2 – S, 3 – P, 4 – Q

(C) 1 – R, S 2 – P, S 3 –Q, S 4 –P, Q **(D)** 1 – S, 2 – P, 3 – Q, 4 – R

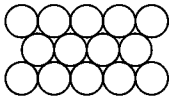
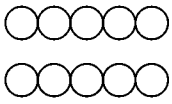
41. MATCH THE FOLLOWING:

	Set – 1		**Set – 2**
(1)	Cubic	**(P)**	All angles are equal
(2)	Ortho rhombic	**(Q)**	Only two sides have equal length
(3)	Monoclinic	**(R)**	Have maximum elements of symmetry
(4)	Hexagonal	**(S)**	Contain two bravais lattice

(A) 1 – P, R 2 – P, 3 – S, 4 – Q **(B)** 1 – R, 2 – P, 3 – Q, 4 – S

(C) 1 – P, 2 – R, 3 – Q, 4 – S **(D)** 1 – P, 2 – Q, 3 – R, 4 – S

42. MATCH THE FOLLOWING:

Set – 1		Set – 2 (Possible arrangement of atoms in different planes)	
(1)	Simple cubic	**(P)**	
(2)	Body centred cubic	**(Q)**	
(3)	Face centred cubic	**(R)**	
(4)	Hexagonal close packing	**(S)**	

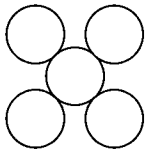
(A) 1 – Q, 2 – R, 3 – P,R,S 4 – P **(B)** 1 – Q, 2 – P, 3 – S, 4 – R

(C) 1 – P, 2 – R, 3 – Q, 4 – S **(D)** 1 – R, 2 – S, 3 – P, 4 – Q

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

43. One the metallic crystal is cubic system with arrangement of atoms over face of the cubic unit cell is:



Find the rank of unit cell.

44. The nearest distance between two atoms of a cubic metallic crystal is $\frac{\sqrt{3}a}{2}$. Find the effective no. of atoms per unit cell of that crystal?

45. How many crystal systems have the relation between inter planar angles as $\alpha = \beta = \gamma$?

46. One of metallic crystal follow cubic system with atoms present at corners and face centred positions. Find the ratio of no. of tetrahedral voids to that of octahedral voids per unit cell in the crystal.

47. In F.C.C system, body diagonal length is x and the nearest distance between octahedral void and a tetrahedral void is y. Find the value of x/y.

48. How many effective Na^+ ions are present in a unit cell of the Rock salt (NaCl) if ions along one of the axis joining opposite faces are removed?

49. A spinel is an important class of oxides consisting of two types of metal ions with oxide ions arranged in CCP layers. The normal spinel has $\frac{1}{8}$th of the tetrahedral void occupied by one type of metal and one half of the octahedral voids occupied by another type of metal ions such a spinel is formed by Zn^{2+}, Al^{3+} and O^{2-} with Zn^{2+} in tetrahedral void. Then the simplest formula of that spinel is $Zn_xAl_yO_z$ then x + y + z is _____.

50. Analysis shows that nickel oxide has formula $Ni_{0.98}O_{1.00}$, the percentage occupation by Ni^{3+} of cationic sites is x%. Then 'x' is _____.

51. The number of octahedral faces that are present in a truncated octahedron is _____.

52. If an atom crystallizes in ABC packing, then the distance between two layers of 'A' is 'X' nm. The edge length of unit cell formed by A is $\sqrt{3}$nm. What is the value of X? (In nearest integer)

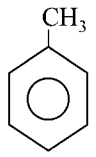
53. A compound AB has Rock salt structure with A : B = 1 : 1. The formula weight of AB is 6.023 y amu and the closest distance between A and B is $y^{1/3}$ nm. The observed density of the lattice in kg/m^3 is_____.

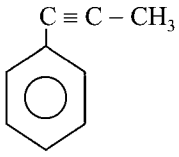
54. An alloy of metals A, B and C is found to have 'A' constituting CCP lattice. If 'B' atoms occupy the edge-centres and 'C' is present at body-centre then the total number of atoms present in a formula unit of the alloy is_____.

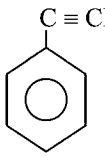
SINGLE CORRECT ANSWER TYPE

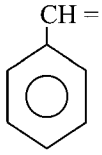
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. $C_6H_5-CH=CH_2 \xrightarrow{Br_2} A \xrightarrow[NaNH_2]{3.0\ eqv.} B \xrightarrow{CH_3I} C$ Compound 'C' in the sequence is:

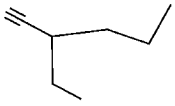
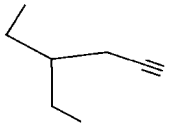
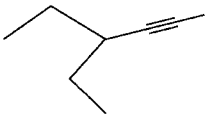

(A)


(B)


(C)


(D)

2. Which alkyne will give 3-ethylhexane on catalytic hydrogenation?

(A)  **(B)**  **(C)**  **(D)** All of these

3. Which of the following statements best explain the greater acidity of terminal alkynes $(RC \equiv CH)$ compared with monosubstituted alkenes $(RCH=CH_2)$

(A) The sp-hybridized carbon atoms of the alkynes are less electronegative than the sp^2-hybridized carbons of the alkene.

(B) The two π-bonds of the alkyne are better able to stabilize the negative charge of the anion by resonance.

(C) The sp-hybridized carbons of the alkyne are more electronegative than the sp^2-hybridized carbon of the alkene.

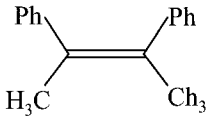
(D) The question is incorrect as alkenes are more acidic than alkynes.

4. In the given reaction trans-2-butene $\xrightarrow{Br_2/CCl_4}$ X. (X) will be:

(A) meso-2, 3-dibromobutane **(B)** d-2, 3-dibromo butane

(C) 1 : 1 mixture of (±) 2, 3-dibromo butane **(D)** 2 : 1 mixture of (±) 2, 3-dibromo butane

5. $CHCl_3 + CH_3NH_2 \xrightarrow{OH^-} CH_3NC$.

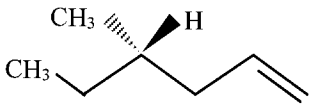
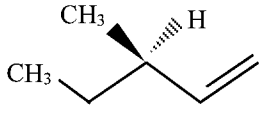
The intermediate of this reaction is treated with the compound 

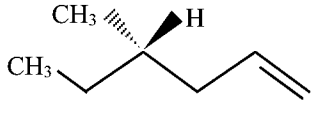
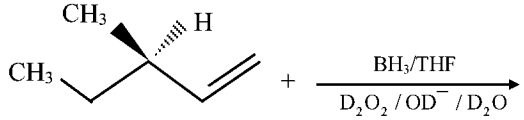
The reaction will be:

(A) Electrophilic addition reaction **(B)** Free radial addition reaction

(C) Nucleophilic addition reaction **(D)** Electrophilic aromatic substitution

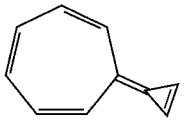
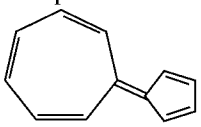
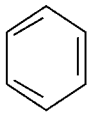
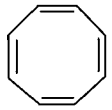
6. Which of the following reactions result in creation of a pair of diastereomers (neglect regioselectivity)?

(I)  **(II)** 

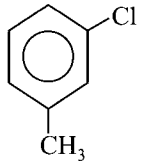
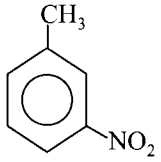
(III)  **(IV)** 

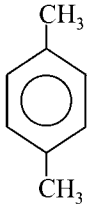
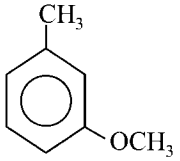
(A) I only **(B)** I & III **(C)** I, II & III **(D)** I, III & IV

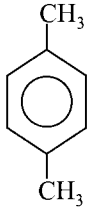
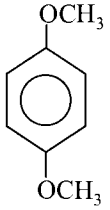
7. Which of the following is aromatic & polar?

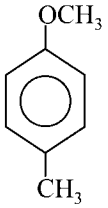
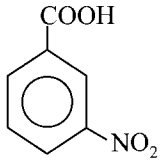
(A)  **(B)**  **(C)**  **(D)** 

8. The compounds which give only one product on mono-nitration.

(A)  & 

(B)  & 

(C)  & 

(D)  & 

9. Which of the following statements concerning a meso compound is false?

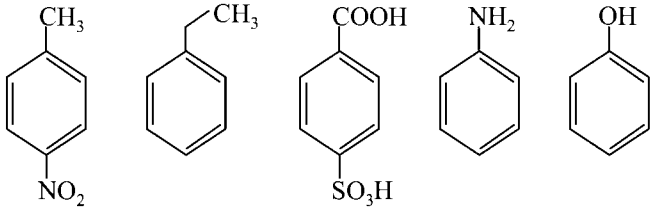
(A) There is no chiral centre in the molecule

(B) There is at least one element of symmetry in the molecule

(C) There is internal compensation for optical inactivity

(D) It cannot have non-superimposable mirror image

10. Which will easily undergo a Friedel–Crafts alkylation reaction?



(1) (2) (3) (4) (5)

(A) 1, 2, 4 **(B)** 1, 3 **(C)** 2 **(D)** 1, 2

11. A sample of 2-chlorobutane has $[\alpha] = 11.55^{\circ}$. The specific rotation of (+)-2-chlorobutane is 23.1°. Which is correct option?

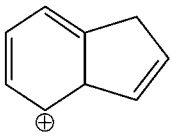
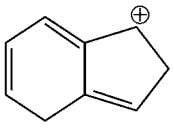
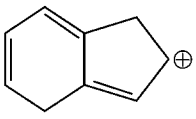
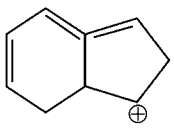
(A) The dextro form is 65%

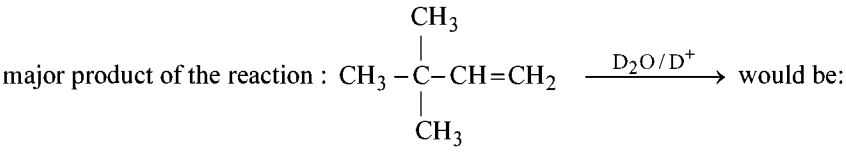
(B) The leavo form is 25%

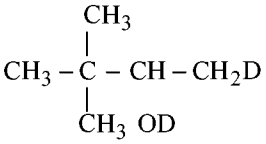
(C) Enantiomeric excess is 50% of (+)2-chlorobutane

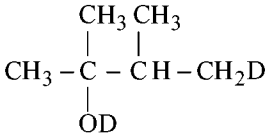
(D) Both (B) and (C)

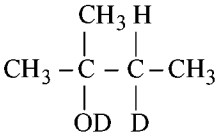
12. Which carbocation is most stabilized?

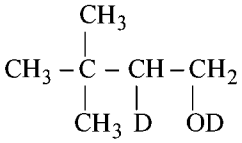
(A)  **(B)**  **(C)**  **(D)** 

13. The major product of the reaction :  would be:

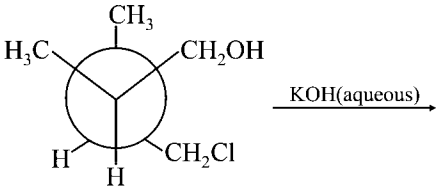
(A) 

(B) 

(C) 

(D) 

14. Find out the correct statement about the product in the following reaction:

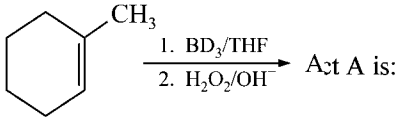


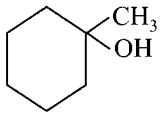
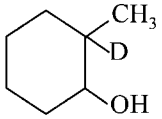
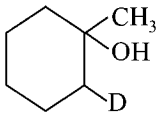
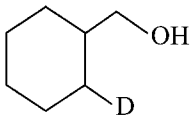
(A) product obtained is a mixture of optically active compounds

(B) product obtained is an optically active compound

(C) product obtained is optically inactive due to plane of symmetry

(D) product obtained is inactive due to 2 – fold alternating axis of symmetry

15.  Act A is:

(A)  **(B)**  **(C)**  **(D)** 

16. $X \xrightarrow[(2)\ H_2O/H^+]{(1)\ O_3} CH_3-CH_2-COOH + HOOC-CH_2-CH_2-COOH + HCOOH$. X is:

(A) $CH_3-CH_2-C\equiv C-(CH_2)_2-C\equiv CH$

(B) $CH_3-C\equiv C-(CH_2)_3-C\equiv CH$

(C) $CH_3-CH_2-C\equiv C-CH_2-C\equiv CH$

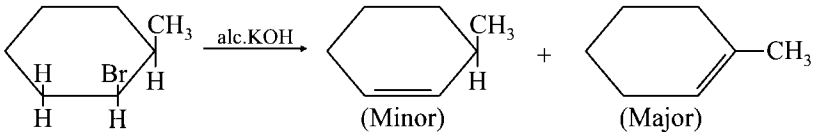
(D) $HC\equiv C-(CH_2)_4-C\equiv CH$

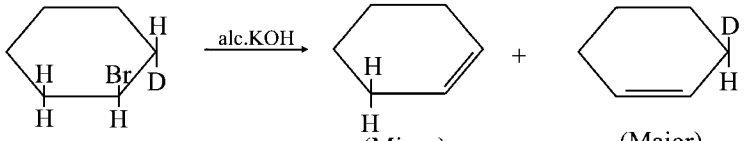
MULTIPLE CORRECT ANSWERS TYPE

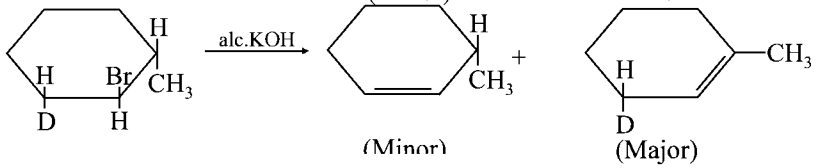
Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

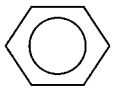
17. Which of the following are correct:

(A) $Me_3C-Cl \xrightarrow{C_2H_5OH} Me_3C-O-C_2H_5\,(Major) + Me_2C=CH_2\,(Minor)$

(B) 

(C) 

(D) 

18.  $+ CH_3CH_2COCl \xrightarrow[AlCl_3]{\text{anhydrous}} (X) \xrightarrow[HCl]{Zn-Hg} (Y)$. The product (Y) can be obtained by

(A) $C_6H_6 + \triangle \xrightarrow[AlCl_3]{\text{anhydrous}} ?$

(B) $C_6H_6 + CH_3CH_2CH_2Cl \xrightarrow[\text{anhydrous}]{AlCl_3}$

(C) $CH_3CH_2CH_2Cl + PhMgCl \longrightarrow$

(D) $(n\text{-}Pr)_2\,CuLi + PhCl \longrightarrow$

19. $CH_3-C\equiv CH \xrightarrow[2.CH_3Br]{1.NaNH_2} (A) \xrightarrow{Na/ND_3(l)} (B) \xrightarrow{H_2/Pt} (C)$

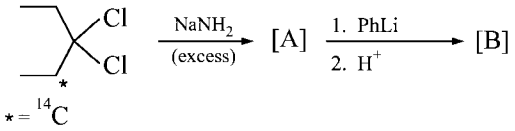
(A) (C) is meso-2, 3-dideutero butane

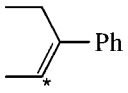
(B) (C) is rac-2, 3-dideutero butane

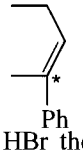
(C) (C) is d-2, 3-dideutero butane only

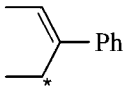
(D) (B) is trans-2, 3-dideutero but-2-ene only

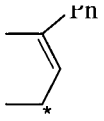
20. What are the possible structures of product [B] in the following sequence of reactions?



(A) 

(B) 

(C) 

(D) 

21. When $CH_2=CH-Br$ is reacted with HBr then the product formed is A and when $CH_2=CH-COOH$ is treated with HBr then the product is formed is C. Hence, here:

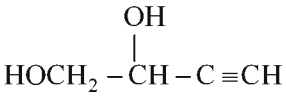
(A) A is $CH_2(Br)-CH_2(Br)$

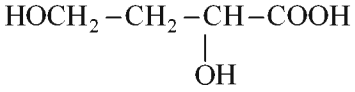
(B) A is $CH_3-CH(Br)_2$

(C) C is $CH_3-CH(Br)-COOH$

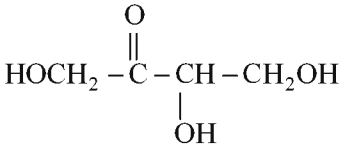
(D) C is $CH_2(Br)-CH_2-COOH$

22. One mole of an unknown organic compound (A) when treated with excess of CH_3MgBr liberates three moles of CH_4 gas. When reduced with HI and red phosphorus, compound (A) gives n- butane. The possible structure(s) of A is(are):

(A) 

(B) 

(C)

(D) 

23. Which of the following carbide(s) on hydrolysis give methane as one of the products?

(A) beryllium carbide **(B)** boron carbide

(C) magnesium carbide **(D)** aluminium carbide

24. Which statement is/are true about resonance?

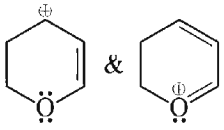
(A) It decreases the energy of system

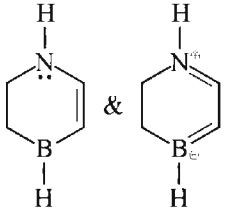
(B) The hybridization of atoms do not change due to resonance

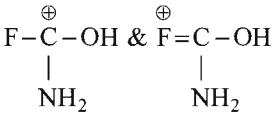
(C) Resonance hybrid is more stable than any resonating structure

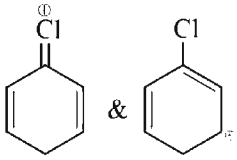
(D) Resonating structures can not be isolated at any temperature

25. In which of the following pairs of compounds, will second structure have more contribution to resonance hybrid than first?

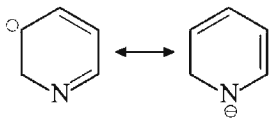
(A) 

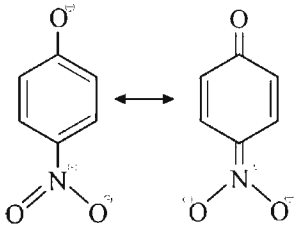
(B) 

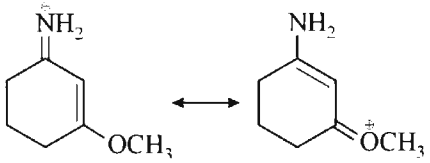
(C) 

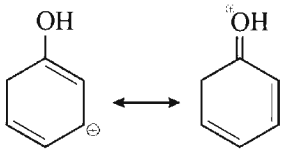
(D) 

26. In which of the following pairs of resonating structures first resonating structure is more stable than second?

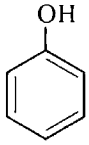
(A) 

(B) 

(C) 

(D) 

27. In which of the following compounds delocalization of electrons and shifting of electron in the same direction?

(A) 

(B) $CH_3 - NH - NO_2$

(C) $CH_2 = CH - CH = CH - NO_2$

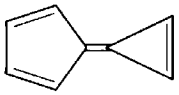
(D) $H_2N - \overset{H}{\underset{|}{C}} = CH_2$

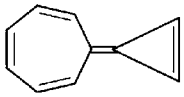
28. Which of the following groups cannot participate in resonance with benzene:

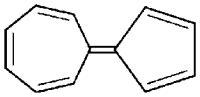
(A) $-COOH$ **(B)** $-COO^{\ominus}$ **(C)** $-\overset{\oplus}{N}H_3$ **(D)** $-COCl$

29. Which of the following is/are correct:

(A)  is antiaromatic

(B)  is aromatic

(C)  is aromatic

(D)  is aromatic

30. Which of the hybrid species are correct?

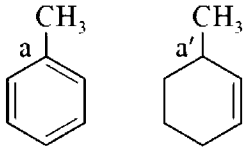
(A) $\overset{\delta}{CH_2} - CH - O - \overset{\delta-}{CH_3}$

(B) $\overset{\delta+}{CH_2} - CH - CH - \overset{\delta}{O}$

(C) $CH_3 - \overset{O^{\delta}}{\overset{\|}{C}} - \overset{\delta-}{NH_2}$

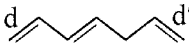
(D) $\overset{\delta+}{CH_2} - CH - CH - \overset{\delta}{CH_2}$

31. The correct orders for bond length are:

(A)  $(a' > a)$

(B) $CH_3 - \overset{b}{\underset{b'}{C}} - NH_2 \quad (b' \equiv b)$ with $\oplus NH_2$ on b'

(C) $CH_3 - \overset{c}{\underset{c'}{C}} - ONa \quad (c > c')$ with O on c'

(D)  $(d > d')$

32. Which of the following statement is/are correct?

(A) Contributing structures contributes to the resonance hybrid is directly proportional of their energies

(B) Equivalent contributing structures make the resonance very important

(C) Contributing structures represent hypothetical molecules having no real existence

(D) Contributing structures are less stable than the resonance hybrid

33. Which of the following compounds will show tautomerism?

(A) 2, 2-Dimethylpropanal

(B) 2,2-Dimethyl-1 nitropropane

(C) Acetyl Acetone

(D) Benzophenene

34. Which of the following is correct regarding stability of the following pair of species?

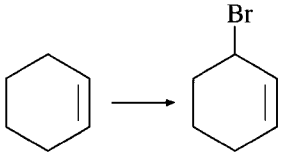
(A) $CH_2=\overset{+}{N}=\overset{-}{N}$ > $\overset{-}{C}H_2-N\equiv N$

(B) $CH_2=CH-\overset{+}{C}H-\overset{-}{O}$ > $\overset{-}{C}H_2-CH=CH-\overset{+}{O}$

(C) $CH_3-\overset{O}{\overset{\|}{C}}-\overset{-}{O}$ > $CH_3-CH_2-\overset{-}{O}$

(D) Pent-2-ene > 2-methylbut-2-en

35. Which reagent will you use for the following reaction?



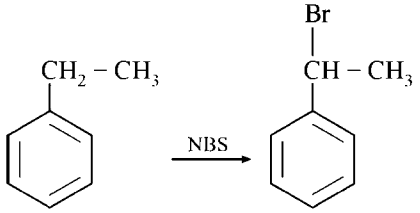
(A) NBS **(B)** Br_2/Fe **(C)** $Br_2/h\nu$ **(D)** Br_2/Δ

36. Which amongs the following reaction is/are correctly matched for major product?

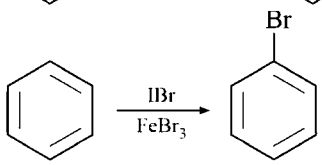
(A) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_3 \xrightarrow[\text{UV light}]{Br_2} CH_3-\overset{\overset{Br}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2-CH_3$

(B) $CH_3-CH=CH_2 \xrightarrow[\text{UV light}]{Br_2} \overset{\overset{Br}{|}}{CH_2}-CH=CH_2$

(C)

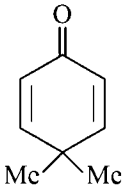


(D)

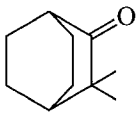


37. Which of the following do not show tautomerism?

(A)

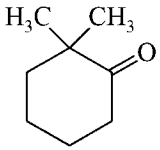


(B)



(C) $C_2H_5-\overset{O}{\overset{\|}{C}}-C_6H_5$

(D)

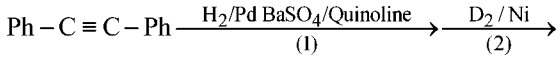


38. Which of the following catalysts is/are used for partial reduction of alkyne?

(A) $Na/NH_3(\ell)$ **(B)** Ni_2B or P-2 catalyst

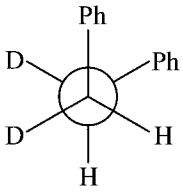
(C) Lindlar catalyst **(D)** Rossenmund catalyst

39. The end product of following reaction is/are:

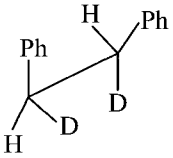


(A) $Ph-CH_2-CD_2-Ph$

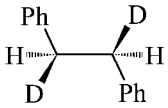
(B)



(C)

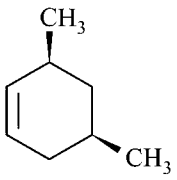


(D)

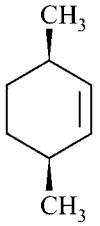


40. Which of the following give only meso compound on catalytic reduction?

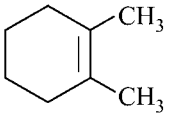
(A)



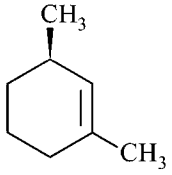
(B)



(C)

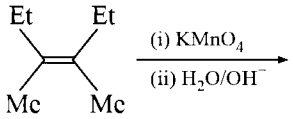


(D)

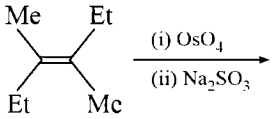


41. Which of the following involve syn addition?

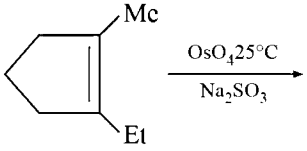
(A)



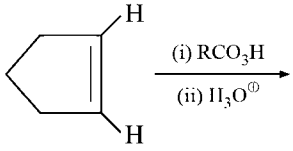
(B)



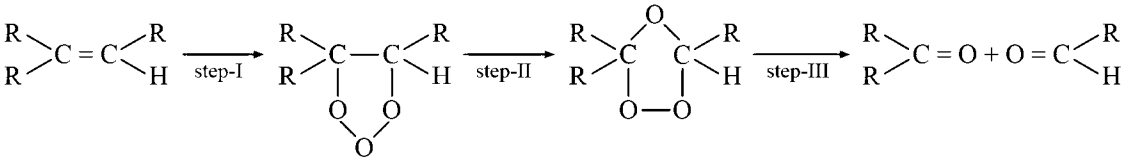
(C)



(D)



42. Mechanism of reductive ozonolysis is given below for an alkene.



Which is correct for the above mechanism?

(A) Ozone act as electrophile and as well as nucleophile in this reaction

(B) First step of this reaction is an electrophile addition

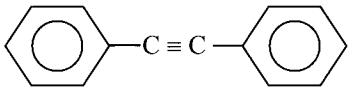
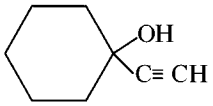
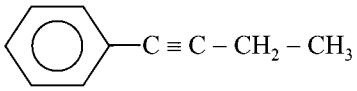
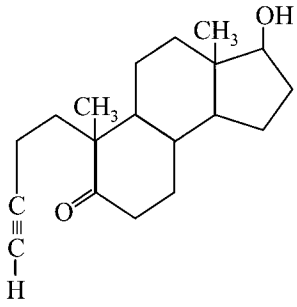
(C) Ozonide is formed in the step-II

(D) When ozonide is cleaved in the presence of reducing agent such as Zn or Me_2S the products will be aldehydes and / or ketones

MATRIX MATCH TYPE

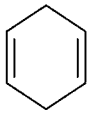
Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

43. Match the following:

	Column 1		Column 2
(A)		(p)	Reacts with Lindlar catalyst (H_2 / Pd – $CaCO_3$)
(B)		(q)	Trans alkene will form, when reacts with (Na/liq. NH_3)
(C)		(r)	Reacts with ammonical $AgNO_3$
(D)		(s)	Double bond equivalent is greater than two

44. Match the following:

What would be the products of ozonolysis of the compounds in column 1

	Column 1		Column 2
(A)		(p)	Formaldehyde
(B)	$CH_2 = CH - CH = CH - CH_3$	(q)	Glyoxal
(C)	$CH_3 - HC = CH - CH = CH_2$	(r)	Propane-1, 3-dial
(D)	$CH_3 - CH = CH_2$	(s)	Acetaldehyde

45. **Match the following:**

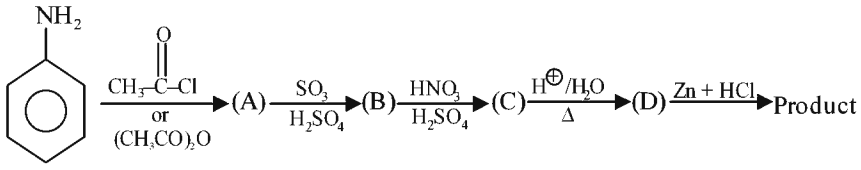
	Column 1		Column 2
(A)	Acid-catalysed hydration of alkenes	**(p)**	Markovnikov hydration
(B)	Oxymercuration demercuration of alkenes	**(q)**	Anti Markovnikov hydration
(C)	Hydroboration-oxidation of alkenes	**(r)**	Stereo selective
(D)	Dehydration of alcohols to alkenes	**(s)**	Regioselective

Numerical Value Type

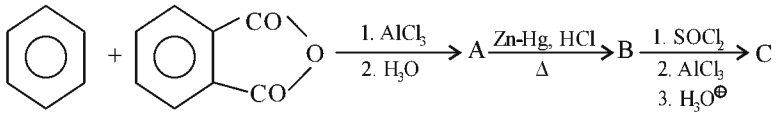
The Answer to the following questions are positive integers of 1/2/3 digits and zero

46. $\underset{(A)}{C_{12}H_{16}} \xrightarrow{\text{hot and conc. } KMnO_4} 2CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + 2HOOC-\overset{O}{\overset{\|}{C}}-COOH$

Number of C=C bond in organic compound (A) is _____.

47. 

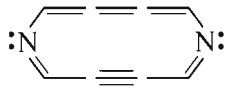
If the molecular weight of product (P) is M, then the value of $\frac{M}{27}$ is _____.

48. 

What is the molecular weight of product (C)?

49. One equivalent of 1-bromo-3-chloro cyclobutane reacts with two equivalents of sodium in dry ether to form organic product [R]. Find out number of carbon-carbon bonds in the product [R].

50. Given compound possess a close loop of delocalizable x π electrons. What is value of x?



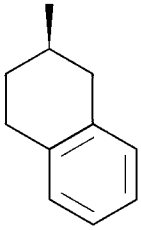
51. Find out number of delocalizable pi electrons in major product of the following reaction.

$CH_3-C\equiv C-CH_3 + CH_2N_2 \xrightarrow[h\nu]{} \text{Major product}$

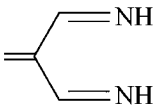
52. Molecule of $C_{13}H_{28}$ with the shortest possible parent carbon chain contains x carbon atoms. Numerical value of x is _____.

53. How many meso isomers are possible for 1, 2, 3, 4, 5, 6-hexachloro cyclohexane?

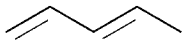
54. Geometrical isomerism is possible in how many of the following molecules/compounds?



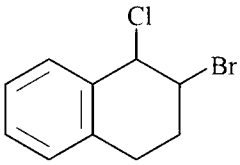
(1)



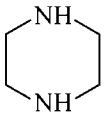
(2)



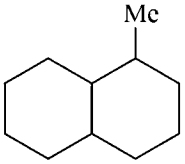
(3)



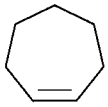
(4)



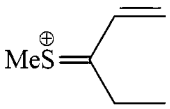
(5)



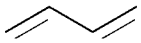
(6)



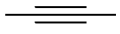
(7)



(8)



(9)

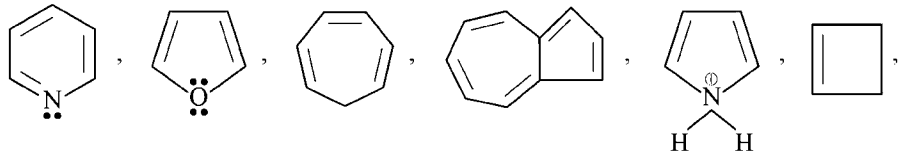


(10)

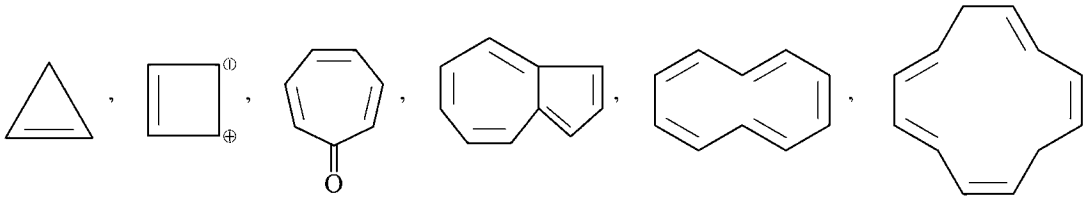
55. How many monocarboxylic acids (including stereoisomers) would give Methylcyclopropane on sodalime decarboxylation?

56. Two stereoisomers (cis and trans) of 3, 4-Dibromocyclopentane-1, 1-dicarboxylic acid undergo decarboxylation, find out the total number of products formed.

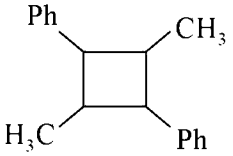
57. How many species out of the following are aromatic?



58. How many species out of the following are aromatic?



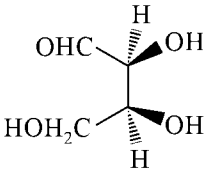
59. Sum of total number of optically active and optically inactive isomers of following compound.

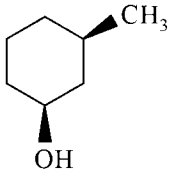


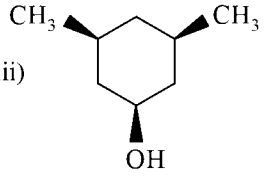
60. The total number of isomers for the alkyne with molecular formula $C_3HDClBr$ is _____.

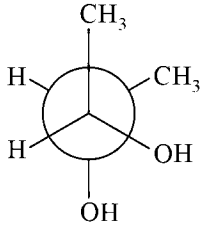
61. How many position isomers of dibromonaphthalene is possible if each ring of naphthalene has one halogen?

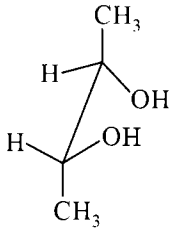
62. Number of meso compounds from the following is _____.

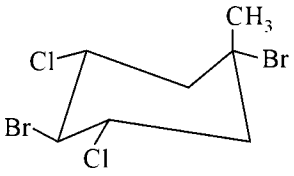
(i) 

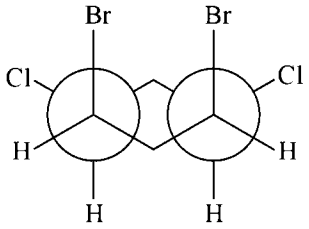
(ii) 

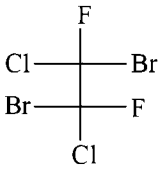
(iii) 

(iv) 

(v) 

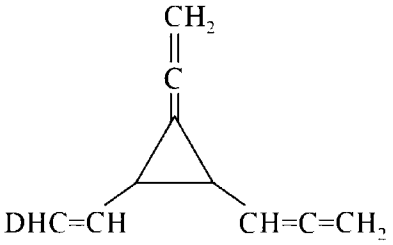
(vi) 

(vii) 

(viii) 

63. The total number of structural isomers with molecular formula C_3H_7N which can show geometrical isomerism is _____.

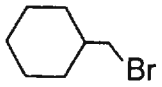
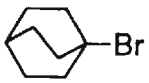
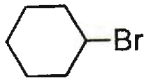
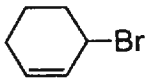
64. Total number of stereo isomers corresponding to structure

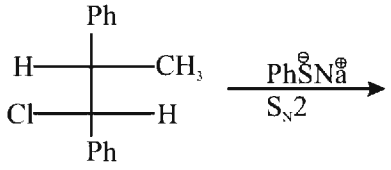


SINGLE CORRECT ANSWER TYPE

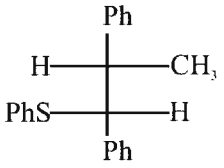
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

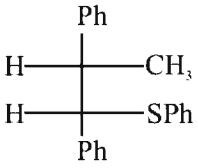
1. The compound, that undergoes S_N1 reaction most rapidly is:

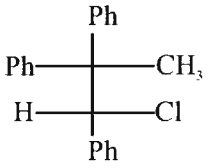
(A)  **(B)**  **(C)**  **(D)** 

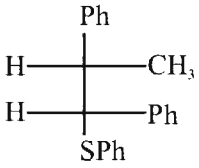
2. 

Principal organic product of the reaction will be:

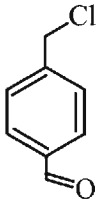
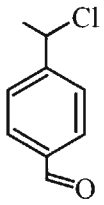
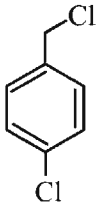
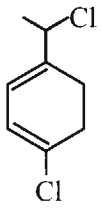

(A)


(B)

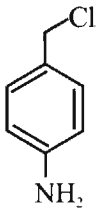
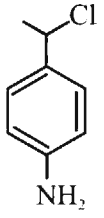
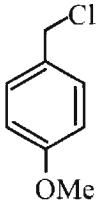
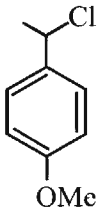

(C)

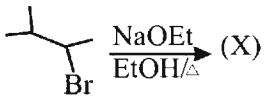

(D)

3. Which of the following benzyl halide would undergo S_N2 reaction faster?

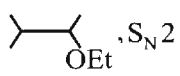
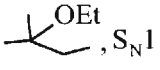
(A)  **(B)**  **(C)**  **(D)** 

4. Which of the following benzyl halide would undergo S_N1 reaction faster?

(A)  **(B)**  **(C)**  **(D)** 

5. 

The major product (X) and major reaction pathway is:

(A)  **(B)** 

(C)  **(D)** 

6. **(I)** $MeI + OH^- \longrightarrow MeOH + I^-$ **(II)** $MeI + NH_3 \longrightarrow Me\overset{\oplus}{N}H_3 + I^-$

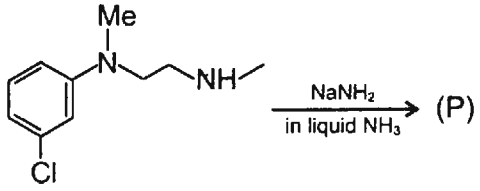
(III) $Me_2\overset{\oplus}{S}Me + OH^- \longrightarrow MeOH + Me_2S$ **(IV)** $Me_2\overset{\oplus}{S}Me + NH_3 \longrightarrow Me\overset{\oplus}{N}H_3 + Me_2S$

In which of the above S_N2 reactions, rate of the reaction increases on increasing the polarity of the solvent?

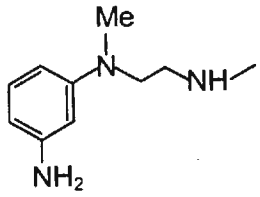
(A) (I) **(B)** (II)

(C) (III) **(D)** (IV)

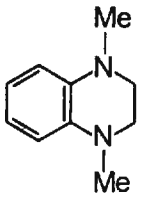
7. The product (P) of the given sequence of reaction,



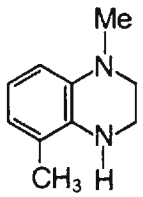
would be:



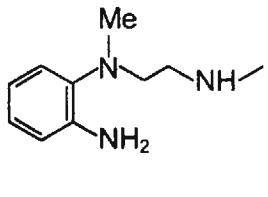
(A)



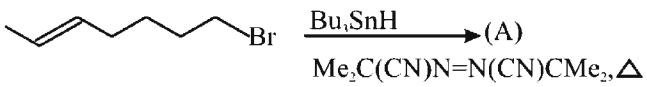
(B)



(C)



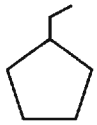
(D)

8. 

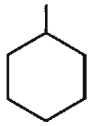
In the given reaction, the major product (A) would be:

(A)

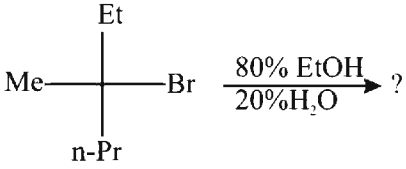
(B)



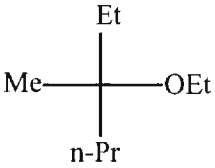
(C)



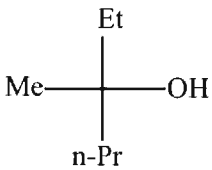
(D)

9. 

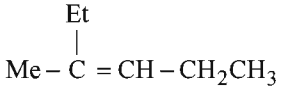
The major product of the above reaction is:



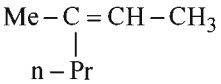
(A)



(B)

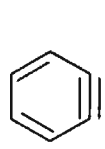


(C)

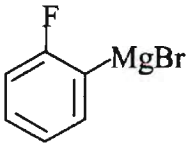


(D)

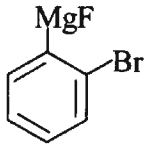
10. Treatment of o-bromofluorobenzene with one equivalent of Mg in presence of ether, generates



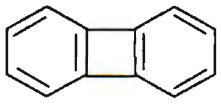
(A)



(B)

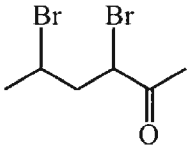


(C)

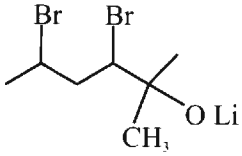


(D)

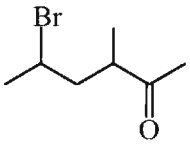
11. The major product of the given reaction is:



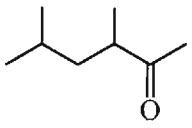
$+ (CH_3)_2 CuLi \xrightarrow[1 \text{ eqv.}]{THF} (A)$



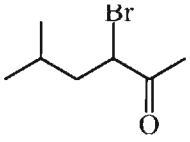
(A)



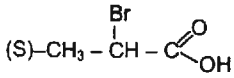
(B)



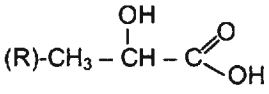
(C)



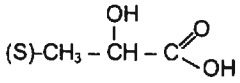
(D)

12. The nucleophilic substitution of 

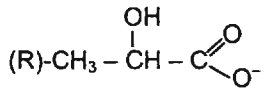
with dilute OH^- followed by acidification gives



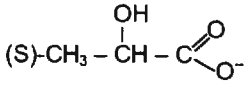
(A)



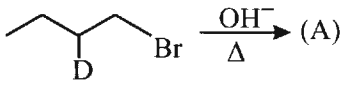
(B)



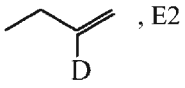
(C)



(D)

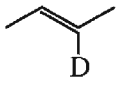
13. 

The major product of the reaction and major pathway followed is:



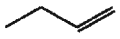
, E2

(A)



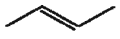
, E1

(B)



, E2

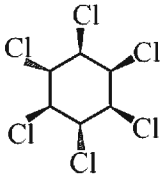
(C)



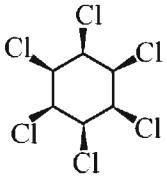
, E1

(D)

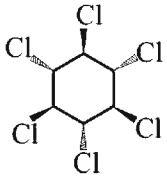
14. Which of the following hexachlorocyclohexane is the least reactive in an E_2 reaction?



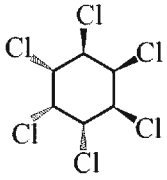
(A)



(B)

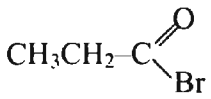


(C)

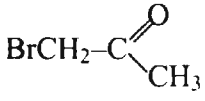


(D)

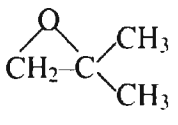
15. $CH_2 = C = O \xrightarrow{Br_2} \xrightarrow{CH_3MgBr} (X)$. The structure of compound (X) would be:



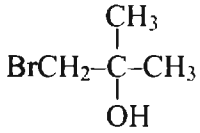
(A)



(B)

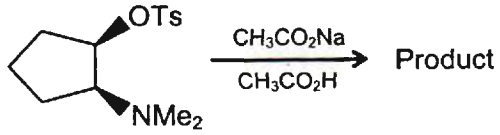


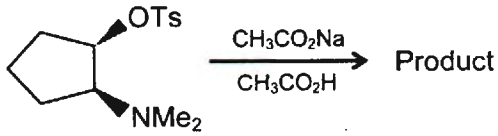
(C)

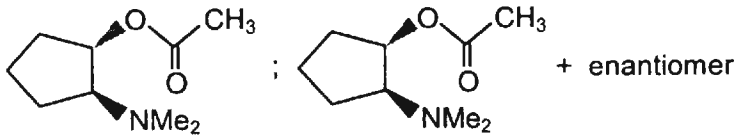


(D)

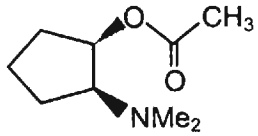
16. Identify products of the given reactions:

Reaction-1 

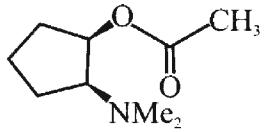
Reaction-2 

(A) 

(B) 

(C) 

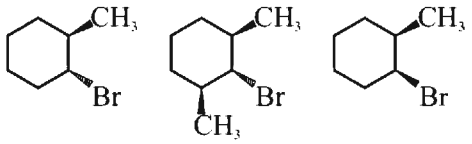
single product is obtained in both the reactions.

(D) 

Single product is obtained in both the reactions.

17. The decreasing order of reactivity of following compounds in an E2 reaction is:

(A) 2 > 3 > 1
(B) 1 > 3 > 2
(C) 2 > 1> 3
(D) 3 > 1 > 2

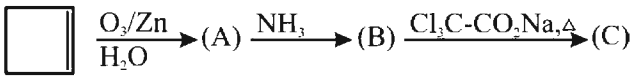


1 2 3

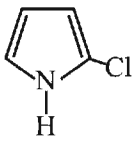
18. 

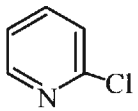
To get the required alkene, the most suitable base is:

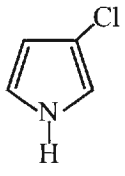
(A) NaOEt/EtOH **(B)** NaOMe/MeOH
(C) t-BuOK/t-BuOH **(D)** NaOPr/PrOH

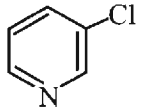
19. 

The product (C) would be:

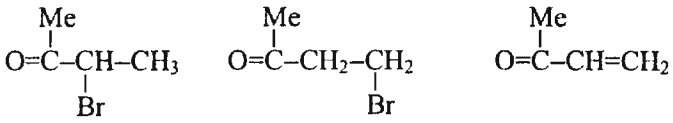
(A) 

(B) 

(C) 

(D) 

20. Both the following compounds (a) and (b) undergo base induced elimination of HBr to form the same product (c).



(a) (b) (c)

Which of the following statement is true?

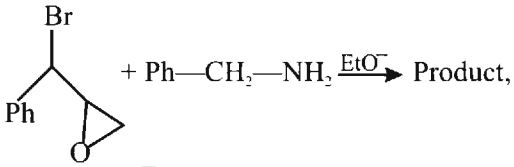
(A) (a) reacts faster than (b) **(B)** (b) reacts faster than (a)

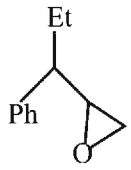
(C) (a) and (b) react at the same rate **(D)** Cannot be predicted

21. In an experiment starting with optically pure radioactive 2-iodopentane, the rate of racemization was found to be 1.80 times the rate of loss of radioactivity of the substrate. The % of reaction that proceeded by S_N2 mechanism is:

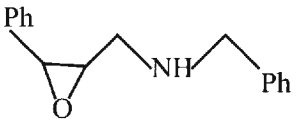
(A) 10% **(B)** 20% **(C)** 40% **(D)** 80%

22.

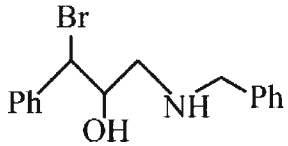




(A)



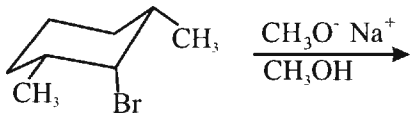
(B)



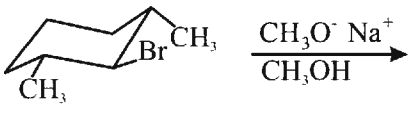
(C)

(D)

23.



(P)



(Q)

Which of the following is correct statement about compounds (P) and (Q)?

(A) Compound (P) undergoes reaction faster than compound (Q)

(B) Compound (P) undergoes reaction slower than compound (Q)

(C) Compound (P) undergoes reaction at the same rate as that of compound (Q)

(D) Can not be commented about their rate of reaction

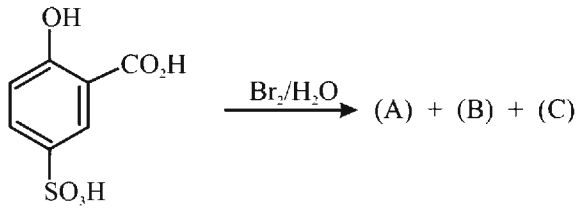
24. Which of the following is not true about given reaction?

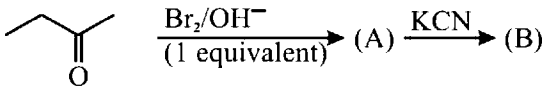
(A) It is an example of electrophilic aromatic substitution reaction

(B) The electrophile is free Br^+

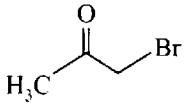
(C) It leads to tribromination

(D) If (A) is 2, 4, 6-tribromophenol, then (B) and (C) are CO_2 and SO_3 gases



25. 

Which of the following is correct about the given reaction sequence?

(A) (A) is 

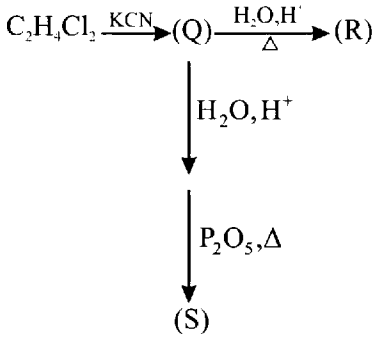
(B) Conversion of (A) to (B) take place via S_N1 pathway

(C) Reduction of (B) with $LiAlH_4$ gives 2- ketopentan-1-amine

(D) Acidic hydrolysis of (B) followed by heating gives original compound

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

26. (P) : 

(A) If (P) is a vicinal dihalide, (S) is a cyclic anhydride

(B) If (P) is a geminal dihalide, (S) is a cyclic anhydride

(C) If (P) is a vicinal dihalide, (R) is a butane-1, 4-dioic acid

(D) If (P) is a geminal dihalide, (R) is a propanoic acid

27. Which of the following statement(s) is(are) correct?

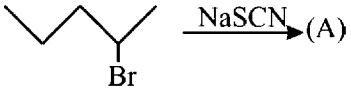
(A) S_N1 reaction of alkyl halides are catalysed by Ag^+ ion.

(B) α - Halo ketones undergo reaction by S_N2 mechanism but not by S_N1 mechanism.

(C) Hydrolysis of t- BuF is faster in acidic solution than in pure H_2O.

(D) S_N2 reactions never involve rearrangement.

28. In the given reaction,



Which of the following statement (s) is/are not true about (A)?

(A) With S_N1 pathway, the attack takes place through N.

(B) With S_N1 pathway, the attack takes place through S.

(C) With S_N2 pathway, the attack takes place through N.

(D) With S_N2 pathway, the attack takes place through S.

29. The rate law for the substitution reaction of 2-bromobutane and OH^- in 75% ethanol and 25% H_2O at 30°C is

Rate = 3.2×10^{-5} [2-bromobutane][OH^-] + 1.5×10^{-6} [2-bromobutane].

Which of the following is/are true statement(s) when the concentration of OH^- is 1.0 M?

(A) % of reaction occurring by S_N1 mechanism is 4.4%

(B) % of reaction occurring by S_N1 mechanism is 44%

(C) % of inversion product is 97.8%

(D) % of racemization in the reaction is 44%

30. Select the correct addition products among the following reactions.

(A) $CH_2=CHCH_3 + HCl(aq.) \longrightarrow CH_3CH(Cl)CH_3$

(B) $CH_2=CHCH_3 + HBr(aq.) \longrightarrow CH_3CH(Br)CH_3$

(C) $CH_2=CHCH_3 + HBr \xrightarrow{\text{Peroxide}} CH_3CH_2CH_2Br$

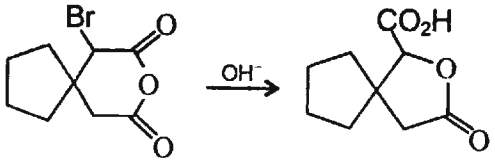
(D) $CH_2=CHCH_3 + HI \xrightarrow{\text{Peroxide}} CH_3CH(I)CH_3$

31. Which of the following reagent(s) can be used to distinguish between $CH_2=CH-CH_2Cl$ and $CH_3CH_2CH_2Cl$?

(A) Sodium fusion; HNO_3 + $AgNO_3$ **(B)** Tollen's reagent

(C) $AgNO_3$ + C_2H_5OH **(D)** Cold aq. $KMnO_4$

32.

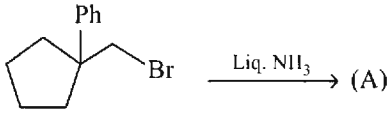


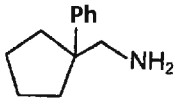
The given reaction involves:

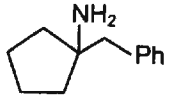
(A) Nucleophilic substitution at acyl carbon. **(B)** Nucleophilic substitution at alkyl carbon.

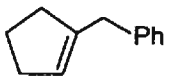
(C) Elimination **(D)** Ring contraction

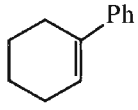
33. The product of the given solvolysis reaction would be:



(A) 

(B) 

(C) 

(D) 

34. (A) : $CH_3O-CH=CH-CH_2Br$ (B) : $CH_2=C(OCH_3)-CH_2Br$

Which of the following is/are true about compounds (A) and (B)?

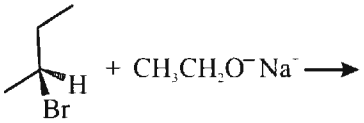
(A) Solvolysis of compound (A) is faster than compound (B)

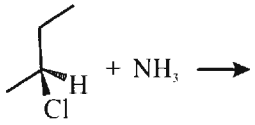
(B) S_N2 reaction of compound (A) is faster than compound (B)

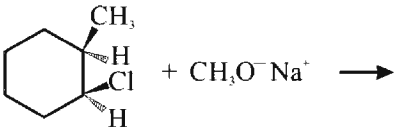
(C) S_N2 reaction of compound (B) is faster than compound (A)

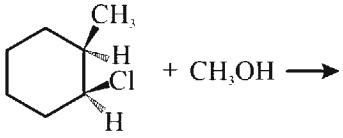
(D) Compound (A) undergoes rearrangement under S_N1 as well as S_N2 conditions

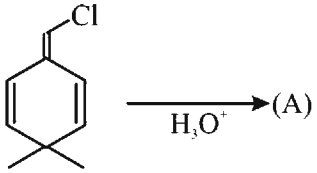
35. In which of the following reactions, inversion of configuration is mainly taking place?

(A) 

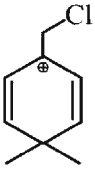
(B) 

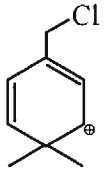
(C) 

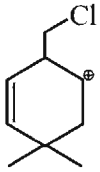
(D) 

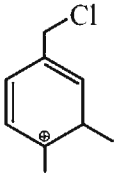
36. 

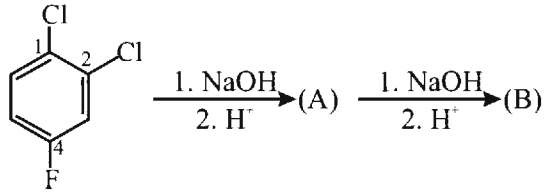
Which of the following is(are) intermediate(s) formed during the formation of product (A)?

(A) 

(B) 

(C) 

(D) 

37. 

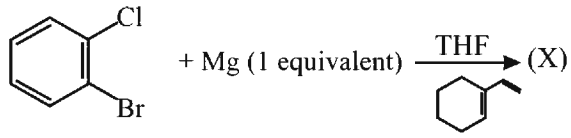
Which of the following is correct about the given reaction?

(A) During formation of (A), Cl at 1 is displaced by OH

(B) During formation of (A), F at 4 is displaced by OH

(C) During formation of (B), Cl at 2 is displaced by OH

(D) During formation of (B), F at 4 is displaced by OH

38. 

Which of the following is/are true about the reaction leading to formation of (X)?

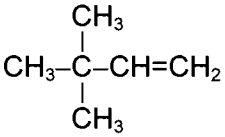
(A) Aryl bromide is more reactive than aryl chloride towards Grignard formation

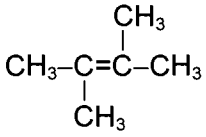
(B) The intermediate formed in the reaction is benzyne

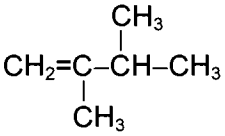
(C) The product formed has three six membered rings

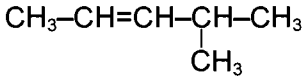
(D) (X) is formed via Diels – Alder reaction

39. When 2-iodo-3, 3-dimethylbutane is treated with $AgNO_3$ in ethanol/ethoxide, elimination reaction takes place. Identify all the products formed in the reaction.

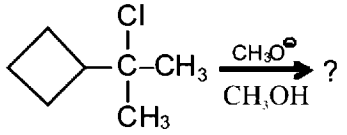
(A) 

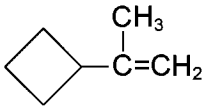
(B) 

(C) 

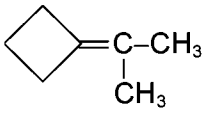
(D) 

40. Which of the following compound(s) is(are) formed in the given reaction?

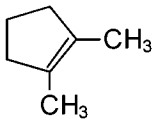




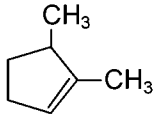
(A)



(B)

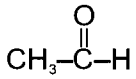
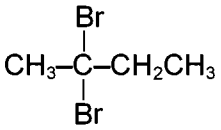
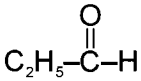
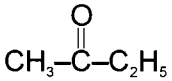


(C)



(D)

41. Which of the following compound(s) will give iodoform test on warming with I_2/NaOH?

(A)  **(B)**  **(C)**  **(D)** 

42. Ethyl alcohol, on treatment with bleaching powder gives chloroform. Which of the following is/are the function(s) of bleaching powder?

(A) Chlorinating agent **(B)** Oxidising agent

(C) Hydrolysing agent **(D)** None of these

43. Which of the following reaction products (major) is(are) incorrect?

(A) $(CH_3)_2CHCl + Ag - CN \longrightarrow (CH_3)_2CH - CN + AgCl$

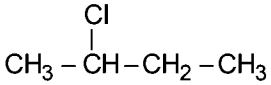
(B) $CH_3 - Cl + Na^+CN^- \longrightarrow CH_3{-}NC + NaCl$

(C) $(CH_3)_2CHCl + Ag - NO_2 \longrightarrow (CH_3)_2CH{-}NO_2 + AgCl$

(D) $CH_3 - Cl + NaNO_2 \longrightarrow CH_3{-}NO_2 + NaCl$

44. Which of the following compound(s) would result in the formation of isobutene on treatment / warming with alcoholic KOH?

(A) $(CH_3)_3C - Cl$ **(B)** $(CH_3)_2CH - CH_2Cl$

(C) $CH_3(CH_2)_2 - CH_2Cl$ **(D)** 

45. In the reaction, $R{-}COOAg{+}X_2 \rightarrow R - X + AgX + CO_2$ the best yield of R–X is obtained when:

(A) R– is 3° alkyl group **(B)** X_2 is bromine

(C) R– is 1° alkyl group **(D)** X_2 is iodine

46. In which of the following reactions, meta isomer is the major product?

(A) o-chlorotoluene + $NaNH_2$ in $NH_3(l)$ **(B)** o-chloroanisole + $NaNH_2$ in NH_3 (l)

(C) m-chlorotoluene + $NaNH_2$ in $NH_3(l)$ **(D)** m-chloroanisole + $NaNH_2$ in NH_3 (l)

47. Which of the following reaction will give chloroethene?

(A) Thermal decomposition of ethylene dichloride at 600 – 650°C.

(B) Acetylene is passed into dilute hydrochloric acid at 65°C in the presence of mercuric ions as catalyst.

(C) Ethylene dichloride is heated in presence of 1 equivalent of alc. KOH.

(D) Ethane is heated in presence of chlorine at 400°C.

48. The reaction of isopropyl bromide with silver nitrite gives:

(A) 1–nitropropane **(B)** propane **(C)** 2–nitropropane **(D)** 2–nitritopropane

49. Which of the following is(are) correct statement(s)?

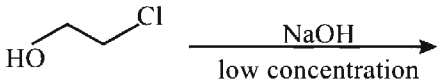
(A) Rate of reaction of $Me_3C-Br+H_2O$ is greater than that of $Me_3C-Cl+H_2O$

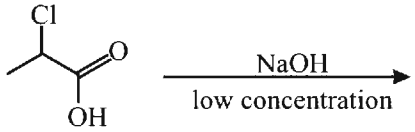
(B) Rate of reaction of $Me_3C-Cl+H_2O$ is greater than that of $Me_3C-Cl+CH_3OH$

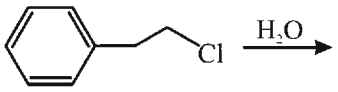
(C) Rate of reaction of $Et_3C-Cl+H_2O$ is equal to that of $Me_3C-Cl+H_2O$

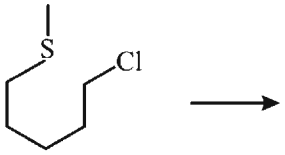
(D) Rate of reaction of $Me_3C-Cl+CH_3SH$ is greater than that of $Me_3C-Cl+CH_3OH$

50. Which of the following reaction involves neighbouring group participation?

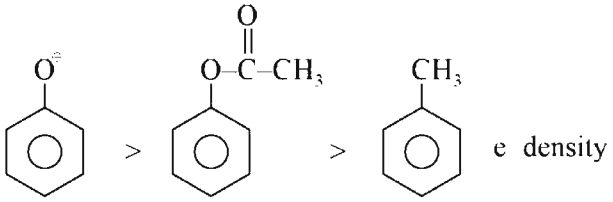
(A) 

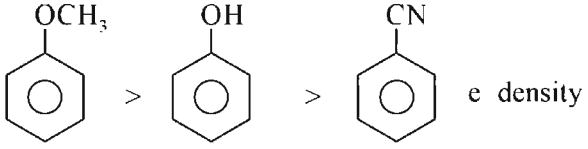
(B) 

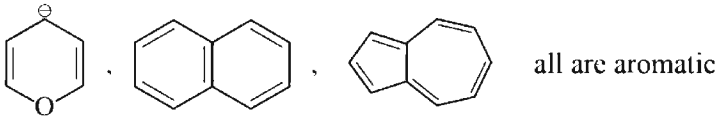
(C) 

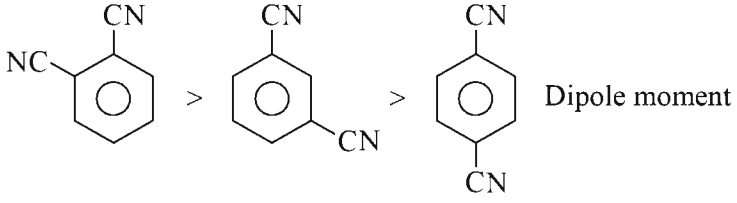
(D) 

51. Which of the following is/are correct statement:

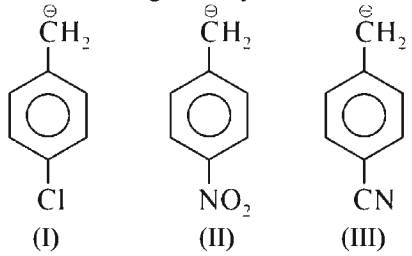
(A) 

(B) 

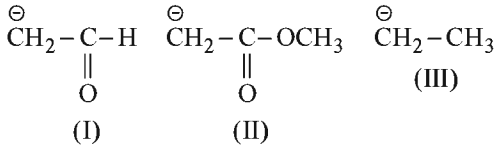
(C) 

(D) 

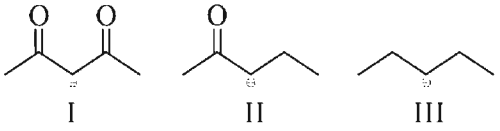
52. Which of the following stability order of anions is/are correct:

(A) 
(I) (II) (III)

II > III > I

(B) 
(I) (II) (III)

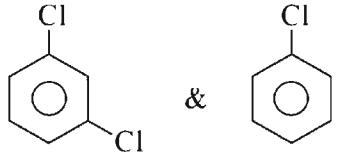
I > II > III

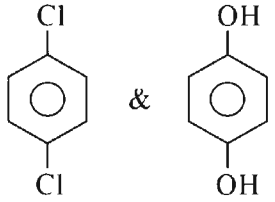
(C) 
I II III

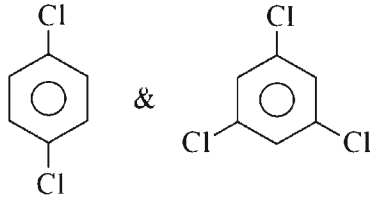
I > II > III

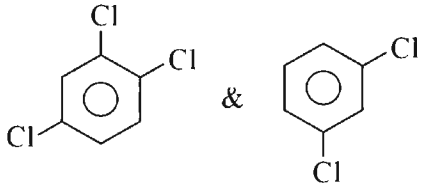
(D) $\overset{\ominus}{C}H_3 > \overset{\ominus}{C}D_3$

53. Which of the following pairs have same dipole moment

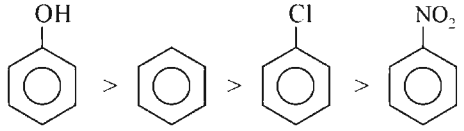
(A) 

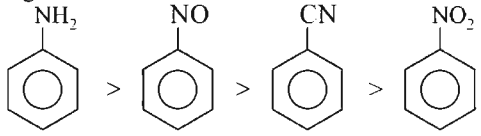
(B) 

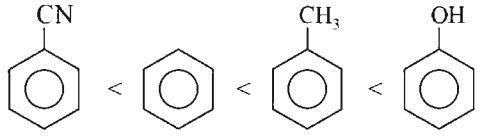
(C) 

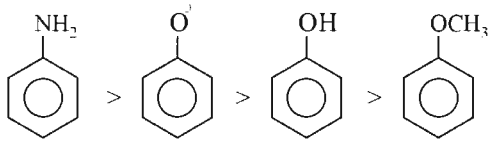
(D) 

54. Which is/are the correct order of electron density in aromatic ring?

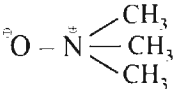
(A) 

(B) 

(C) 

(D) 

55. In which cases delocalization of charge is possible?

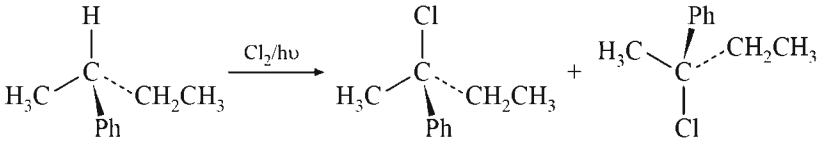
(A) 

(B) $\overset{\ominus}{O}-P(CH_3)_2$

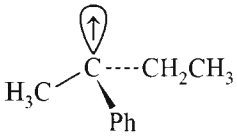
(C) $\overset{\ominus}{O}-\overset{\oplus}{P}(CH_3)_3$

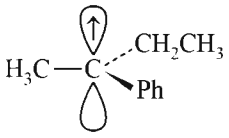
(D) $\overset{\ominus}{O}-B(CH_3)_2$

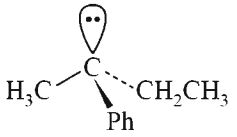
56. Observe the following reaction and given products.

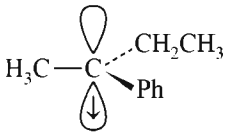


In this reaction the structures of reaction intermediate should be:

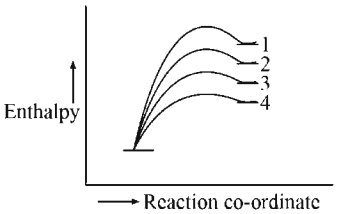
(A) 

(B) 

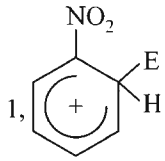
(C) 

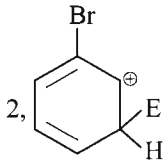
(D) 

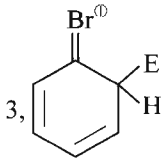
57.

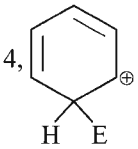


Out of the followings which one is/are correct:

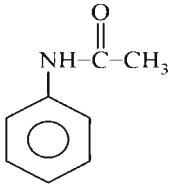
(A) 

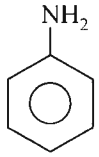
(B) 

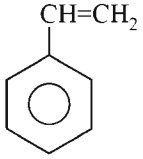
(C) 

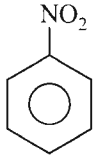
(D) 

58. Friedel craft acylation is/are not observed in:

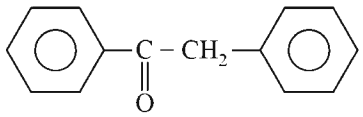
(A) 

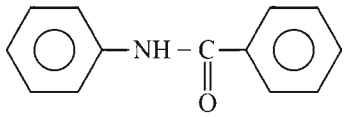
(B) 

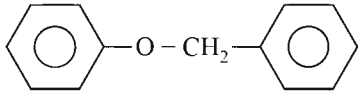
(C) 

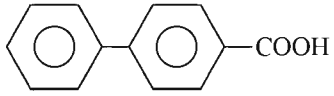
(D) 

59. In which of following electrophilic aromatic substitution reaction takes place on left hand side phenyl ring?

(A) 

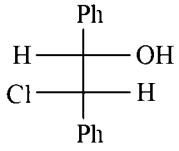
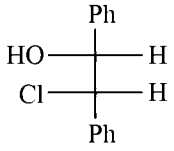
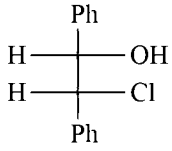
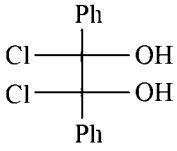
(B) 

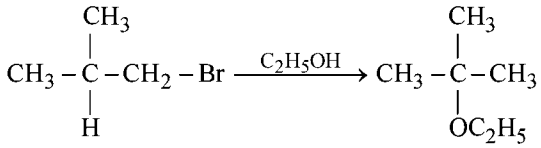
(C) 

(D) 

60. $Ph-C\equiv C-Ph \xrightarrow{Na/NH_3} A \xrightarrow{HOCl/H^+} B$

B is/are:

(A)  **(B)**  **(C)**  **(D)** 

61. 

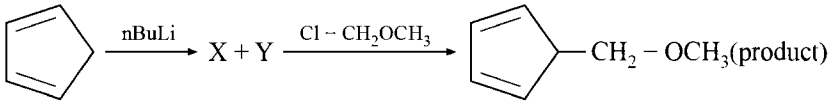
What is correct about the given reaction?

(A) It is unimolecular nucleophilic substitution reaction

(B) Major product obtained by rearranged carbocation

(C) It is two step process

(D) Rate of reaction depends on the concentration of alkyl halide and nucleophile

62. 

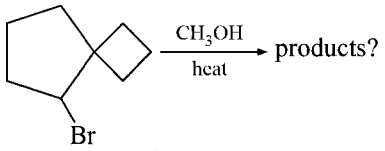
In the above reaction which of the following are correct?

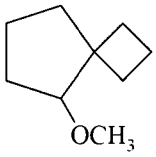
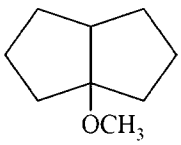
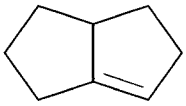
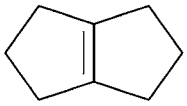
(A) step-1 is an acid-base reaction

(B) step-2 is an S_N2 reaction

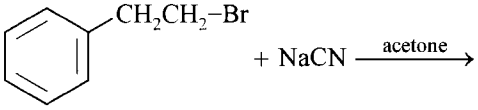
(C) X = n-Butane ; Y = aromatic salt

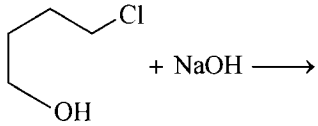
(D) the nucleophile in 2nd reaction is : $Bu^{\ominus}$

63. 

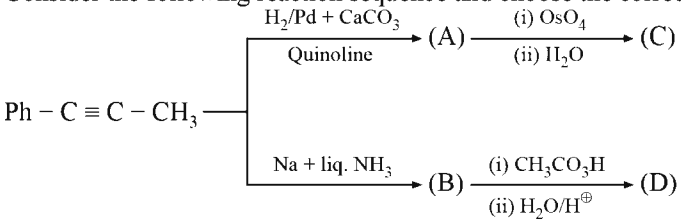
(A)  **(B)**  **(C)**  **(D)** 

64. Which of the following will give major product by S_N2 ?

(A) $CH_3CH_2SNa + CH_3CH_2Cl \longrightarrow$ **(B)** 

(C)  **(D)** $CH_3(CH_2)_8CH_2Cl + NaI \xrightarrow{acetone}$

65. Consider the following reaction sequence and choose the correct options.



(A) (A) and (B) are diastereomer's of each other

(B) Upon catalytic hydrogenation (A) and (B) gives same product

(C) Product (C) and (D) are identical

(D) Product (C) and (D) can be separated by fractional distillation

66. Two optically active acyclic compounds X and Y (molecular formula C_5H_9Br) give following reactions:

$$X \xrightarrow{H_2(1\ mole)} W\ (achiral)$$

$$Y \xrightarrow{H_2(1\ mole)} S\ (chiral)$$

Which of the following is/are correct?

(A) $W = CH_3-CH_2-\underset{\underset{Br}{|}}{CH}-CH_2-CH_3$

(B) $Y = CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-CH=CH_2$

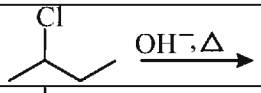
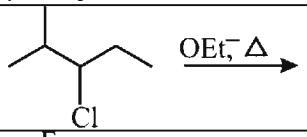
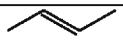
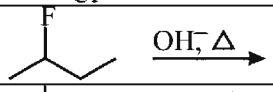
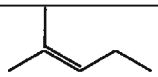
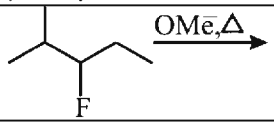
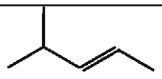
(C) $X = CH_3-CH_2-\underset{\underset{Br}{|}}{C}=CH-CH_3$

(D) $S = CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-CH_2-CH_3$

MATRIX MATCH TYPE

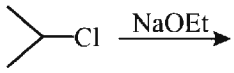
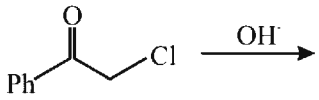
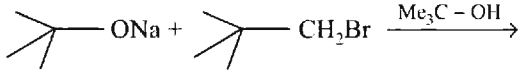
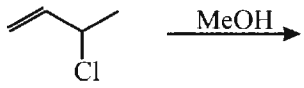
Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

67. Match the following reaction in list I with appropriate products in list II and select the correct answer using the code given below the lists.

	List I		List II
(P)		**1.**	
(Q)		**2.**	
(R)		**3.**	
(S)		**4.**	

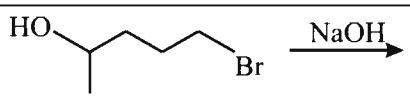
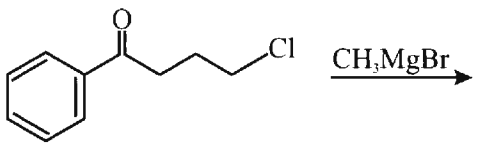
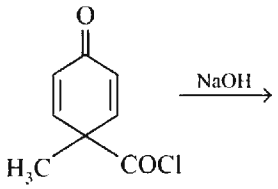
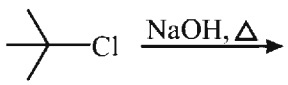
	P	Q	R	S		P	Q	R	S
(A)	2	4	1	3	**(B)**	2	3	1	4
(C)	1	4	2	3	**(D)**	1	3	2	4

68. Match the following reaction in list –I with appropriate reaction in list – II and select the correct answer using the code given below the lists:

	List I		List II
(P)		**1.**	S_N2
(Q)		**2.**	E2
(R)		**3.**	S_N1
(S)		**4.**	E1

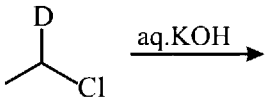
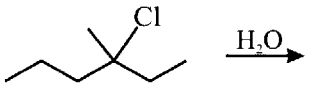
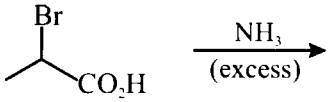
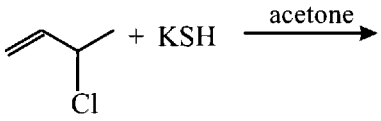
	P	Q	R	S		P	Q	R	S
(A)	2	1	4	3	**(B)**	2	1	3	4
(C)	1	3	2	4	**(D)**	1	3	4	2

69. Match the following reaction in list –I with appropriate comment in list – II and select the correct answer using the code given below the lists:

	List I		List II
(P)		**1.**	Nucleophilic substitution
(Q)		**2.**	Nucleophilic acyl substitution
(R)		**3.**	Elimination
(S)		**4.**	Nucleophilic addition

	P	Q	R	S		P	Q	R	S
(A)	1	4	3	2	**(B)**	3	4	2	1
(C)	1	4	2	3	**(D)**	2	4	1	3

70. MATCH THE FOLLOWING:

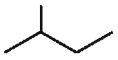
	Column I		Column II
(P)		**(A)**	Inversion
(Q)		**(B)**	Racemization
(R)		**(C)**	Retention
(S)		**(D)**	Mixture of inversion and an optically inactive product
		(E)	S_N2

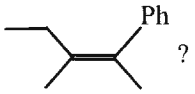
71. MATCH THE FOLLOWING:

	Column I		Column II
(P)	C – X is broken in RDS	**(A)**	E1cB
(Q)	Rate of reaction increases to a small extent by the presence of an electron withdrawing group at β-position.	**(B)**	S_N1
(R)	$\frac{k_H}{k_D}=1$	**(C)**	S_N2
(S)	Product formation increases by a large extent by the presence of an electron withdrawing group at β-position.	**(D)**	E2
		(E)	No Kinetic isotope effect

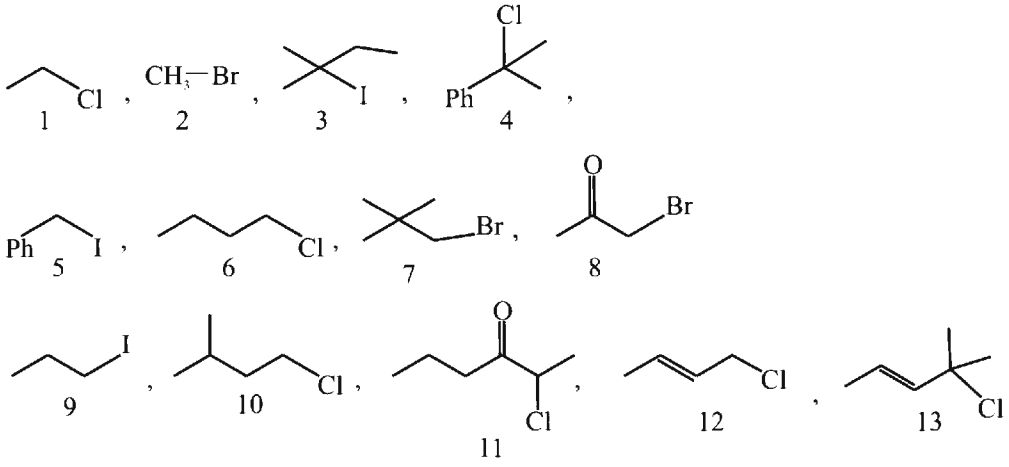
Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

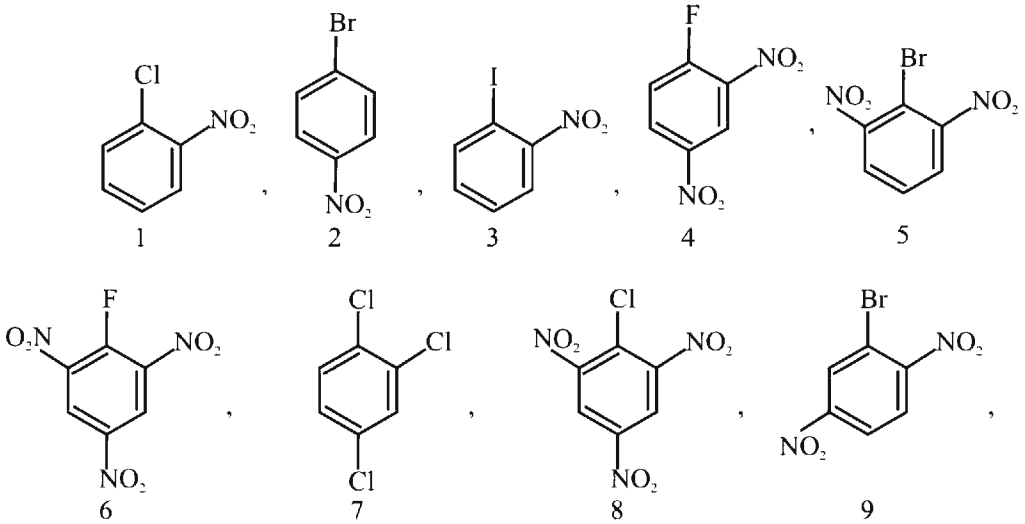
72. The number of optically active compounds formed on monochlorination of  will be _____.

73. How many alkyl chlorides can be used for the preparation of given alkene  ?

74. How many of the following alkyl halides can undergo reaction by S_N2 mechanism under suitable conditions?



75. Which of the following aryl halides will undergo reaction by bimolecular S_NAr pathway at the fastest rate?



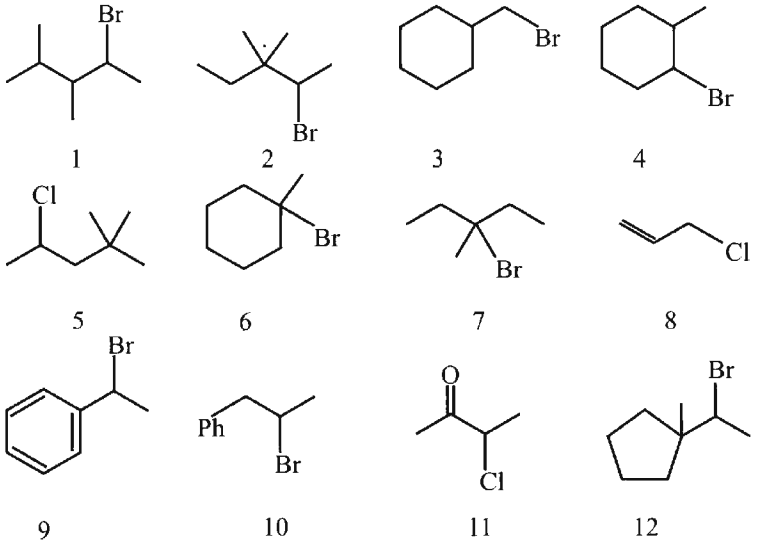
76. How many optically active bromides are possible with molecular formula $C_5H_{11}Br$?

77. $\underset{\text{Allyl diazomethane}}{CH_2=CH-CH_2-CHN_2} \xrightarrow{\text{Light}} (A)$

The molecular weight of the compound (A) is 'xy'.

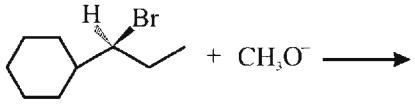
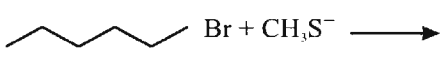
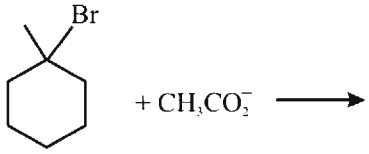
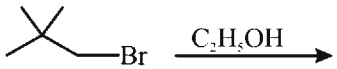
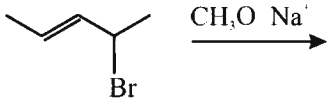
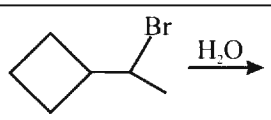
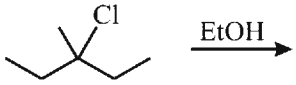
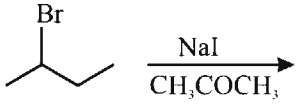
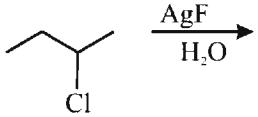
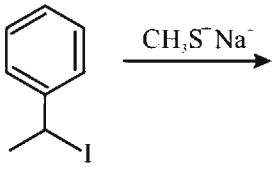
The sum of x and y is _____.

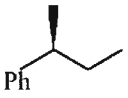
78. How many of the following alkyl halides form a substitution product in an S_N1 reaction that is different from that formed in an S_N2 reaction?

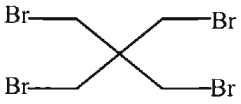


1 2 3 4 5 6 7 8 9 10 11 12

79. In how many of the following reactions, the rate of reaction increases by increasing the concentration of nucleophile?

1.		**2.**	
3.		**4.**	
5.		**6.**	
7.		**8.**	
9.		**10.**	

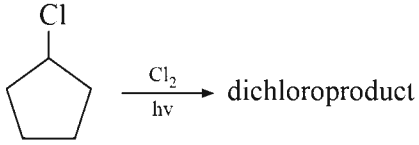
80. In the given reaction,  'm' products. What is the value of 'm'?

81.  . In the given reaction, the degree of unsaturation in product (A) is ____.

82. CH_3COCH_3 is treated with I_2 and NaOH to form yellow precipitate of iodoform. Find out sum of stoichiometric coefficients of all reactants of balanced reaction of acetone with I_2 and NaOH to form iodoform.

83. An ester $C_4H_8O_2$ on reaction with excess of CH_3MgBr in dry ether followed by acidification produce alcohol C_3H_8O as sole organic product. Find out number of carbon atoms in principal chain of ester $C_4H_8O_2$.

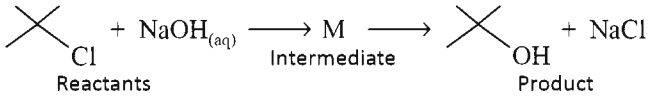
84. Identify total number of theoretically possible dichloro products formed in following reaction.



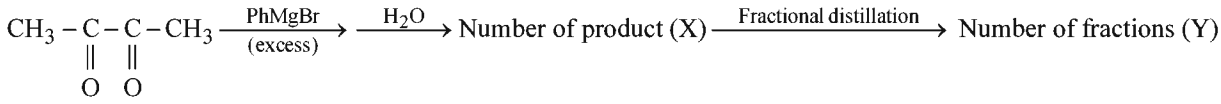
85. Total number of position isomers of tetrachlorocyclobutane which can show geometrical isomerism are :

86. How many butyl bromide can be converted into Grignard reagent followed by their reaction with acid to form n-Butane.

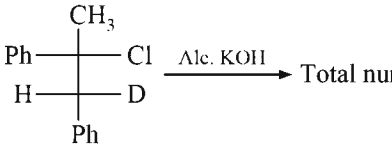
87. Consider the following reaction sequence.

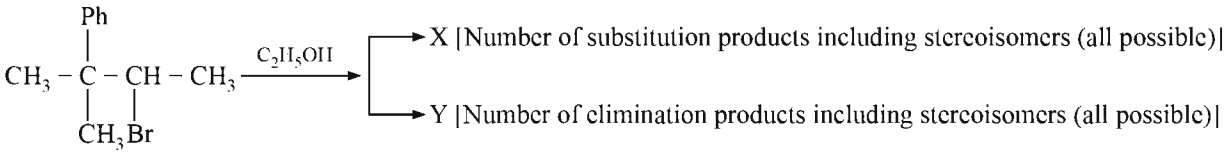


How many hyperconjugative structures are possible for intermediate M of above reaction?

88. 

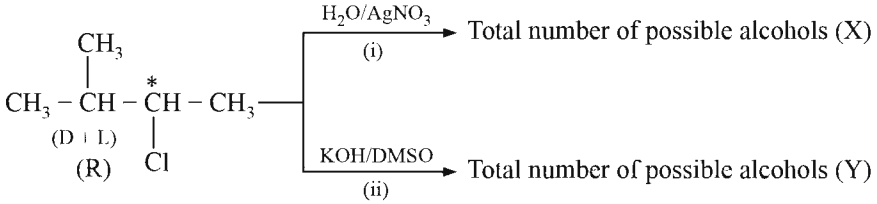
Report your answer as XY.

89. 

90. 

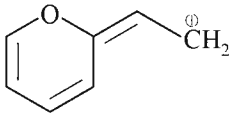
Report your answer as $\boxed{X}\boxed{Y}$

91. Consider the following reaction,

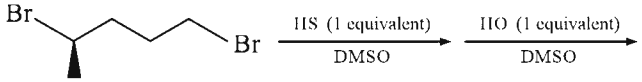


Report your answer as X|Y

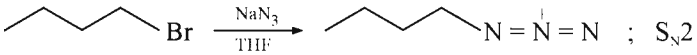
92. How many p-electrons are involved in resonance in the given structure?



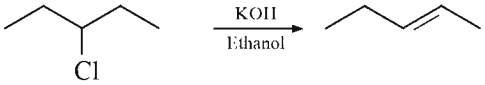
93. What is percent of sulphur in major product of the following reaction?



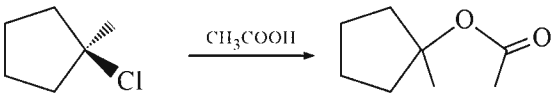
94. How many of the following reactions are correctly matched with reaction mechanism?

1. 

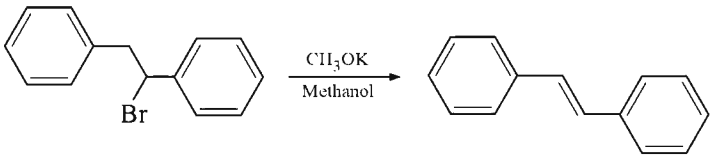
; S_N2

2. 

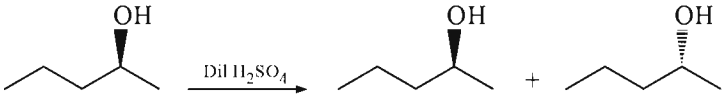
; E2

3. 

; S_N1

4. 

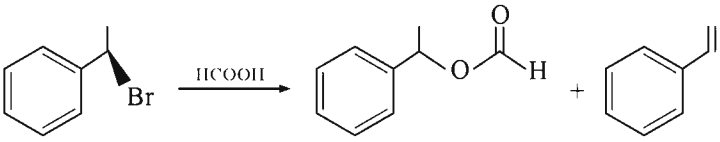
; E2

5. 

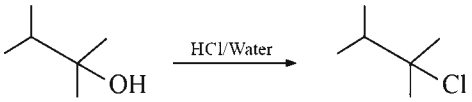
; S_N1

6. 

; E1CB

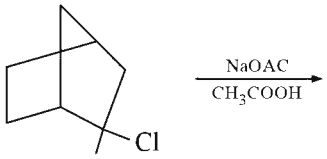
7. 

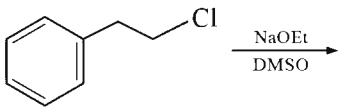
; E1

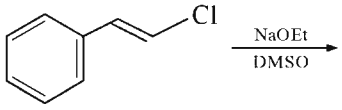
8. 

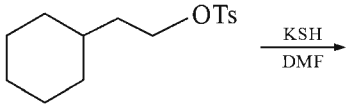
; S_N1

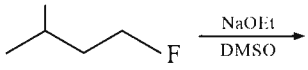
95. How many of the following reactions are most likely to proceed through S_N1 pathway?

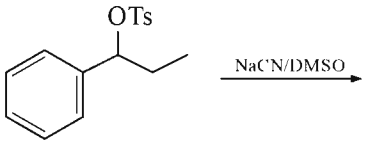
1. 

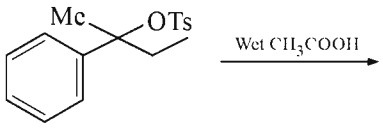
2. 

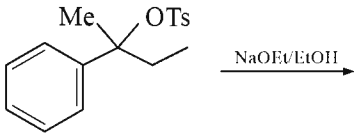
3. 

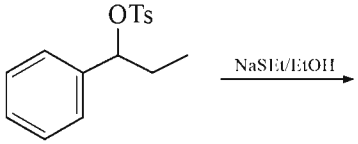
4. 

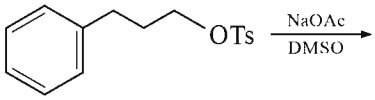
5. 

6. 

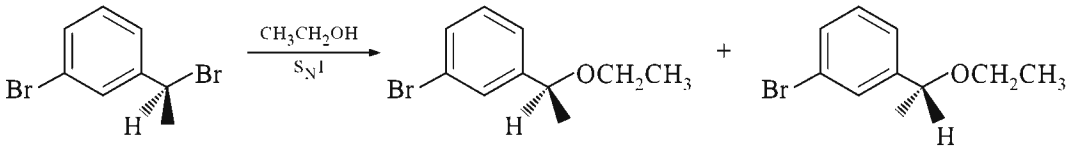
7. 

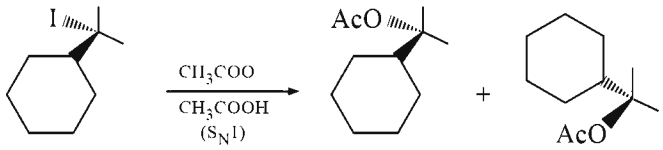
8. 

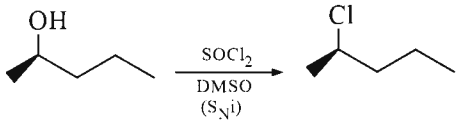
9. 

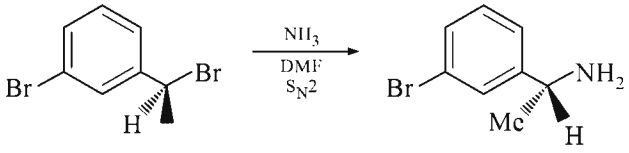
10. 

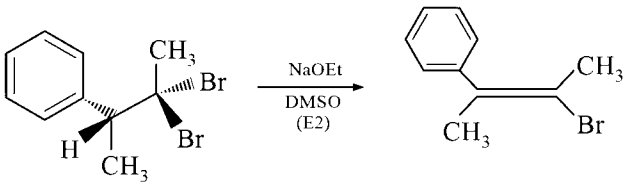
96. How many of the following reactions are correctly labelled with respect to reaction mechanism and stereochemistry of product wherever possible?

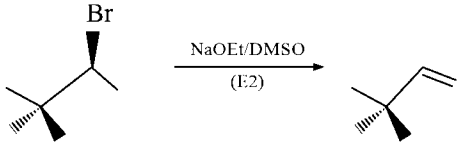
1. 

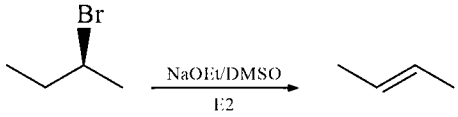
2. 

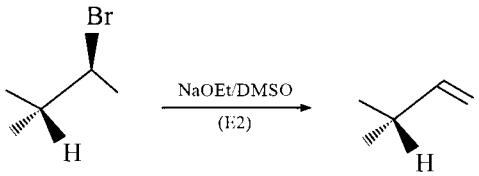
3. 

4. 

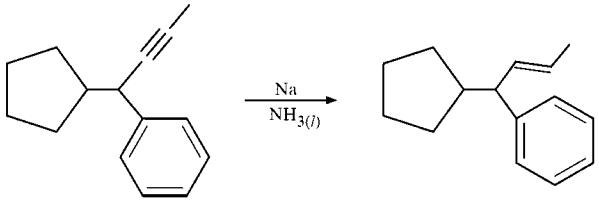
5. 

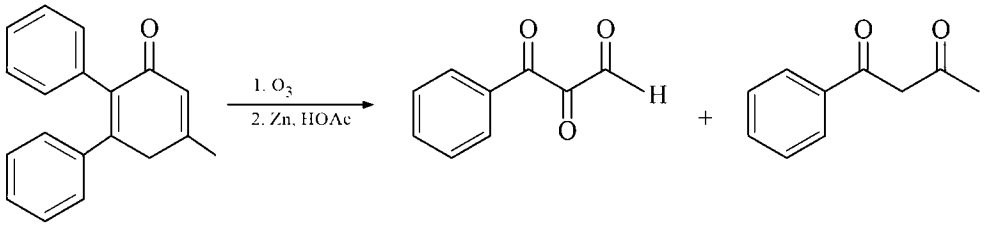
6. 

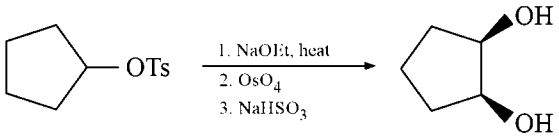
7. 

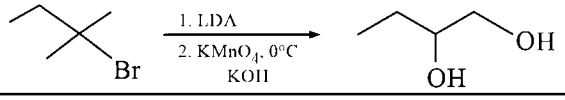
8. 

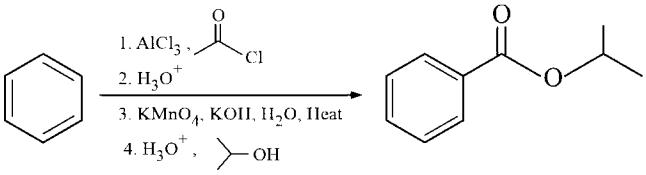
97. How many of the following reactions are correctly represented?

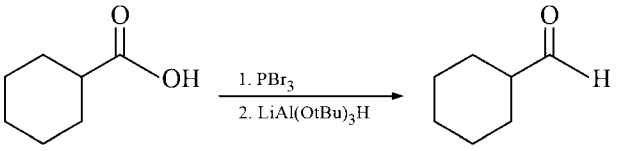
1. 

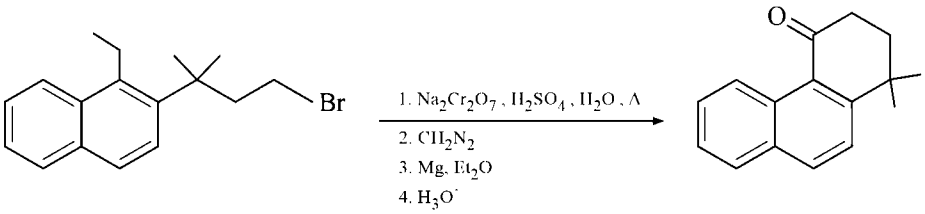
2. 

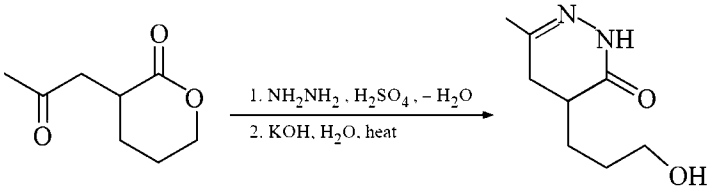
3. 

4. 

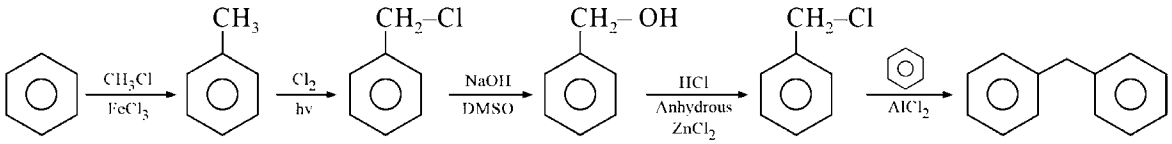
5. 

6. 

7. 

8. 

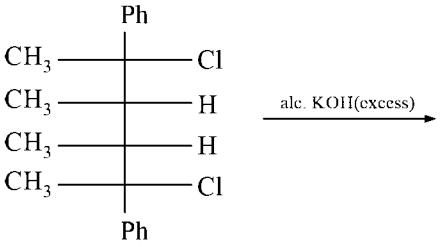
98. In the following sequence of reactions, number of Nucleophilic substitution is:



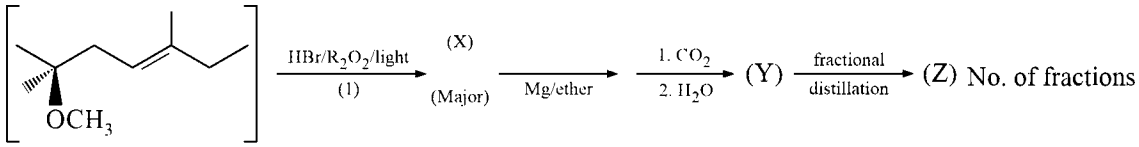
99. Rearrangement of carbon skeleton of substrate is possible in which of the following reactions?

EAS (Electrophilic aromatic substitution), electrophilic addition on alkenes, free radical substitution of alkanes, S_N1, S_N2, E1, E2, E1cB, S_NAr

100. Find the number of products (including stereoisomers) formed in the following reaction (consider only major product).

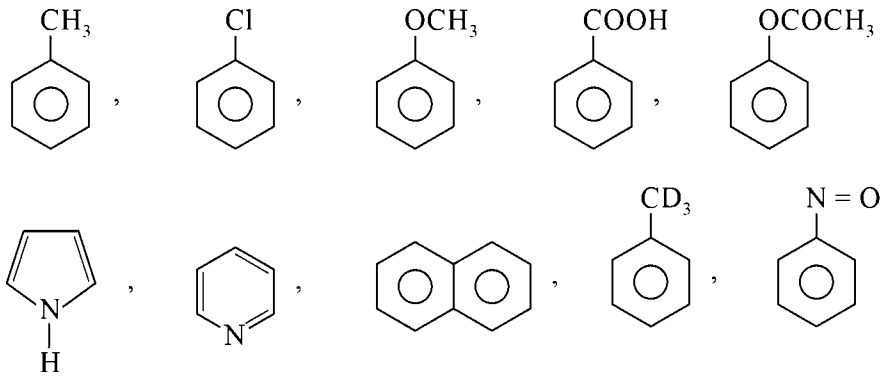


101.

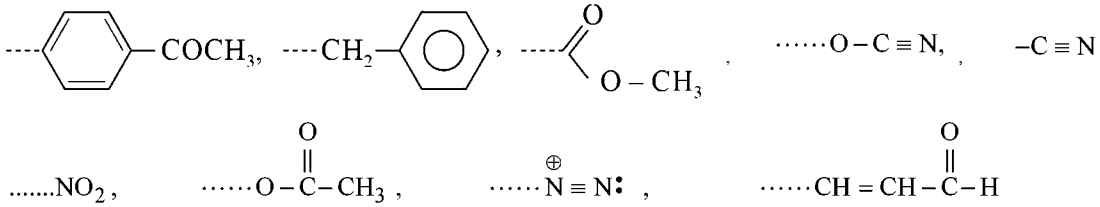


Find the value of (Z).

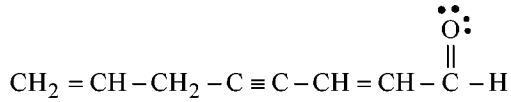
102. How many compounds are more reactive than benzene towards Nitration?



103. How many of the following groups exert –M effect?

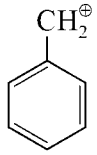
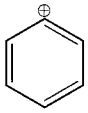
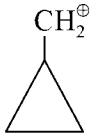
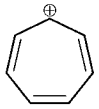
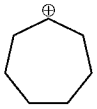


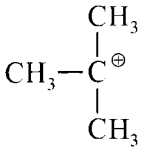
104.



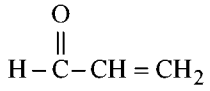
The maximum number of π – electron pairs in direct conjugation with each other is:

105. Number of carbocations which are more stable than $CH=CH-\overset{\oplus}{C}H_2$ from the following is:

(i)  (ii)  (iii)  (iv)  (v)  (vi) 

(vii)  (viii) $CH_3-\overset{\oplus}{C}H-CH_3$ (ix) $O=CH-\overset{\oplus}{C}H_2$

106. How many compounds are more reactive than ethene towards electrophilic addition?

$CH_3-CH=CH_2$,  , $Cl-CH=CH_2$, $CH_3-O-CH=CH_2$,

(I) (II) (III) (IV)

$H-C\equiv C-H$, $Ph-CH=CH_2$, $CH_2=CH-CH=CH_2$

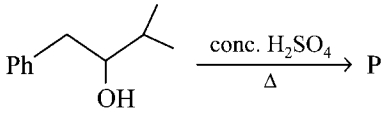
(V) (VI) (VII)

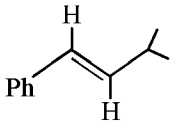
107. Calculate total number of alkene products when 3-chloro-3-methyl heptane react with alcoholic KOH and heat.

SINGLE CORRECT ANSWER TYPE

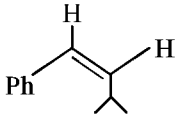
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Identify the major product P in the following reaction.

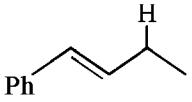




(A)



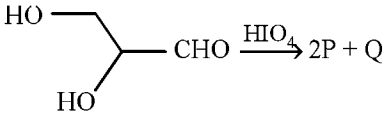
(B)



(C)

(D) All are formed in equal amount

2.

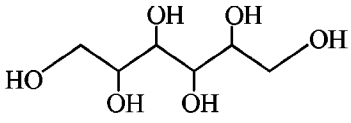


Where P and Q are respectively:

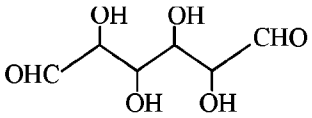
(A) HCOOH + HCHO **(B)** CO_2 + HCHO

(C) HCHO + HCOOH **(D)** CO_2 + HCOOH

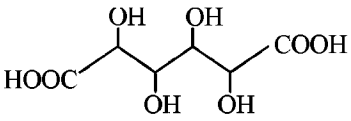
3. A (1 mole) + $6HIO_4$ (6 mole) $\longrightarrow$ 6HCOOH (6 moles). The compound A is:



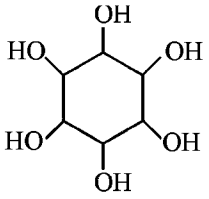
(A)



(B)

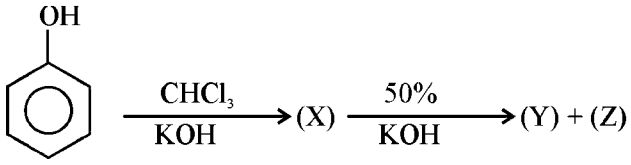


(C)



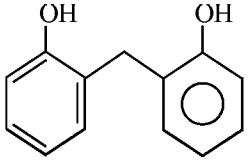
(D)

4. The end products of the reaction:

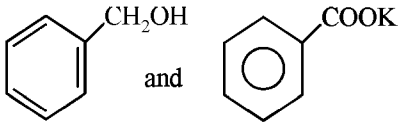


(Y) and (Z) are:

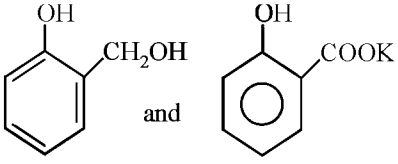
(A)



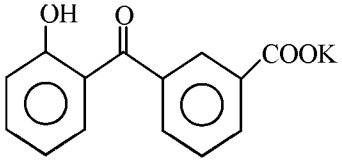
(B)

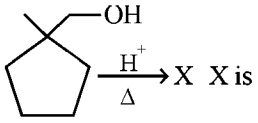


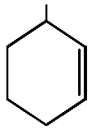
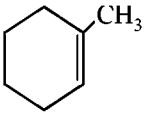
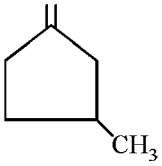
(C)

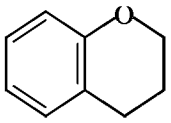


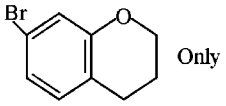
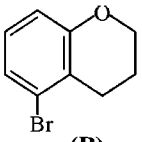
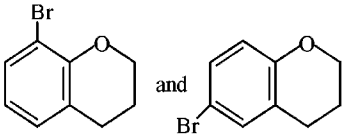
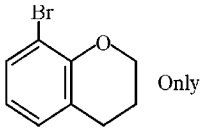
(D)

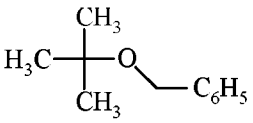


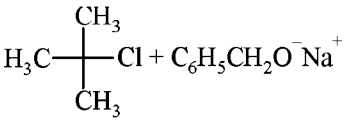
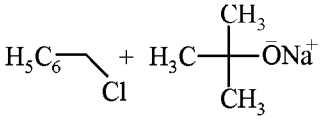
5. The product of the reaction:  X is

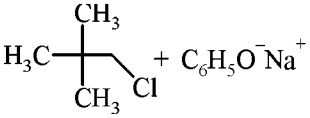
(A)  (B)  (C)  (D) 

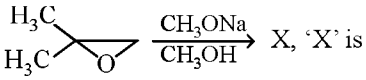
6. When  $\xrightarrow{Br_2}$ A + B + HBr Hence A + B would be:

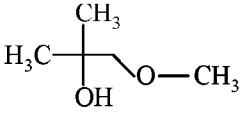
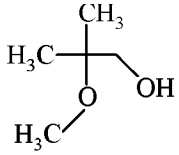
 Only (A)  Only (B)  (C)  Only (D)

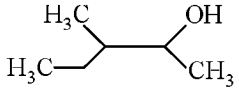
7. Which of the following reaction is useful for the synthesis of 

(A)  (B) 

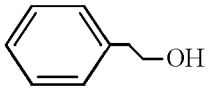
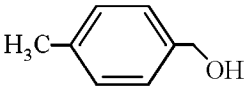
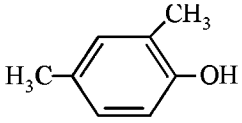
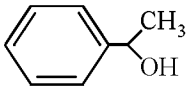
(C)  (D) None of these

8. 

(A)  (B) 

(C)  (D) None of these

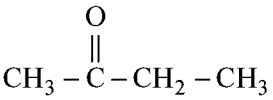
9. An organic compound of molecular formula $C_8H_{10}O$ on reaction with iodine and sodium hydroxide gives an yellow precipitate. The most likely structure of the compound should be:

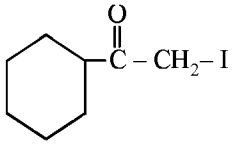
 (A)  (B)  (C)  (D)

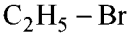
MULTIPLE CORRECT ANSWERS TYPE

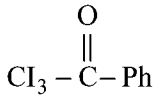
This Section contains Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which One or More Choices may be Correct:

10. Haloform reaction is(are) given by:

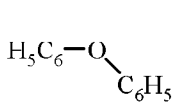
(A) 

(B) 

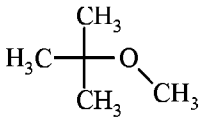
(C) 

(D) 

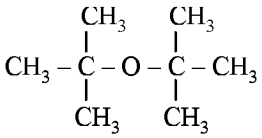
11. Which of these cannot be prepared by Williamson ether synthesis?



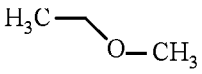
(A)



(B)

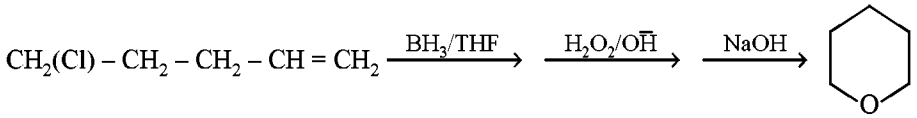


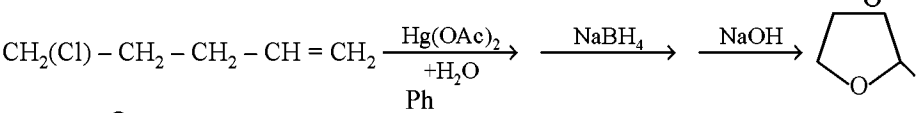
(C)

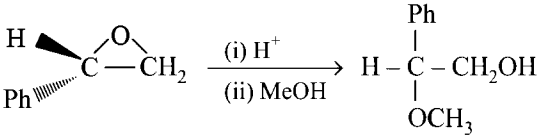


(D)

12. Identify the reactions giving correct product.

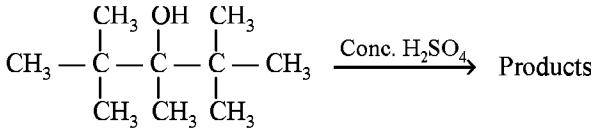
(A) 

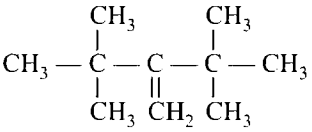
(B) 

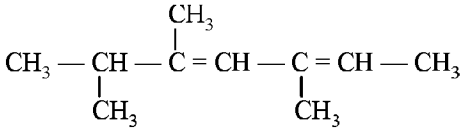
(C) 

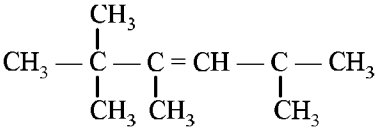
(D) $C_6H_5 - Br + (CH_3)_3CONa \longrightarrow (CH_3)_3CO - C_6H_5 + NaBr$

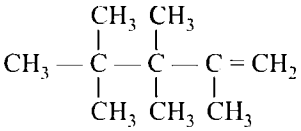
13. Predict the products formed in the following reaction:



(A) 

(B) 

(C) 

(D) 

14. Which of the following compound gives positive haloform test?

(A) $CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - COOC_2H_5$

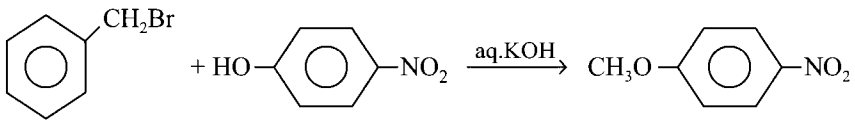
(B) $Ph - \overset{OH}{\underset{|}{C}} = CH - \overset{\overset{O}{\|}}{C} - CH_3$

(C) $CH_3 - \overset{\overset{O}{\|}}{C} - Ph$

(D) All of these

15. Which of the following methods are useful for the synthesis of ether?

(A) $(CH_3)_3CBr + CH_3CH_2ONa \longrightarrow (CH_3)_3COCH_2CH_3$

(B) 

(C) $CH_3ONa + CH_3CH_2OSO_2$–C$_6$H$_4$–$CH_3 \longrightarrow CH_3CH_2OCH_3$

(D) $CH_3 - CH_2OH + CH_2N_2 \xrightarrow{BF_3} CH_3CH_2OCH_3 + N_2$

16. $CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3$ is detected by the following test(s)

(A) Lucas test **(B)** Victor Meyer's test

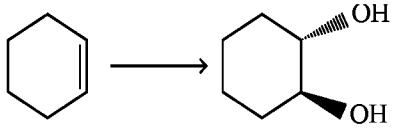
(C) Iodoform test **(D)** $FeCl_3$ solution

17. $2C_2H_5OH \xrightarrow{[X]} \underset{\text{(major)}}{C_2H_5 - O - C_2H_5}$. [X] should be:

(A) conc.H_2SO_4/140°C **(B)** Al_2O_3/250°C

(C) conc.H_2SO_4/170°C **(D)** Dil.H_2SO_4/300°C

18. Which of the following reagents can be used to carry out the following transformation?



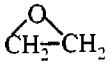
(A) $OsO_4/NaHSO_3$

(B) Cold alkaline $KMnO_4$

(C) $CH_3COOH/H_2O_2/H_3O^+$

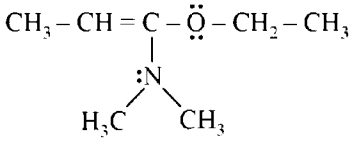
(D) *m*-chloroperbenzoic acid /H_3O^+

19. $(X) + Mg \xrightarrow[\text{ether}]{\text{dry}} (Y) \xrightarrow[(ii)H_3O^+]{(i)(Z)} CH_3CH_2CH_2OH$. Identify (X) and (Z) in the above sequence of reaction:

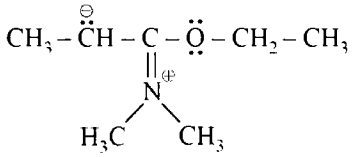
(A) (X) : CH_3CH_2Br ; (Z) : HCHO **(B)** (X) CH_3Br ; (Z) : 

(C) (X) : CH_3Br ; (Z) : CH_3CH_2CHO **(D)** (X) : CH_3Br ; (Z) : CH_3CHO

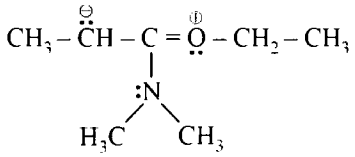
20. The acceptable resonating structure(s) of the following molecule is/are:



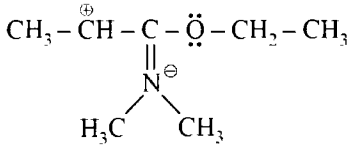
(A)



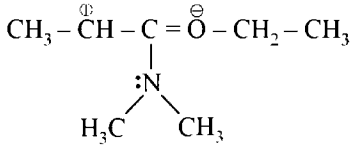
(B)



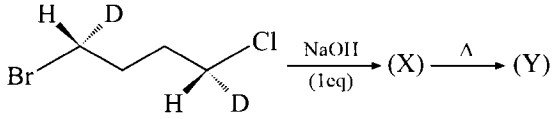
(C)



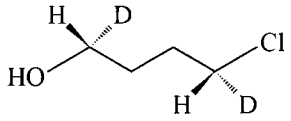
(D)



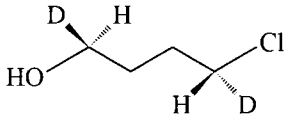
21. The products X and Y of the following reaction can be:



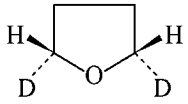
(A) X is



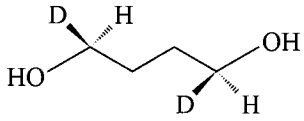
(B) X is



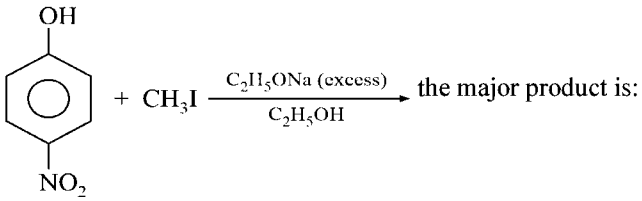
(C) Y is



(D) Y is

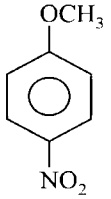


22.



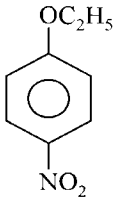
the major product is:

(A)

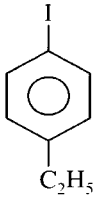


(B) $C_2H_5O-CH_3$

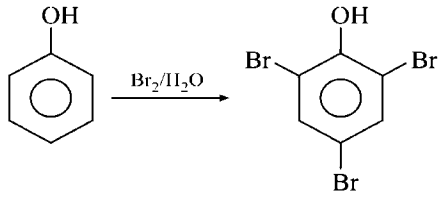
(C)

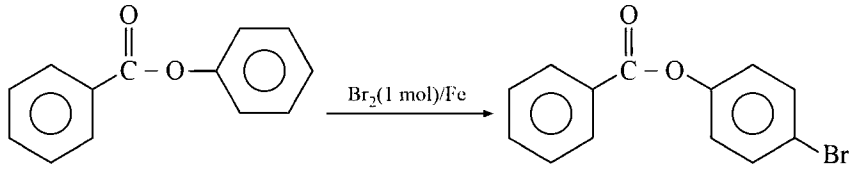


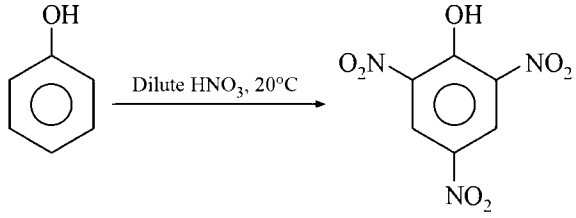
(D)

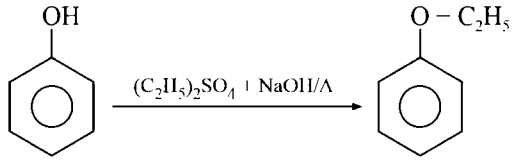


23. Identify the options in which the correct products have been reported in the reaction?

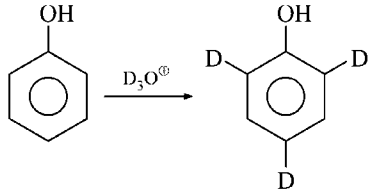
(A) 

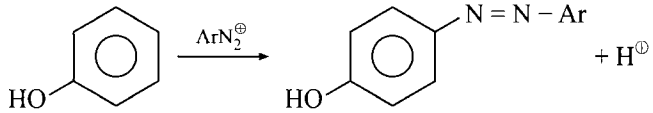
(B) 

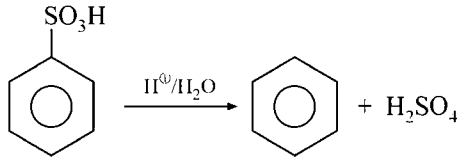
(C) 

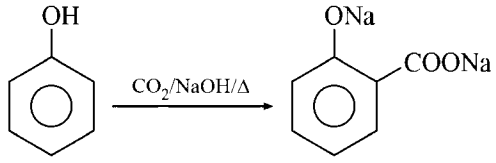
(D) 

24. Select the electrophilic substitution reaction(s):

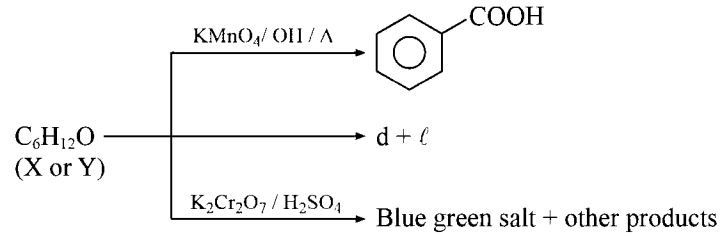
(A) 

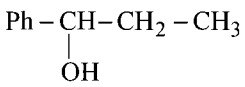
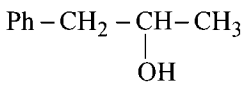
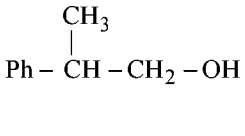
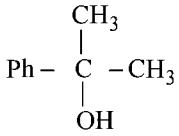
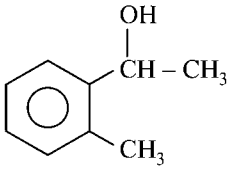
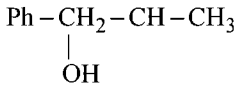
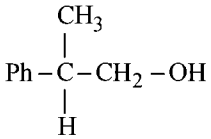
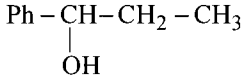
(B) 

(C) 

(D) 

25. Identify the possible structure of X and Y



	X	Y
(A)		
(B)		
(C)		
(D)		

26. Propan-1-ol and Propan-2-ol can be best distinguished by:

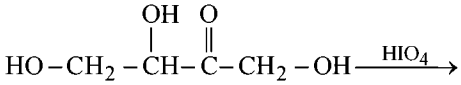
(A) oxidation with alkaline $KMnO_4$ followed by reaction with H_2O

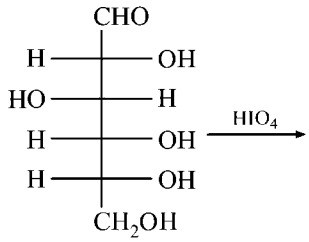
(B) oxidation with PCC followed by reaction with Tollen's reagent

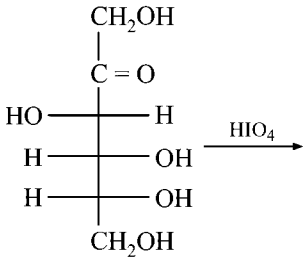
(C) oxidation by heating with copper followed by reaction with iodoform test

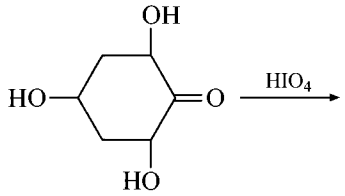
(D) reaction with conc. H_2SO_4 followed by reaction with Fehling solution

27. Which of the following reaction involve formation of CO_2 as a one of the product?

(A) 

(B) 

(C) 

(D) 

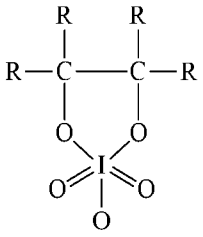
28. Per-iodic acid is generally used for the oxidation of vicinal diols or α-hydroxycarboxyl compounds. Which of the following statements are correct for this reaction?

(A) Oxidative cleavage takes place in this reaction

(B) Final products are generally carbonyl compounds or carboxylic acids

(C) HIO_4 reduced into HIO_3

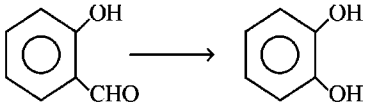
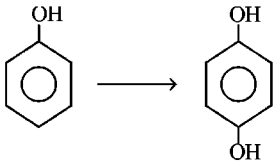
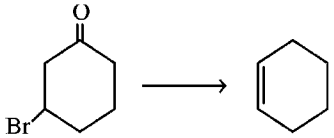
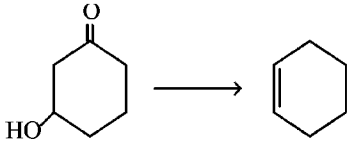
(D) Intermediate of this reaction for a vicinal diol is



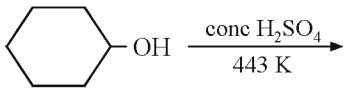
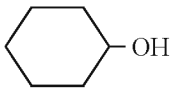
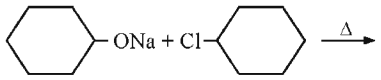
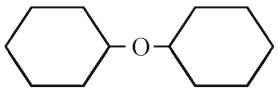
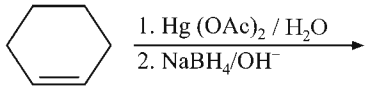
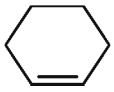
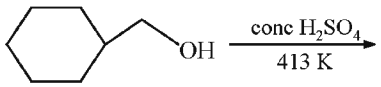
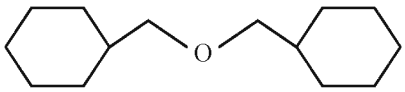
MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

29. MATCH THE FOLLOWING:

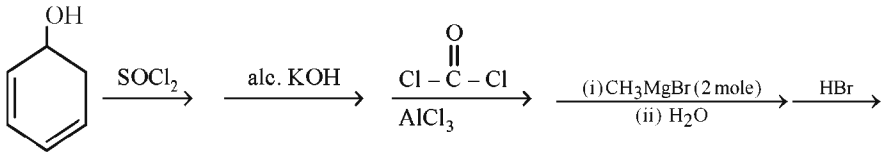
	Column 1 (Reactant and product)		Column 2 (Reagent)
(A)		**(p)**	$H_2O_2 + OH^-/H_3O^+$
(B)		**(q)**	Zn-Hg + conc.HCl
(C)		**(r)**	$K_2S_2O_8 + OH^-/H_3O^+$
(D)		**(s)**	$NH_2–NH_2/OH^-$
		(t)	Ag_2O(moist)

30. MATCH THE FOLLOWING LISTS:

Column 1		Column 2 [Major Product]	
(A)		(p)	
(B)		(q)	
(C)		(r)	
(D)		(s)	

Numerical Value Type

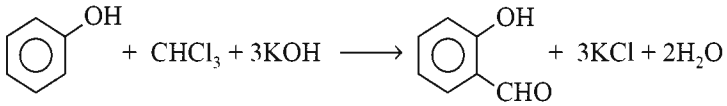
The Answer to the following questions are positive integers of 1/2/3 digits and zero

31. 

In the above sequence of reaction how many nucleophilic substitution taking place?

32. How many constitutional isomers exist for formula $C_5H_{12}O$ that contain an ether as a functional group.

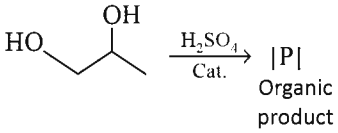
33. Synthesis of salicyldehyde from phenol involved chlorine containing reactive species.



Find out sum of number of bond pairs and lone pairs of electrons of this reactive species.

34. Three moles of salicyclic acid reacts quantitatively with excess of bromine dissolved in water to form a white precipitate of brominated organic compound [P] having 72.5 % of bromine by mass. If reaction proceed by 100 % yield then find out number of moles of Br_2 used. [Atomic mass of Br = 80]

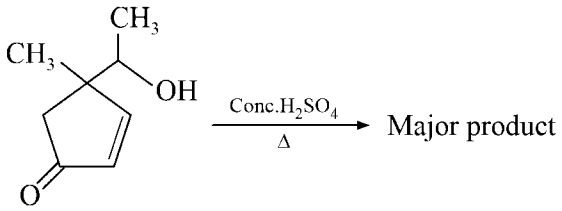
35. Consider the following reaction:



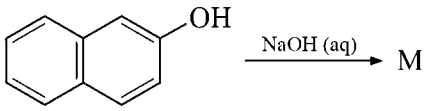
Find out total number of σ bonds in the organic product [P].

36. How many alcohols having molecular formula $C_5H_{12}O$ can't be oxidised by PCC?

37. What is the sum of locants of all groups or substituents in IUPAC name of major product of the following reaction?



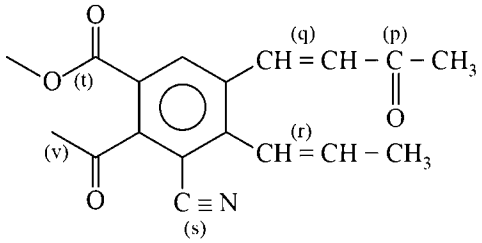
38.



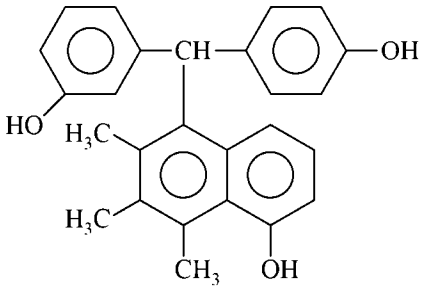
How many resonating structures are possible for organic salt M?

39. How many carbonyl compounds will give secondary alcohol with molecular formula $C_5H_{12}O$ after reaction with $LiAlH_4$.

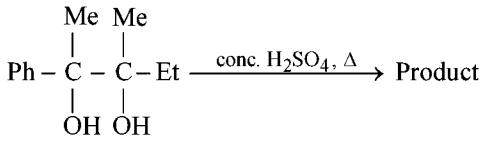
40. How many groups can be reduced by $NaBH_4$ in given compound.



41. The following compound is treated with excess of Br_2/H_2O. Find the total number of positions, where bromination will occur significantly:

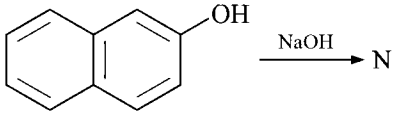


42.



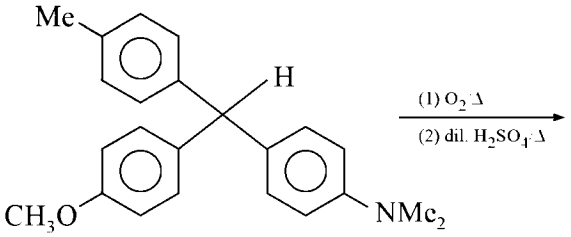
How many number of different type of carbonyl products (only structural isomers) can be formed (major or minor) in this reaction, (considering all types of possible migrations).

43. The number of resonance structures for N is:



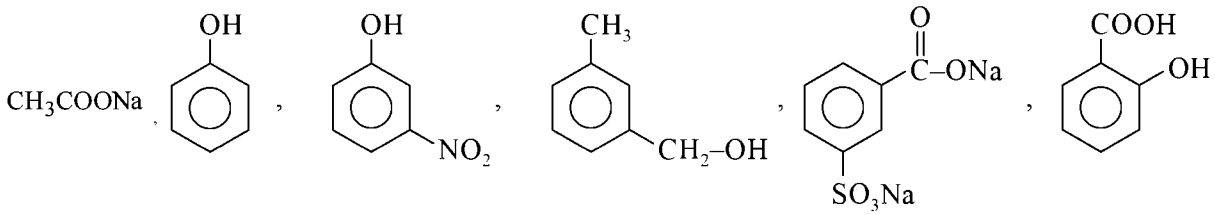
44. Many aromatic compounds can be drawn with molecular formula $C_8H_8O_2$. Find out the no. of aromatic compounds which can be drawn with this molecular formula and which also contains an – O – (ether) linkage.

45.



Total number of organic products formed (major, minor all).

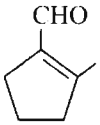
46. How many of the following produce a characteristic coloration/ppt with neutral $FeCl_3$?

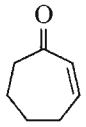


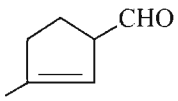
SINGLE CORRECT ANSWER TYPE

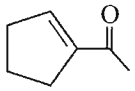
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Which of the following will not be formed on intramolecular aldol reaction of 6-oxoheptanal when treated with aqueous solution of NaOH?

(A) 

(B) 

(C) 

(D) 

2. The product formed in the following reaction could be: *trans*-2-chlorocyclohexan-1-ol $\xrightarrow{OH^{\ominus}/\Delta}$

(A) Epoxycyclohexane **(B)** Cyclohexanone

(C) Cyclohexene **(D)** Cyclohaxane-1, 2 diol

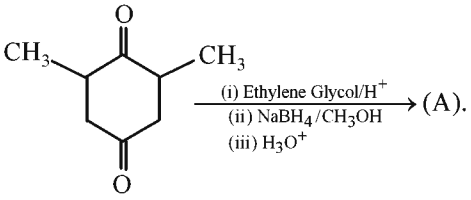
3. When two moles of HCHO and 1 mole C_6H_5CHO react with NaOH, quantitatively the products formed are:

(A) 0.5 mole of HCOONa, 1 mole of $C_6H_5CH_2OH$ and 1.5 mole of CH_3OH

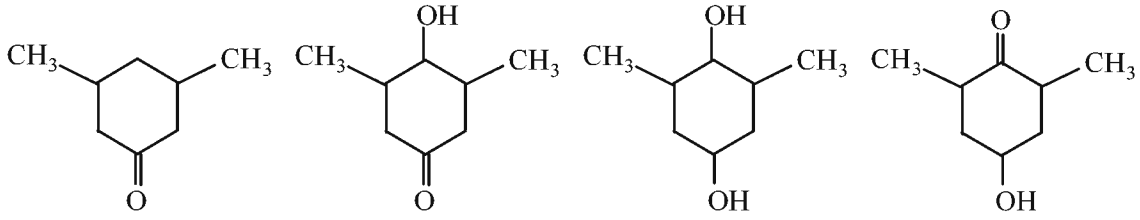
(B) 1 mole each of HCOONa,$C_6H_5CH_2OH$ and CH_3OH

(C) 1 mole each of HCOONa ,$C_6H_5CH_2OH$ and ½ mole of CH_3OH

(D) 1.5 mole of HCOONa , 1 mole of $C_6H_5CH_2OH$ and 0.5 mole of CH_3OH

4. 

Product (A) in above sequence of reaction is:

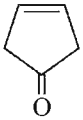


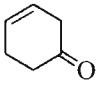
(A) **(B)** **(C)** **(D)**

5. Dipole moment of which ketone is maximum?

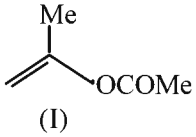
(A) 

(B) 

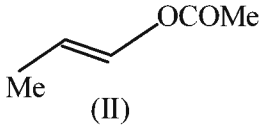
(C) 

(D) 

6. Which of the following reagent cannot be used to distinguish the products obtained by acidic hydrolysis of (I) and (II)?



(I)



(II)

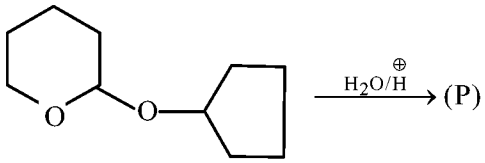
(A) Brady's reagent (2, 4-DNP test)

(B) Tollen's reagent

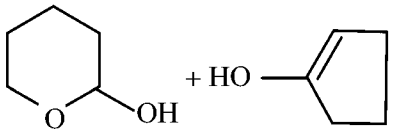
(C) Fehling's reagent

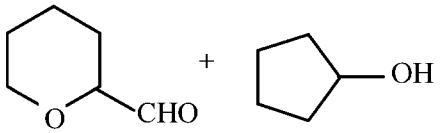
(D) Benedict's reagent

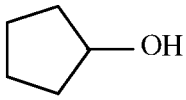
7. In the given reaction:

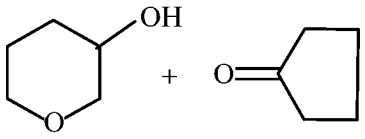


(P) will be:

(A) 

(B) 

(C) $HO-(CH_2)_4-CHO+$ 

(D) 

8. $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-\underset{\underset{O}{\|}}{C}-OC_2H_5 \xrightarrow[(2)\ CH_3-I]{(1)\ C_2H_5ONa} \xrightarrow[(2)\ \Delta]{(1)\ H_2O/H^+}$

(A) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_3$

(B) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-CH_3$

(C) $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$

(D) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-COOH$

Paragraph for Questions 9 - 10

Labels of two bottles (X) and (Y) were missing in the lab, as result scientist was not able to know the names of compounds present in those bottles. By quantitative analysis he found that compounds in both the bottles have molecular formula $C_6H_{12}O$. Now to know the structure and name of compounds, he did some qualitative test for identification of these compounds present in bottles (X) and (Y). Compound in bottle (X) was found to meet following criterion:

(i) It gives iodoform test. **(ii)** It gives DNP test.

(iii) It shows optical rotation. **(iv)** On vigorous oxidation it gives only acetic acid.

On the other hand, compound in bottle (Y) was found to meet following criterion:

(i) It gives Tollen's reagent test **(ii)** It gives DNP test

(iii) It shows optical rotation **(iv)** On aldol condensation it goes upto α-β unsaturated carbonyl

(v) It forms crystals with $NaHSO_3$

9. The structure of compound in bottle (X) using above information would be:

(A) $CH_3-CH_2-\underset{\underset{O}{\|}}{C}-\underset{\underset{CH_3}{|}}{CH}-CH_3$

(B) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{O}{\|}}{C}-CH_3$

(C) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-CHO$

(D) $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-CH_2-CH_3$

10. Structure of compound in bottle (Y) would be:

(A) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{O}{||}}{C}-CH_3$ **(B)** $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-CHO$

(C) $CH_3-CH_2-CH_2-\underset{\underset{CH_3}{|}}{CH}-CHO$ **(D)** $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-CHO$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Questions has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

11. Tautomerization, the process of converting one tautomer into another, is catalysed by both acid as well as with base.

$$\underset{\text{Keto}}{CH_3-\overset{\overset{O}{||}}{C}-CH_3} \xrightarrow{H^+ \text{ or } OH^-} \underset{\text{Enol}}{CH_3-\overset{\overset{OH}{|}}{C}=CH_2}$$

Which of the following statement(s) is(are) correct?

(A) Enol is generally less stable than keto since C = O bond in latter is stronger than C = C of former

(B) In acid catalysed tautomerism, protonation precedes deprotonation

(C) In base catalysed tautomerism, deprotonation precedes protonation

(D) In the following compound, enol formed from α-H is more than the enol formed from α′–H

$$C_6H_5-\overset{\alpha}{CH_2}-\overset{\overset{O}{||}}{C}-\overset{\alpha'}{CH_3}$$

12. Which of following method(s) is(are) suitable for the formation of methylene cyclohexane in major quantity?

(A) l-chloro-1-methyl cyclohexane $\xrightarrow{Me_3CO^-K^+/Me_3COH}$

(B) Cyclohexylchloromethane $\xrightarrow{\text{alco KOH}/\Delta}$ **(C)** Cyclohexanone $\xrightarrow{[Ph_3PCH_2]^{\oplus}I^{\ominus}}$

(D) Cyclohexylcarbinol $\xrightarrow{\text{Conc } H_2SO_4/\Delta}$

13. Following sequence of reactions show the formation of a compound named as α- Tetralone.

$$C_6H_6 \xrightarrow[\text{Succinic anhydride}]{AlCl_3} (A) \xrightarrow{Zn/Hg/HCl} (B) \xrightarrow{SOCl_2} (C) \xrightarrow{AlCl_3/\Delta} \underset{\alpha\text{–Tetralone}}{(D)}$$

Select the correct option(s) for above sequence of reaction.

(A) (A) is a γ-keto acid compound

(B) (D) is an aromatic compound

(C) (B) is $C_6H_5(CH_2)_3CO_2H$

(D) (D) can also be formed by reacting 4-phenyl butanoyl chloride with $AlCl_3$

14. Select the correct statement(s):

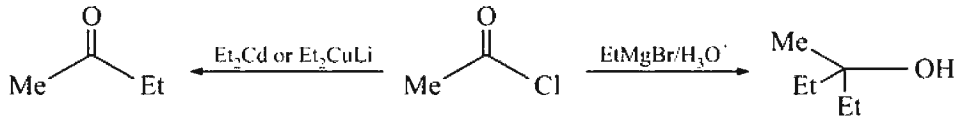
(A) PhCHO and $CH_3COCH_2CH_3$ gives $PhCH{=}CHCOCH_2CH_3$ in basic medium

(B) PhCHO and $(CH_3CO)_2O$ gives cinnamic acid in aqueous solution of sodium acetate

(C) 5 chloropentan-2-one in aq NaOH gives cyclopentanone as well as cyclopropylmethyl ketone in unequal quantities

(D) Only (A) and (B) are correct

15. Which of the statements are correct about the following reaction?



(A) Ketones are more reactive than RCOCl, therefore ketones further react with RMgX to give 3^0 alcohols

(B) (C– Mg) bond is more ionic than (C– Cu) or (C–Cd) bond

(C) EtMgBr, Et_2Cd or Et_2CuLi, all are the source of ethyl carbanion but their reactivity with same substrate is different

(D) R-COCl can show Nucleophilic addition-elimination reaction whereas carbonyl show only addition

16. Which of the statement are correct about the following reactions?

$$CH_3CHO + [Ag(NH_3)_2]^{\oplus} + 3OH^- \longrightarrow CH_3COO^- + Ag + 2NH_3$$

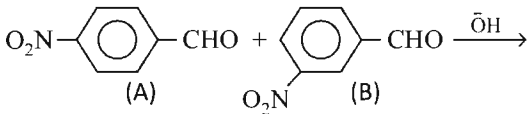
(A) The equivalent weight of CH_3CHO is 22

(B) Three moles of OH^- are required for 2 mole of $[Ag(NH_3)_2]^+$ and 1 mole of CH_3CHO

(C) Ag formed in the product appear as silver mirror

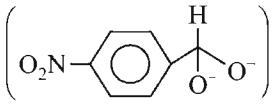
(D) α-hydroxyacetone cannot reduce $[Ag(NH_3)_2]^{\oplus}$

17. Which of the following statement(s) is(are) correct for Crossed Canizzaro reaction?

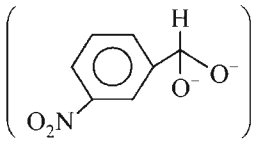


(A) OH^- attacks at the (C =O) group of (A) **(B)** OH^- attacks at (C = O) group of (B)

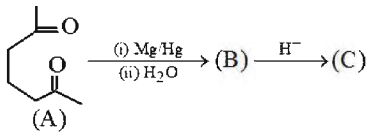
(C) The H^- ion transfer takes place from



(D) The $H^{\ominus}$ ion transfer takes place from



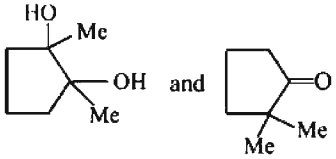
18. Which of the following statement(s) is(are) wrong about the given reaction?



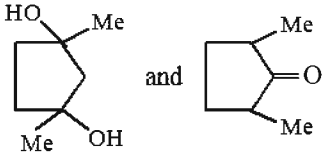
(A) Formation of (B) from (A) is called bimolecular reduction and takes place by radical anion mechanism

(B) Formation of (B) from (A) takes place by free radical mechanism.

(C) Product (B) and (C) respectively are



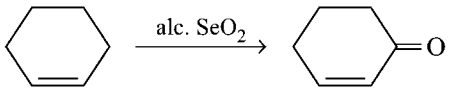
(D) Product (B) and (C), respectively, are



19. Which of the following sequence of reaction is(are) correct?

(A) $(CH_3)_2C = CHCOCH_3 \xrightarrow[(ii)\,H^+]{(i)NaOI} (CH_3)_2C = CH - CO_2H$

(B) $HCOOH \xrightarrow[Sod.Pot.tartarate]{Amm.CuSO_4} CO_2 + Cu_2O$ **(C)** $CH_3COCH_3 \xrightarrow{SeO_2/CH_3COOH} CH_3COCHO$

(D) 

20. Go through the list of following pair of compounds

1. $Ph - CH = CH - CH_2 - OH$ and $Ph - CH = CH - CHO$

2. $CH_3 - CH_2 - CH_2 - CH_2 - CHO$ and $CH_3 - CH_2 - CO - CH_2 - CH_3$

3. $Ph - CH_2 - CHO$ and $Ph - CO - CH_3$

4. $Ph - CH_2 - CO - C_2H_5$ and $Ph - CH(OH) - CH_2 - CH_2 - CH_3$

Which of the following statement(s) is(are) correct for while distinguishing above pair of compounds?

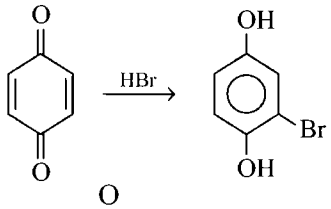
(A) All pairs can be distinguished by iodoform test

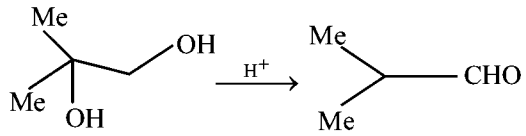
(B) All pairs can be distinguished by Tollen reagent test

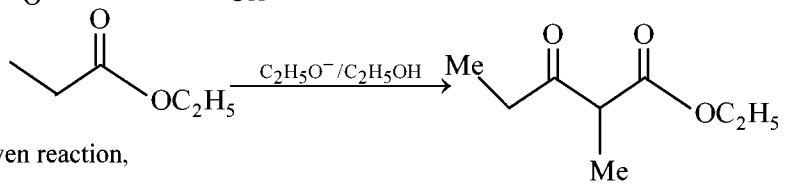
(C) Pair 1, 2, 3 can be distinguished by Tollen reagent test whereas pair 4 by DNP test

(D) Pair 3 can also be distinguished by iodoform test

21. Which of the following reaction(s) is(are) correct?

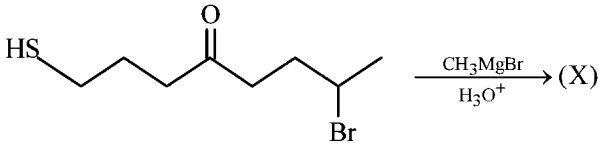
(A) 

(B) 

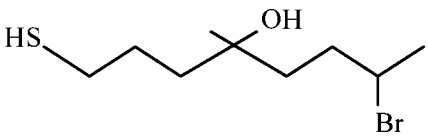
(C) 

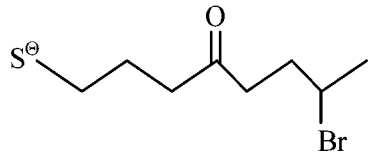
(D) None of these

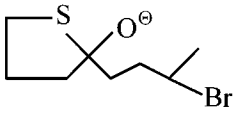
22. In the given reaction,

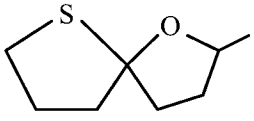


The product (X) and the intermediate(s) (I) involved is(are):

(A) (X): 

(B) (I) : 

(C) (I) : 

(D) (X) : 

23. Which of following is true for 3-methyl butan-2-one?

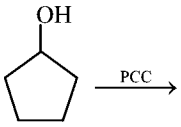
(A) This compound is an isomer of 4-penten-1-ol

(B) It may be prepared by acidic Hg^{+2} catalysed hydration of 3-methyl-1-butyne

(C) This compound on oxidation with I_2/NaOH followed by acidic hydrolysis gives propionic acid

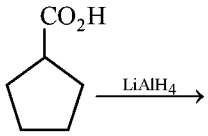
(D) It can be prepared by treating ethyl acetoacetate with two mole (C_2H_5ONa/CH_3I) and then followed by hydrolysis and heat.

24. Which of the following is(are) method(s) to prepare cyclopentanone?

(A) 

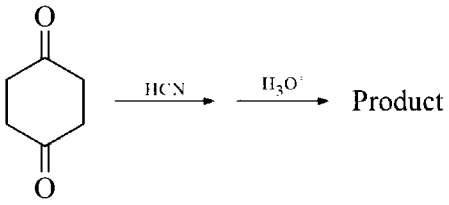
(B) $HO_2CCH_2CH_2CH_2CH_2CO_2H \xrightarrow{BaO,\Delta}$

(C) $CH_3CH_2CH_2CH_2-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[\text{Quinoline+S}]{Pd/BaSO_4}$

(D) 

25. Which of the following reagent will give similar type of reaction with formaldehyde, acetaldehyde, benzaldehyde and acetone?

(A) HCN **(B)** NH_2NH_2 **(C)** $NaHSO_3$ **(D)** NH_3

26. 

The correct statements about products is/are

(A) The product are optical inactive **(B)** The product is meso compound

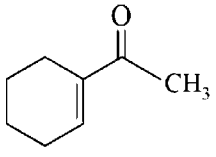
(C) The product is mixture of two enantiomers **(D)** Product exist in two diastereomeric forms

27. Which of the following aldol reaction product is correctly mentioned?

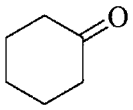
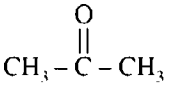
(A) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H+CH_3-CH_2-CHO \xrightarrow[\Delta]{\ominus OH} CH_3-CH_2-CH=\underset{CH_3}{\overset{|}{C}}-CHO$

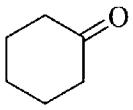
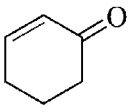
(B) $PhCHO+Ph-\overset{O}{\overset{\|}{C}}-CH_2-CH_3 \xrightarrow[\Delta]{\ominus OH} Ph-CH=\underset{CH_3}{\overset{|}{CH}}-\overset{O}{\overset{\|}{C}}-Ph$

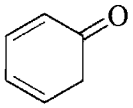
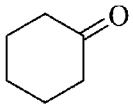
(C) $PhCHO+CH_3COCH_3 \xrightarrow{\Delta} Ph-CH=CH-\overset{O}{\overset{\|}{C}}-CH_3$

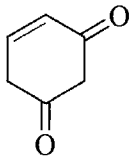
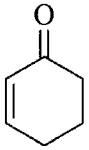
(D) $CH_3-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-H \xrightarrow[\Delta]{\ominus OH}$ 

28. Among the given pairs, in which pair second compound has less enol content:

(A)  and 

(B)  and 

(C)  and 

(D)  and 

29. Observe the following reaction $CH_3-\underset{\underset{O}{\|}}{C}-CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow{HCN\,(excess)} \xrightarrow{\overset{\oplus}{H_3O}/\Delta}$ Products.

The correct statement is:

(A) The product is a mixture of two compounds

(B) The product is optically inactive

(C) The product is a mixture of two chiral and one achiral stereoisomer

(D) The product is a mixture of three steroisomers

30. The following conversion is/are possible by

$$Ph-CH_2-CH=O \longrightarrow \overset{(Phenyl\,alanine)}{Ph-CH_2-\underset{\underset{NH_2}{|}}{CH}-COOH}$$

(A) $\xrightarrow{KCN/H_2O} \xrightarrow{NH_3,\,\Delta} \xrightarrow{H_3O^{\oplus},\Delta}$

(B) $\xrightarrow{KCN/NH_4Cl} \xrightarrow{H_3O^{\oplus},\Delta}$

(C) $\xrightarrow{HCN/NaOH} \xrightarrow{SOCl_2} \xrightarrow{NH_3} \xrightarrow{H_3O^{\oplus},\Delta}$

(D) $\xrightarrow{Br_2/CH_3COOH} \xrightarrow{NH_3} \xrightarrow{CrO_3/H^{\oplus}}$

31. In the given reaction which one of the following statement is correct:

$$C_6H_5-\underset{\underset{CH_3}{|}}{C}=O+NH_2-OH \longrightarrow Oxime \xrightarrow{PCl_5} Amide$$

(A) Oxime may be E/Z

(B) Amide on hydrolysis gives a mixture of acetic acid, benzoic acid, Aniline and methylamine

(C) Preparation of oxime is nucleophilic addition followed by elimination reaction

(D) Oxime and amides are isomers

32. Which of the following will give 3-pentanone

(A) $(CH_3-CH_2COO)_2Ca \xrightarrow{\Delta}$

(B) $CH_3-CH_2-C\equiv N \xrightarrow[(2)\ H_3O^+]{(1)\ CH_3-CH_2-MgBr}$

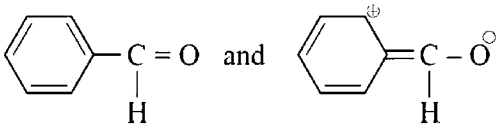
(C) $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-OC_2H_5 \xrightarrow[(2)\ NaOH(CaO)]{(1)\ H_2O/H^+}$

(D) $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\underset{\underset{CH_3}{|}}{CH}-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{\Delta}$

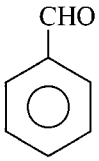
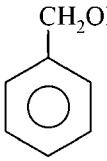
33. The tautomeric pairs are:

(A) $Me_2C=NOH$ and $Me_2CH-N=O$

(B) $CH_2=CH-NHCH_3$ and $CH_3-CH=N-CH_3$

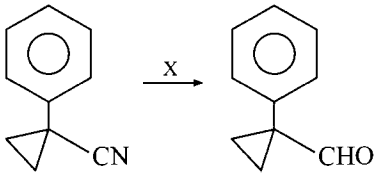
(C)  and

(D) $CH_2=CH-\underset{\underset{OH}{|}}{CH}-CH_3$ and $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

34.  can be reduced to  by the reagents:

(A) $LiAlH_4$ **(B)** $NaBH_4$

(C) Red P + HI **(D)** H_2 / Pd

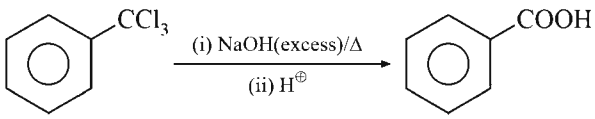
35. 

X can be:

(A) $LiAlH_4$ / ether / H_2O **(B)** $NaBH_4$ / C_2H_5OH

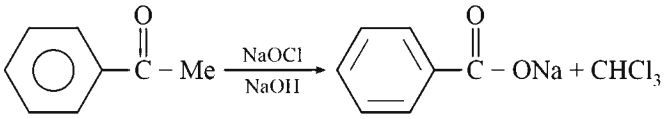
(C) DIBAL - H **(D)** $SnCl_2$ / HCl

36. Identify the reactions having correct products:

(A) 

(B) $CCl_3CHO \xrightarrow[(ii)\ H^{\oplus}]{(i)\ NaOH(excess)} HOOC-CHO$

(C) $CH_3-\underset{\underset{O}{\|}}{C}-CBr_3 \xrightarrow[(ii)\ H^{\oplus}]{(i)\ NaOH(excess)/\Delta} CH_3COOH + CHBr_3$

(D) 

37. Which of the following products is/are correctly mentioned in the following reactions?

(A) $HCHO \xrightarrow{NaOD} HCOONa + CH_3OD$ **(B)** $HCDO \xrightarrow{NaOH} DCOONa + CH_2DOH$

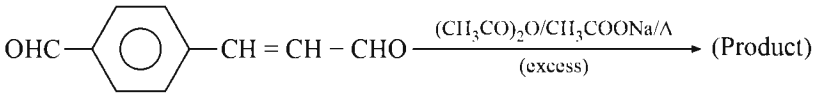
(C) $HCDO \xrightarrow{NaOEt} DCOOEt + DCH_2ONa$ **(D)** $D_2CO \xrightarrow{NaOD} DCOONa + CD_3OD$

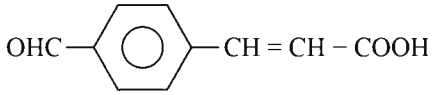
38. The true statement about the major product of $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-H$ in reaction with aq. NaOH are:

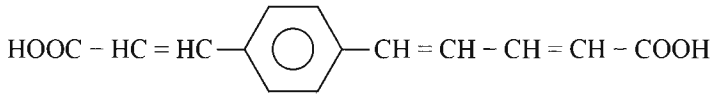
(A) It gives yellow ppt with $I_2/\overset{\ominus}{O}H$ **(B)** It gives silver mirror with Tollen's reagent

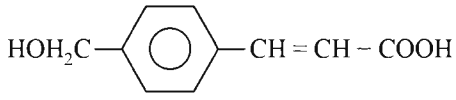
(C) It shows stereoisomerism **(D)** It does not give yellow ppt with 2, 4 DNP

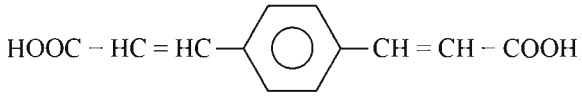
39. The product of following reaction is:

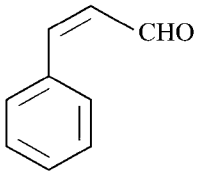


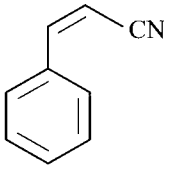
(A) 

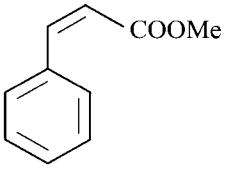
(B) 

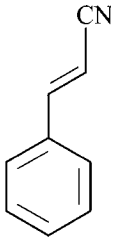
(C) 

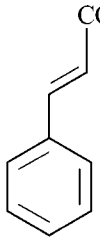
(D) 

40. X $\xrightarrow[2.\ H_2O]{1.\ DiBAL\text{-}H}$  X is:

(A) 

(B) 

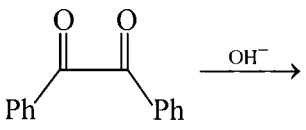
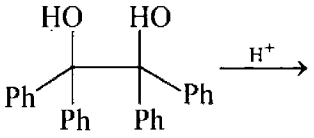
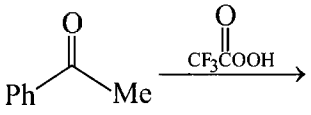
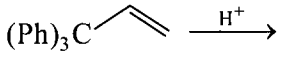
(C) 

(D) 

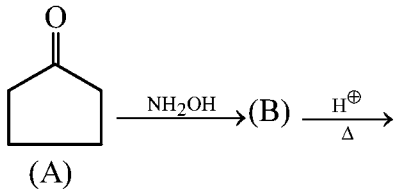
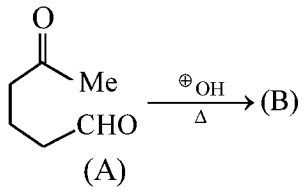
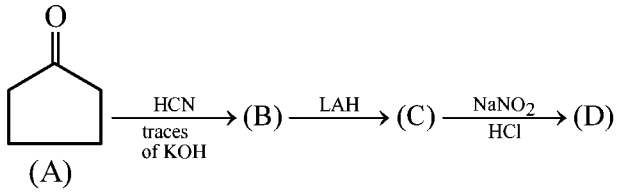
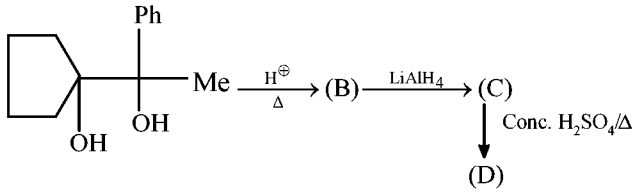
MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

41. MATCH THE FOLLOWING COLUMNS:

Column 1		Column 2	
(A)		**(p)**	Intermolecular migration.
(B)		**(q)**	Intramolecular migration.
(C)		**(r)**	Carbocation intermediate.
(D)		**(s)**	Rearrangement by phenyl shift.
		(t)	Free radical mechanism

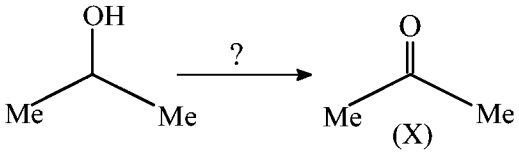
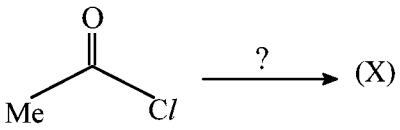
42. MATCH THE FOLLOWING:

	Column 1		Column 2
(P)		**(1)**	Final product is α, β– unsaturated ketone.
(Q)		**(2)**	Final product may further undergo polymerisation to give nylon type product.
(R)		**(3)**	Final Product do not have carbonyl group.
(S)		**(4)**	Sequence of reaction proceeded through formation of diazonium salt.

Codes :

	P	Q	R	S		P	Q	R	S
(A)	4	3	1	2	**(B)**	2	1	3	4
(C)	3	2	1	4	**(D)**	2	1	4	3

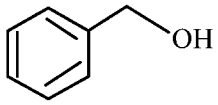
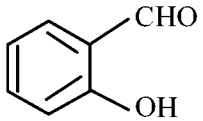
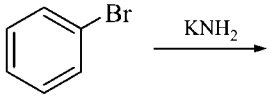
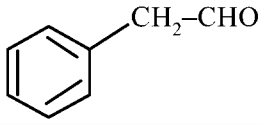
43. MATCH THE FOLLOWING :

	Column 1 [Reaction]		**Column 2** [Reagent]
(P)		**(1)**	Me_2Cd
(Q)	$Me-C\equiv C-H \xrightarrow{?} (X)$	**(2)**	$CH_3MgBr/H_3O^{\oplus}$
(R)		**(3)**	$(C_5H_5NH)_2Cr_2O_7/H^+$
(S)	$Me-C\equiv N \xrightarrow{?} (X)$	**(4)**	$HgSO_4 + H_2SO_4$

Codes

	P	**Q**	**R**	**S**		**P**	**Q**	**R**	**S**
(A)	3	4	2	1	**(B)**	2	3	1	4
(C)	3	4	1	2	**(D)**	4	1	3	2

44. MATCH THE COLUMN :

	Column 1 [Substrate]		**Column 2** [Substrate could undergo]
(P)		**(1)**	Nucleophilic Addition.
(Q)		**(2)**	Substitution by benzyne mechanism.
(R)		**(3)**	Self condensation reaction in presence of alkali.
(S)		**(4)**	Dehydrogenation.

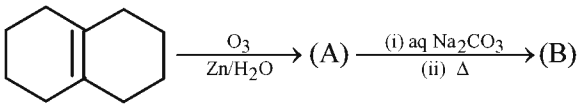
Codes :

	P	**Q**	**R**	**S**		**P**	**Q**	**R**	**S**
(A)	1	3	2	4	**(B)**	4	1	3	2
(C)	4	1	2	3	**(D)**	1	2	4	3

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

45. Go through the following sequence of reactions:



Ratio of degree of unsaturation of (B) to number of π-bonds in (B) is _____.

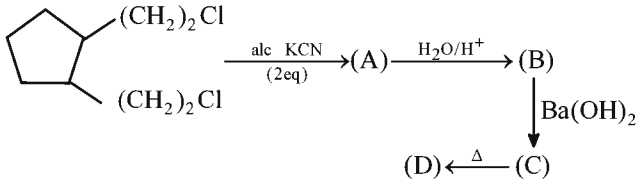
46. During ozonolysis of mixture of 2 mol each of m–xylene and o–xylene, maximum no of moles of methyl glyoxal generated is/are_____.

47. The number of product(s) formed when smallest ketone and its next homologue are reacted with NH_2OH in acidic medium is/are_____

48. Acetone and butan-2-one undergoes both self and cross aldol(ketol)condensation to give aldol(ketol) products which on heating loses water to give α, β unsaturated ketones. The number of α, β unsaturated products formed (excluding stereoisomers) _____.

49. Number of N–C–N bonds present in urotropine are _____.

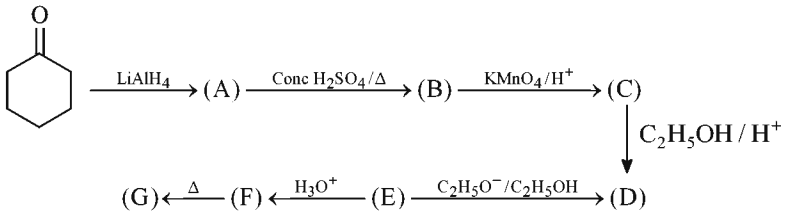
50.



Degree of unsaturation in final product (D) is _____

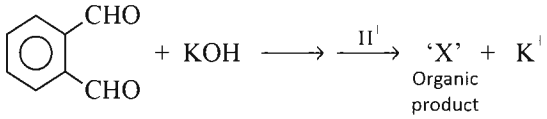
51. In the following list of compounds, how many will give negative Iodoform test?
Acetamide, Methyl acetate, Acetone, Acetic acid, 2,2-dichloropropane, Isopropyl alcohol, Acetic anhydride, Benzaldehyde, Diethyl ketone, t-butyl alcohol, Benzyl alcohol.

52.



In the above sequence of reactions from (A) to (G), how many compound(s) is(are) cyclic?

53. Consider the following reaction.

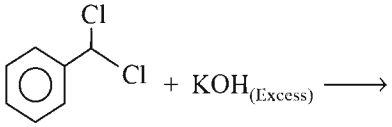


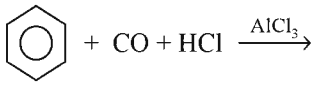
What is the value of half of difference of molecular mass of organic product 'X' and molecular mass of reactant? [Given: Atomic mass H = 1, C = 12, O = 16, K = 39]

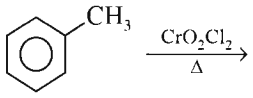
54. How many isomeric products are obtained on reaction of 2-butanone with hydroxyl amine in acidic medium?

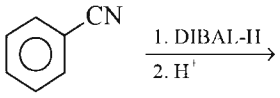
55. Formaldehyde on reaction with 50% KOH by mass undergoes disproportionation. What is order of disproportionation reaction of formaldehyde with KOH?

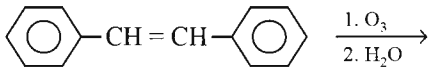
56. How many of the following reactions produce benzaldehyde?

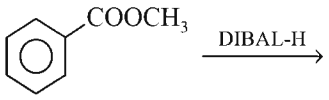
(i) 

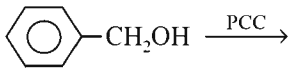
(ii) 

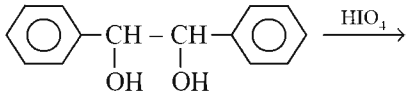
(iii) 

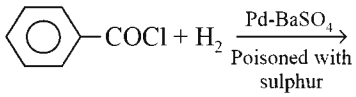
(iv) 

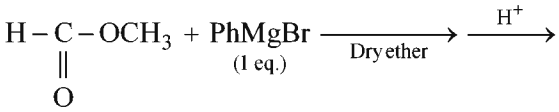
(v) 

(vi) 

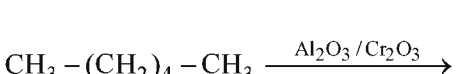
(vii) 

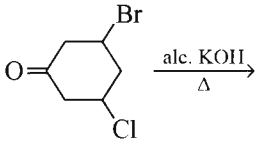
(viii) 

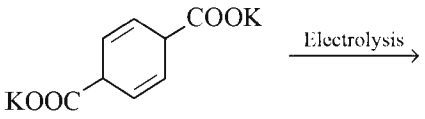
(ix) 

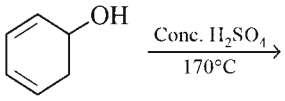
(x) 

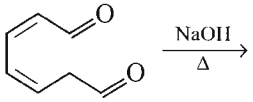
57. How many of the following reactions produce an aromatic compound as major product?

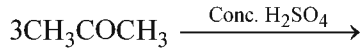
(i) 

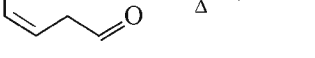
(ii) 

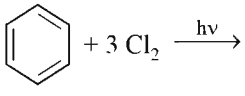
(iii) 

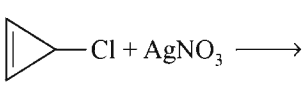
(iv) 

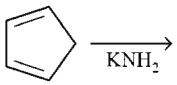
(v) 

(vi) 

(vii) 

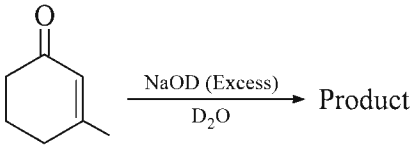
(viii) 

(ix) 

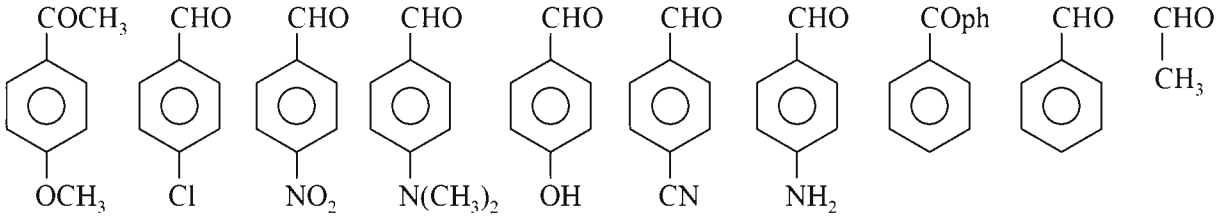
(x) 

58. How many aldol products may be formed by the reaction of CH_3CH_2CHO and $CH_3COCH_2CH_3$?

59. How many deuterium atoms are present in product of the following reaction?



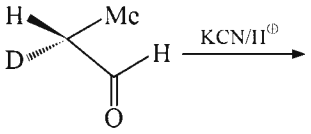
60. How many of the following compounds are more reactive toward nucleophilic addition reaction than p-methyl benzaldehyde?



61. How many isomeric ketone having molecular mass equal to 100 on reaction with methyl magnesium bromide followed by acidification produce mixture of diastereomeric alcohols?

62. How many substituted phenols are possible with the molecular formula $C_8H_{10}O$.

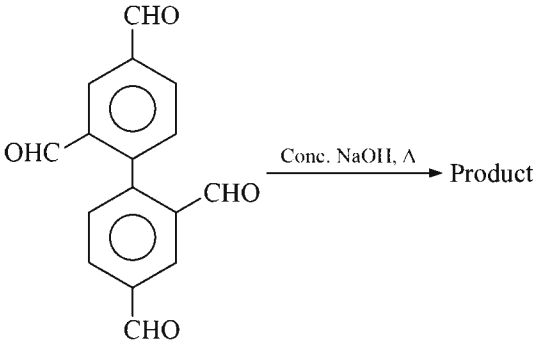
63. Total number of products formed in the following reaction is:



64. $CH_3-CH=O+CH_3CH_2-CH=O \xrightarrow{HO^-/\Delta}$ mixture of aldols

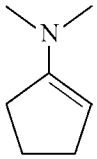
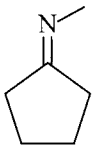
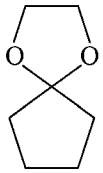
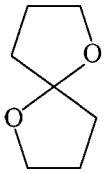
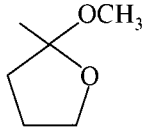
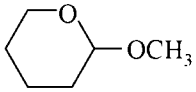
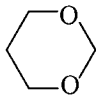
The number of aldols including stereoisomers are:

65.

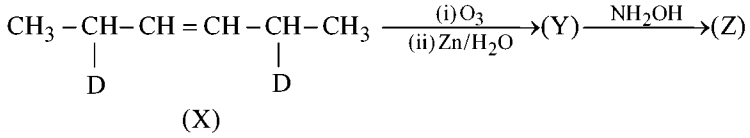


Find the total number of possible products formed in the above reaction.

66. How many of the following on hydrolysis produce hydroxy carbonyl compound?

1. 
2. 
3. 
4. 
5. 
6. 
7. 

67. In the following sequence of reactions all stereoisomers of (X) have been taken.

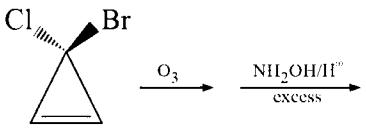


(X)

Here P = Total number of stereoisomers of X

Q = Total number of stereoisomers of Y

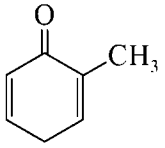
R = total number of stereoisomers of Z

68. 

The total number of isomeric products (including stereoisomers) formed at the end of the reaction is:

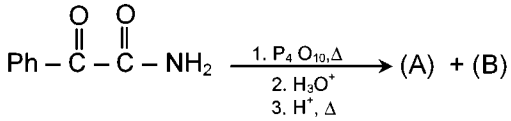
69. How many aldol products are possible (structural only) when mixture of HCHO, CH_3CHO and $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ are reacted in dilute NaOH?

70. How many enol forms are possible for $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$?

71. The number of deuterium atoms found in the tautomer of  when it is kept in $OD^{\ominus}$ / D_2O for a long period of time?

SINGLE CORRECT ANSWER TYPE

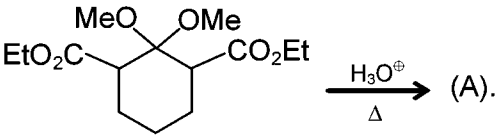
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. 

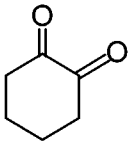
The products of the given reaction are:

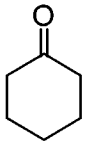
(A) $PhCOCO_2H + NH_3$ **(B)** $PhCO_2H + CO$

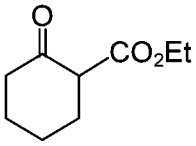
(C) $PhCOCH_3 + CO_2$ **(D)** $PhCO_2H + CO_2$

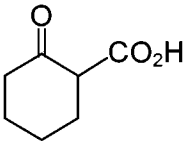
2. 

Product (A) obtained is:

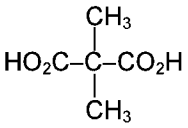
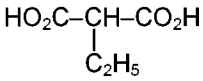

(A)

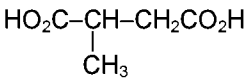

(B)

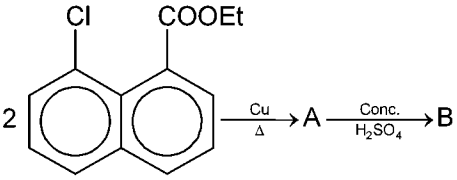

(C)


(D)

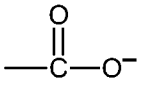
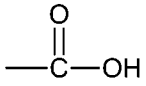
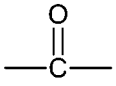
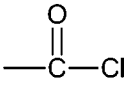
3. Identify the dicarboxylic acid having molecular formula $C_5H_8O_4$, which is chiral, form cyclic anhydride and does not decarboxylate.

(A)  **(B)** 

(C)  **(D)** $HO_2CCH_2CH_2CH_2CO_2H$

4. 

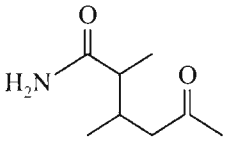
The functional group present in B is/are:

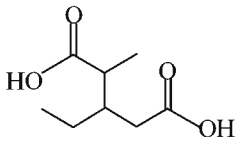
(i)  (ii)  (iii)  (iv) 

(A) (i) and (iii) **(B)** (ii) only **(C)** (iii) only **(D)** (i) and (iv)

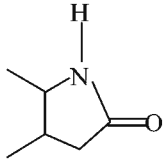
5. A compound A when reacted with PCl_5 and then with ammonia gave B. B when treated with bromine and caustic potash produced C. C on treatment with $NaNO_2$ and HCl at 0°C and then boiling produced ortho cresol. Compound A is:

(A) o-toluic acid **(B)** o-chlorotoluene **(C)** o-bromotoluene **(D)** m-toluic acid

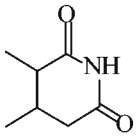
6.  $\xrightarrow[2.\ H^+,\Delta]{1.\ NaOH,\ Br_2}$ product. The main product is:



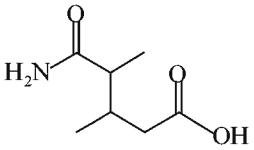
(A)



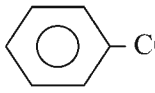
(B)

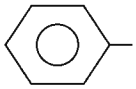
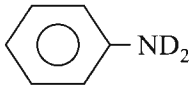


(C)

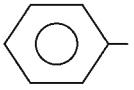
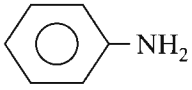


(D)

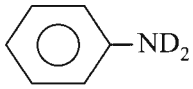
7. Y $\xleftarrow[2.\ KOH,Br_2/H_2O,\ \Delta]{1.\ NH_3,\ \Delta}$  $\xrightarrow[2.\ KOH,Br_2/H_2O,\ \Delta]{1.\ ND_3,\ \Delta}$ X. What are X and Y :

X is  ; Y is 

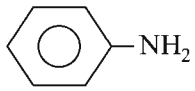
(A)

X is  ; Y is 

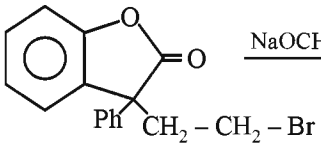
(B)

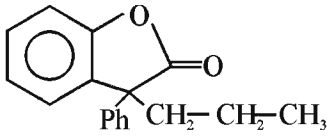
Both 

(C)

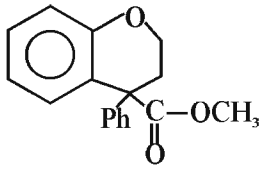
Both 

(D)

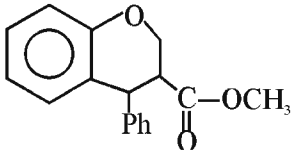
8.  $\xrightarrow{NaOCH_3}$ Product is :



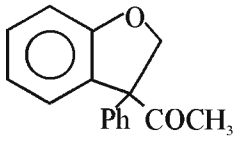
(A)



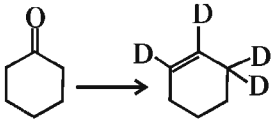
(B)



(C)



(D)

9. 

Arrange the following reagents in the correct order in which above transformation is carried out:

(A) KOD/D_2O, $LiAlD_4$/Ether, $H_2O/H^+/\Delta$ **(B)** $H_2O/H+/\Delta$, KOD/D_2O, $LiAlD_4$/Ether

(C) KOD/D_2O, $H_2O/H^+/\Delta$, $LiAlD_4$/Ether **(D)** $LiAlD_4$/Ether, $H_2O/H^+/\Delta$, KOD/D_2O

10. Which of the following order are correct?

I. Acidity order: *o*-nitrobenzoic acid > *p*-nitrobenzoic acid > *m*-nitrobenzoic acid

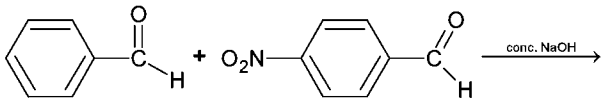
II. Basicity order: NH_2^- > EtO^- > OH^- > $RCOO^-$ > Cl^-

III. Heat of hydrogenation: cis-2-butene > trans-2-butene

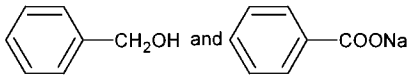
IV. Ease of decarboxylation:

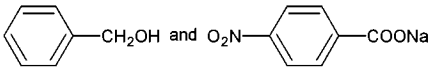
$$C_6H_5COCOOH > Ph-\underset{\underset{O}{\|}}{C}-CH_2-COOH > Ph-\underset{\underset{OH}{|}}{CH}-COOH > Ph-\underset{\underset{NH_2}{|}}{CH}-COOH$$

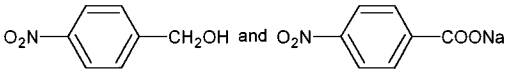
(A) I and II **(B)** I and III **(C)** I and IV **(D)** I, II and III

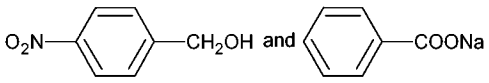
11. 

The products likely to be obtained are:

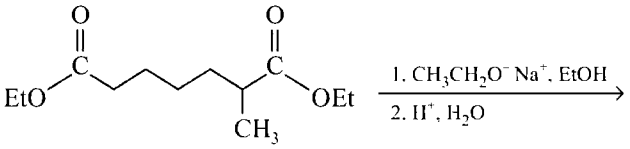
(A) 

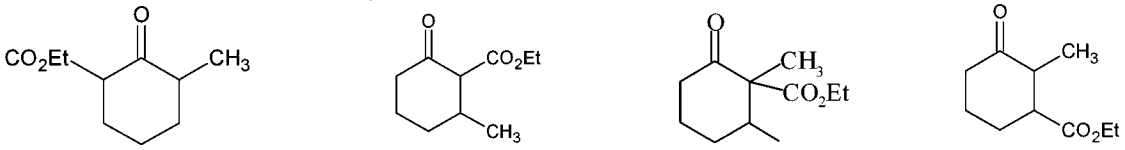
(B) 

(C) 

(D) 

12. Predict the product for the following reaction:





(A) **(B)** **(C)** **(D)**

13. Which of the following will be oxidized by HIO_4?

(1) **(2)** **(3)** **(4)**

Select the correct answer using the codes below:

(A) 1, 2 and 3 **(B)** 1, 3 and 4 **(C)** 1, 2 and 4 **(D)** 2, 3 and 4

14. $Ph-\underset{14}{C}(=O)-C(=O)-OH \xrightarrow[H_2SO_4/\Delta]{conc.}$?. The product (after hydrolysis) is:

(A) $Ph\overset{14}{C}OOH + CO$ **(B)** $PhCOOH + \overset{14}{C}O$ **(C)** $Ph\overset{14}{C}HO + CO_2$ **(D)** $PhCHO + \overset{14}{C}O_2$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

15. Which of the following reactions are used for the preparation of aldehyde only:

(A) $R-C\equiv N \xrightarrow[(ii)\ H_3O^+]{(i)\ Sn+HCl}$ Product

(B) $RCH_2OH \xrightarrow[CH_2Cl_2]{PCC}$ Product

(C) $RCOCl \xrightarrow{LiAlH(t\text{-}BuO)_3}$ Product

(D) $RCOCl + H_2 \xrightarrow[S\text{ or Quinoline}]{Pd\text{-}BaSO_4}$ Product

16. Compound (A) $C_8H_8O \xrightarrow[HCl]{\text{Boil } NH_2OH} \underset{\text{Geometrical isomers}}{B + C}$; $C \xrightarrow{H^+} D$

$$B \xrightarrow{H^+} E \xrightarrow[(ii)H^+/H_2O]{(i)\text{Boil KOH}} \underset{\text{(White solid)}}{G(C_7H_8O_2)}\ ;\ D \xrightarrow[(ii)H^+/H_2O]{\text{Boil. KOH}} \underset{\text{(Oil)}}{F(C_6H_7N)} \xrightarrow[\Delta]{CH_3COOH} D$$

[B, C, D and E are isomeric having molecular formula C_8H_9NO]:

(A) Compound (A) is an aldehdye and can give (+ve) Tollen's test.

(B) Compound (D) and (E) can show geometrical isomerism.

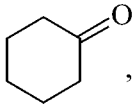
(C) Compound (A) is an aromatic ketone having structure $PhCOCH_3$

(D) Compound (G) is more acidic than CH_3COOH.

17. $CH_2 = CH - CHO \longrightarrow CH_2 = CH - COOH$. Which of the following reagents can be used to carry out the above reactions?

(A) Tollen's reagent

(B) Fehling Solution

(C)  , $Al(OCHMe_2)_3$

(D) $KMnO_4 / H_2SO_4 / \Delta$

18. Consider the following reaction sequence : $(B) \xleftarrow{2CH_3MgBr / H_3O^+} (A) \xrightarrow{H_3O^+} CH_3-\underset{CH_3}{\underset{|}{CH}}COOH$

Which of the following statements are true?

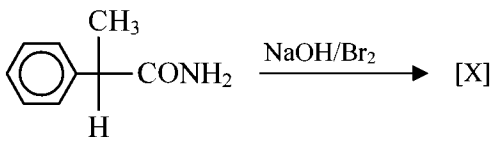
(A) Compound (A) can be $CH_3-\underset{CH_3}{\underset{|}{CH}}COOC_2H_5$

(B) Compound (A) can be $CH_3\underset{CH_3}{\underset{|}{CH}}COOC_6H_5$

(C) Compound (B) can be $CH_3-CH(CH_3)-\underset{CH_3}{\overset{OH}{\overset{|}{C}}}-CH_3$

(D) Compound (B) can be $CH_3-\underset{MgBr}{\overset{CH_3}{\overset{|}{C}}}-COOC_6H_5$

19. Which of the following statements are true about the major product (X) in the reaction?



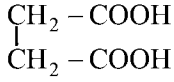
(A) (X) is a cyclic amide

(B) (X) has an asymmetric centre

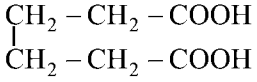
(C) (X) is a primary amine

(D) (X) can also be obtained by treatment of NH_3 with $C_6H_5\underset{CH_3}{\underset{|}{CH}}-Br$

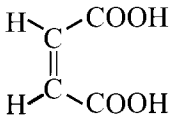
20. Which of the following compounds form anhydrides on heating?



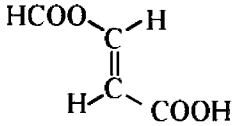
(A)



(B)



(C)



(D)

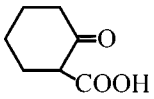
21. Acetophenone is oxidised by peroxyacetic acid followed by acid catalysed hydrolysis to give two products (I) and (II). Identify the products (I) and (II).

(A) (I) is benzoic acid **(B)** (II) is phenol

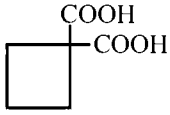
(C) (I) is acetic acid **(D)** (II) is methanol

22. Which of the following compounds are expected to undergo decarboxylation just by heating?

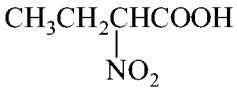
(A)



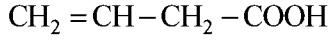
(B)



(C)



(D)

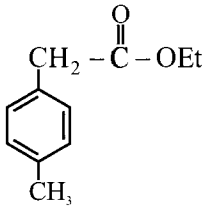


23. Which of the following compounds undergo cyclisation on heating?

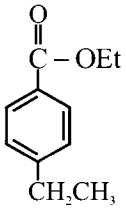
(A) Lactic acid **(B)** Fumaric acid

(C) Alanine **(D)** Pyruvic acid

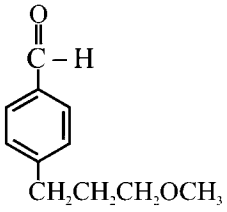
24. A compound (M. F $C_{11}H_{14}O_2$) on hydrolysis gives a product, which on oxidation with acidified $KMnO_4$ gives terephthalic acid. The compound could be:



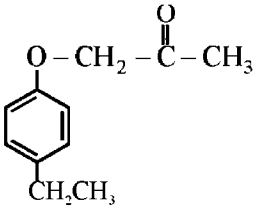
(A)



(B)

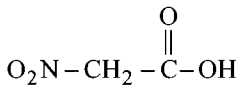


(C)

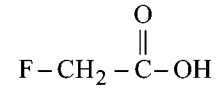


(D)

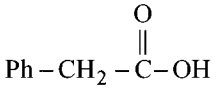
25. Consider the following compounds



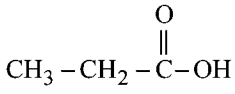
(I)



(II)



(III)



(IV)

Which statement is/are correct:

(A) I > II > III > IV (Acidic strength order)

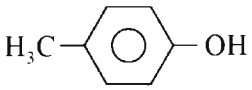
(B) I is most acidic because of –M effect of $-NO_2$ group

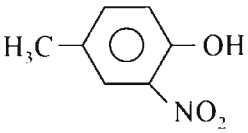
(C) I is most acidic because of –I effect of $-NO_2$ group

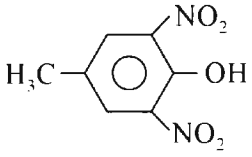
(D) IV is least acidic because of +I effect

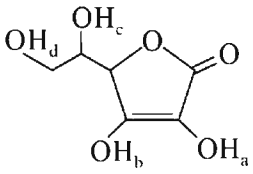
26. Carbolic acid is less acidic than:

(A) CH_3COOH

(B) 

(C) 

(D) 

27. 

Observe the compound and choose correct statement:

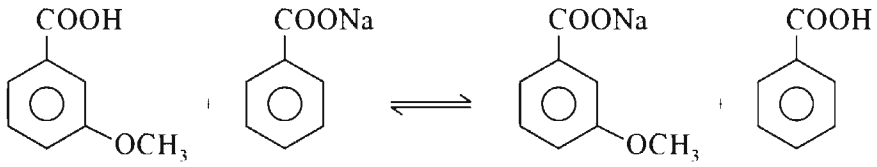
(A) It has carboxylic acid group

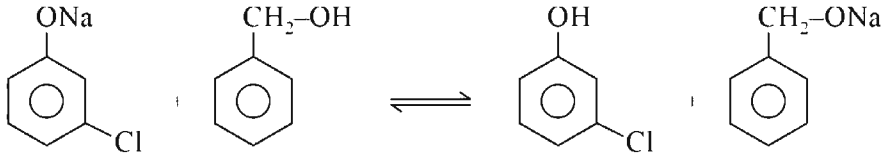
(B) It is Ascorbic acid

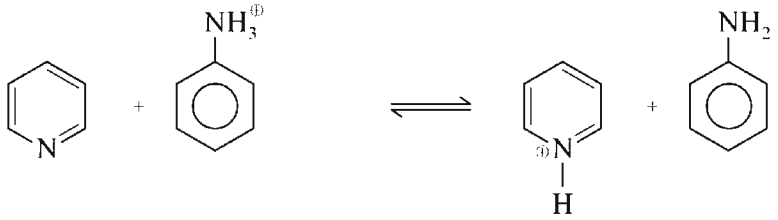
(C) H_b is most acidic Hydrogen atom

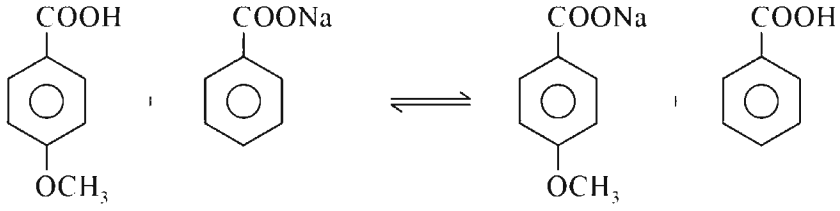
(D) H_a is least acidic Hydrogen atom

28. Which of the following reactions favour backward direction?

(A) 

(B) 

(C) 

(D) 

29. In which reaction product is hydrocarbon?

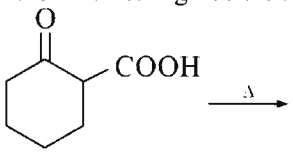
(A) $CH_3COOK \xrightarrow{\text{Electrolysis}}$

(B) $CH_3COOAg \xrightarrow{Br_2/CCl_4}$

(C) $Ph-COOH \xrightarrow[CaO,\Delta]{NaOH}$

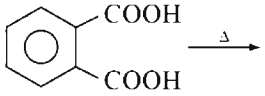
(D) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-Cl \xrightarrow{C_2H_5OH}$

30. Which of them no heating liberate a gas which turns lime water milky?

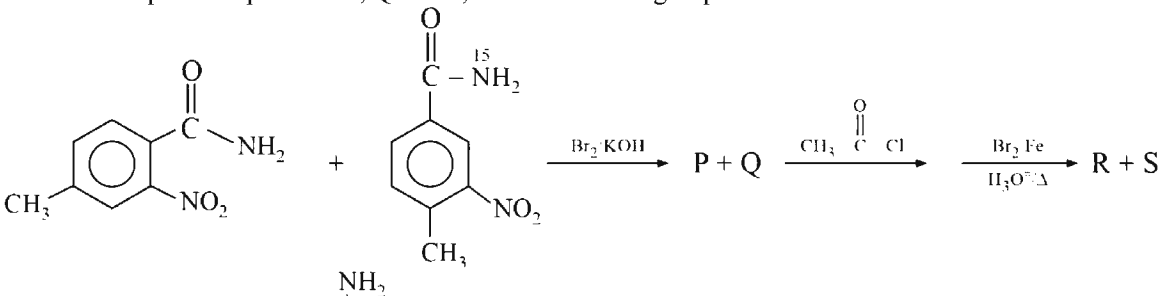
(A)  $\xrightarrow{\Delta}$

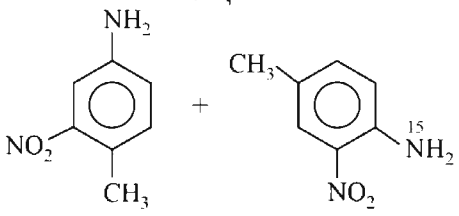
(B) $CH_3-\underset{\displaystyle COOH}{\overset{\displaystyle COOH}{\overset{|}{\underset{|}{CH}}}}-CH_3 \xrightarrow{\Delta}$

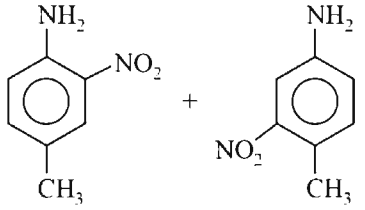
(C) $HOOC-(CH_2)_5-COOH \xrightarrow{Ca(OH)_2/\Delta}$

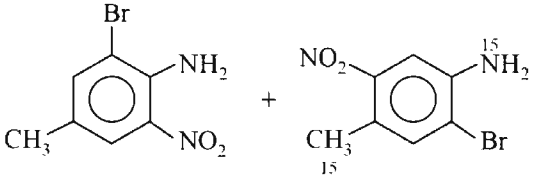
(D)  $\xrightarrow{\Delta}$

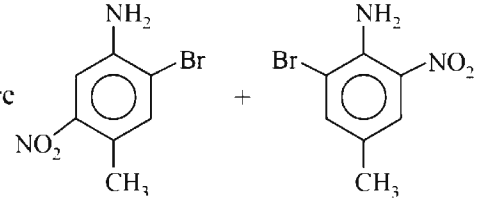
31. The correct option for products P, Q and R, S in the following sequence of reaction is/are:



(A) P & Q are 

(B) P & Q are 

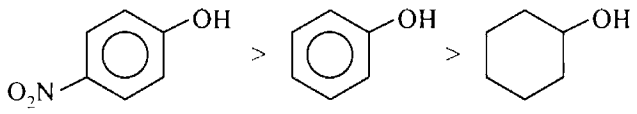
(C) R & S are 

(D) R & S are 

32. Which are correct against property mentioned?

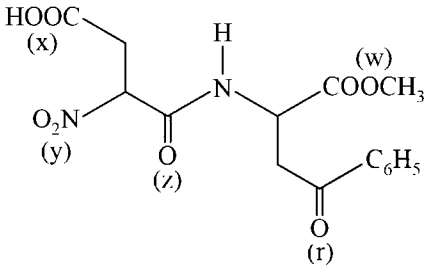
(A) $CH_3COCl > (CH_3CO)_2O > CH_3COOEt > CH_3CONH_2$ (Rate of hydrolysis)

(B) $CH_3-CH_2-COOH > CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}-COOH > CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\underset{|}{\overset{|}{C}}}}-COOH$ (Rate of esterification)

(C)  (Rate of esterification)

(D) $CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-COOH > CH_3-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-COOH > Ph-CH_2-COOH$ (Rate of decarboxylation)

33. Observe the following natural product and choose the correct statement(s):



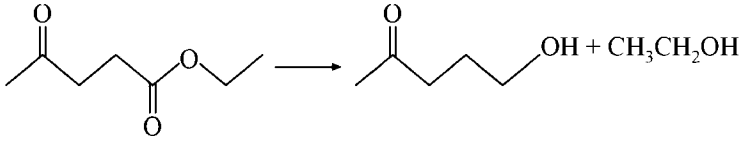
(A) $LiAlH_4$ will reduce x, y, z, w, r

(B) $NaBH_4$ will reduce r

(C) Na/C_2H_5OH will reduce r & w

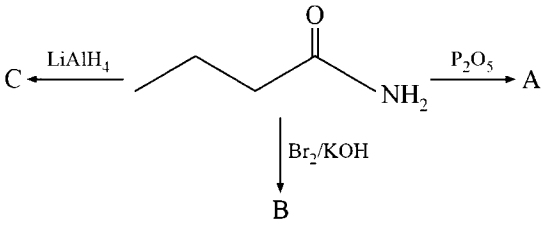
(D) $(CH_3)_2CHOH+[(CH_3)_2CHO]_3Al$, Δ(MPV) will reducer

34. Which of the following reagents are involved in the following transformation?



(A) $LiAlH_4$ **(B)** Acetone **(C)** Ethylene glycol **(D)** $H_3O^{\oplus}$

35. Correct statement about A, B and C is/are:



(A) A can be hydrolysed in basic medium

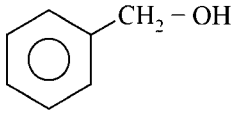
(B) B can form alcohol on treatment with aqueous $NaNO_2$ / HCl

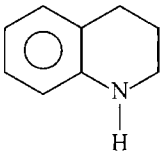
(C) C produces foul smell on treatment with chloroform in presence of base

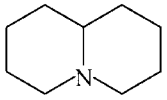
(D) Compound A, B and C have same number of C

36. Which of the following will not react with acetyl chloride $CH_3-\overset{\overset{O}{\|}}{C}-Cl$?

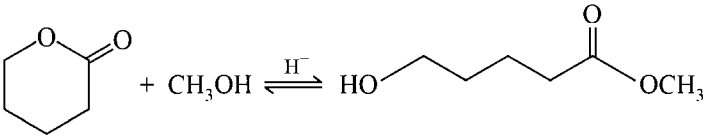
(A) H_2O

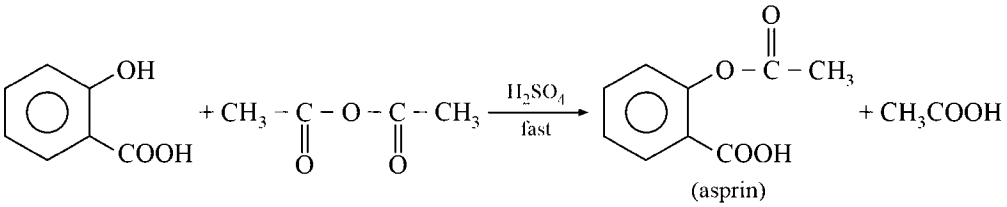
(B) 

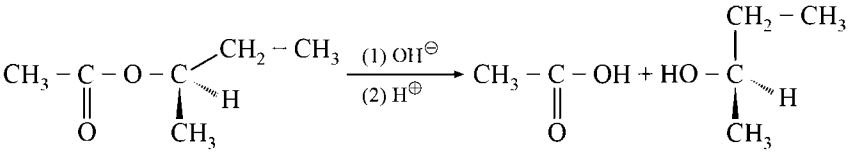
(C) 

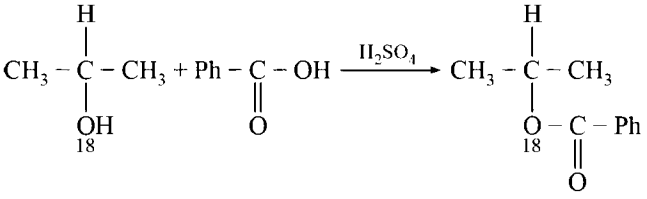
(D) 

37. In which of the following reactions correct major product is mentioned?

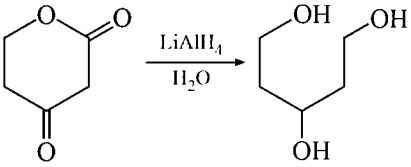
(A) 

(B) 

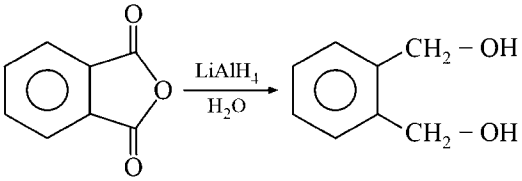
(C) 

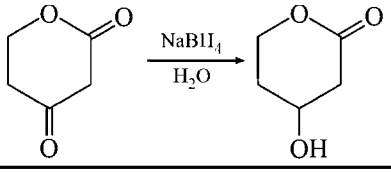
(D) 

38. Which of the following reaction is are correct?

(A) 

(B) $CH_3-C\equiv N \xrightarrow[H_2O]{LiAlH_4} CH_3-CH_2-NH_2$

(C) 

(D) 

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

39. Match the compounds in Column 1 with their experimental observation listed in column 2. Indicate your answer by darkening the appropriate bubbles of the 4 × 4 matrix given in the ORS:

	Column-1		**Column-2**
(A)	Acetic acid	**(p)**	Effervescence of CO_2 with $NaHCO_3$
(B)	Cinnamic acid	**(q)**	Decolourises Br_2 water
(C)	Formic acid	**(r)**	Colour with $FeCl_3$
(D)	2, 4, 6-Trinitro phenol	**(s)**	Silver mirror with Tollen's reagent

40. **MATCH THE FOLLOWING:**

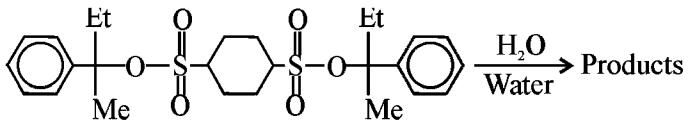
Column 1 (Reactions)		**Colum 2 (Reagents)**	
(A)	$C_6H_5-\overset{\overset{O}{\|\|}}{C}-Cl \longrightarrow C_6H_5-\overset{\overset{O}{\|\|}}{C}-H$	**(p)**	$HI + \text{red P}$
(B)	$C_6H_5-\overset{\overset{O}{\|\|}}{C}-Cl \longrightarrow C_6H_5-\overset{\overset{O}{\|\|}}{C}-CH_3$	**(q)**	CH_3Li
(C)	$C_6H_5-\overset{\overset{O}{\|\|}}{C}-OH \longrightarrow C_6H_5-\overset{\overset{O}{\|\|}}{C}-CH_3$	**(r)**	$H_2 + (Pd - BaSO_4)$
(D)	$C_6H_5-\overset{\overset{O}{\|\|}}{C}-OH \longrightarrow C_6H_5-CH_3$	**(s)**	$(CH_3)_2Cd$
		(t)	$(Zn - Hg) + HCl$

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

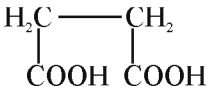
41. $CH_3CH=CHCHO \xrightarrow[\Delta]{OH^-} A \xrightarrow[HCl]{Zn/Hg} C(C_8H_{12})$

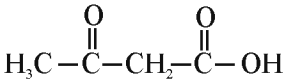
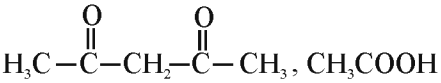
No. of stereo isomers possible for compound (C) are:

42. 

The total number of possible products (including stereoisomers) obtained in above reaction is:

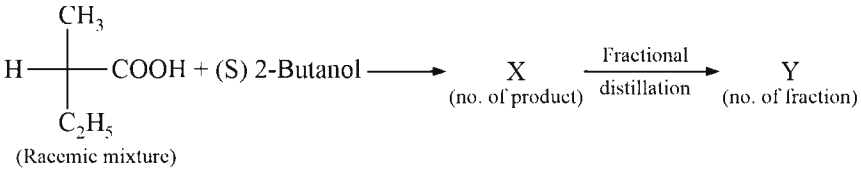
43. How many of following compound will evolve CO_2 on heating?

$HCOOH$, $(COOH)_2$, $CH_2(COOH)_2$ 

  , CH_3COOH

44. How many of the following contain carboxylic acid functional group?

Picric acid, Styphnic acid, Aspirin, Ascorbic acid, Penicillin, Valeric acid, Anthranilic acid, Carbolic acid

45. 

(Racemic mixture)

Report your answer as XY:

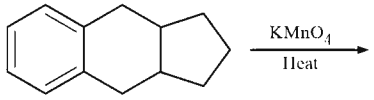
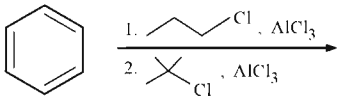
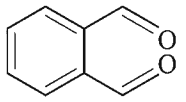
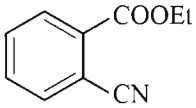
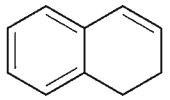
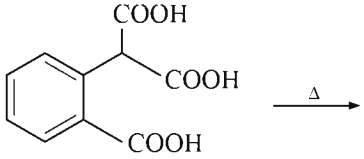
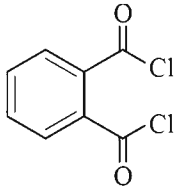
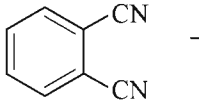
46. $\underset{(\pm)}{CH_3CHClCOOH} + CH_3 - CH_2 - OH \xrightarrow{H^+}$ Total number of ester 'M' $\xrightarrow[\text{Distilation}]{\text{Fractional}}$ Number of Fractions 'N'.

Report your answer as MN.

47. $CH_3CH_2CH = CH(CH_2)_2COOCH_3 \xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3} [(X)+(Y)] \xrightarrow[H_2O]{LiAlH_4}$ product mixture.

How many moles of ethanoic acid are required for complete esterification of the compounds present in the product mixture.

48. How many of the following reactions results in formation of phthalic acid?

1. 
   $KMnO_4$, Heat
2. 
   1. , $AlCl_3$
   2. , $AlCl_3$
   3. $KMnO_4$, heat
3. 
   1. Tollen's reagent
   2. H_3O^+
4. 
   1. DIBAL-H, Excess
   2. H_3O^+
   3. Fehling's solution
5. 
   1. O_3
   2. H_2O
   3. $KMnO_4$, heat
6. 
   Δ
7. 
   1. H_2–Pd/$BaSO_4$, Excess
   2. KOH
   3. H_3O^+
8. 
   1. CH_3MgBr, Excess
   2. H_3O^+
   3. I_2/NaOH, Excess
   4. H_3O^+

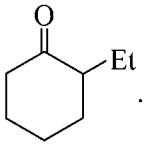
49. An aromatic tetracarboxylic acid $(C_{10}H_6O_8)$ can form two type of monoanhydrides on heating with P_4O_{10}. The sum of locants of all carboxylic groups in this compound will be:

50. $\begin{matrix} CH_2-Br \\ | \\ CH_2-Br \end{matrix} \xrightarrow[(1)]{CH_2(COOEt)_2/EtO^-/\Delta} \xrightarrow[(2)]{OH^{\ominus}/\Delta} \xrightarrow{\text{ester hydrolysis}} \xrightarrow{H^+/\Delta} \xrightarrow[\Delta]{NaOH/CaO} (P)$

Find out the molecular weight of end product (P).

51. A compound(P) with formula $C_4H_6O_2$ has a fruity smell. It produces no color with phenolphthalein. On adding NaOH to (P) and phenolphthalein mixture, a pink color is seen. But this color of phenolphthalein fades away slowly on reaction with (P). Number of possible structural isomers for (P) is:

52. The compound 'X' is composed of carbon, hydrogen and oxygen. It has 2 geometrical isomers. It has 4 stereoisomers. All 4 stereoisomers are optically active. If X is the smallest alkenoic acid which satisfies all these conditions then find number of carbon present in compound X.

53. Total number of β – Keto monocarboxylic acids (including stereoisomers) which on heating give 

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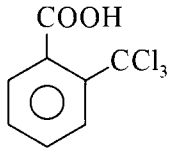
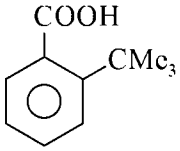
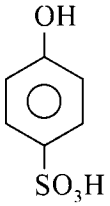
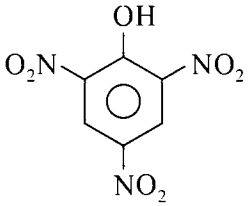
54. How many organic compounds (given below) react with $NaHCO_3$ and liberate CO_2 ?

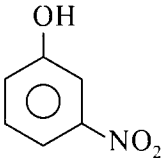
CCl_3-COOH $\quad$ CH_3-CH_2-OH $\quad$ 

$\quad$ HCl





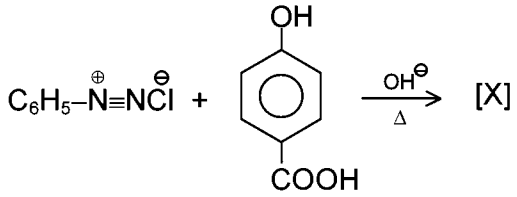




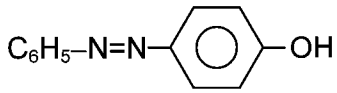
SINGLE CORRECT ANSWER TYPE

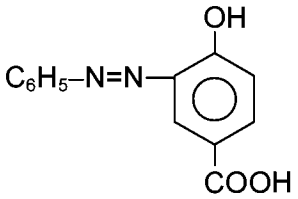
Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

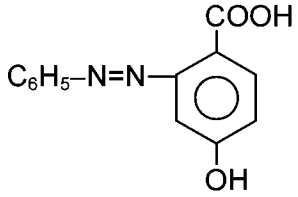
1. In the given reaction,

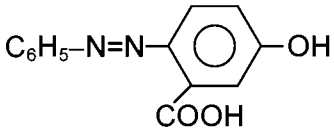


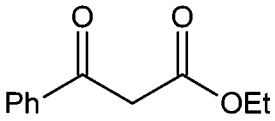
Product [X] will be:

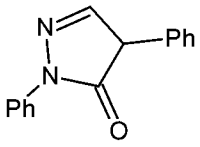
(A) 

(B) 

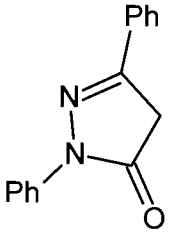
(C) 

(D) 

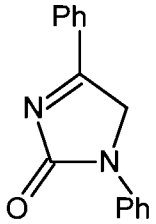
2.  $\xrightarrow{PhNHNH_2}$ Product X, X is



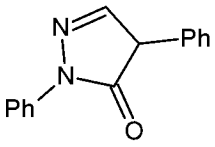
(A)



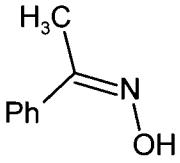
(B)

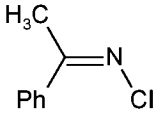


(C)

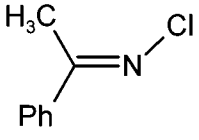


(D)

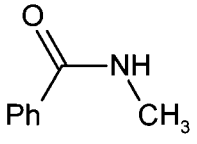
3.  $\xrightarrow{PCl_5}$ X, X is



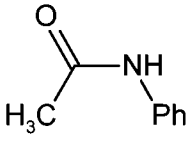
(A)



(B)



(C)



(D)

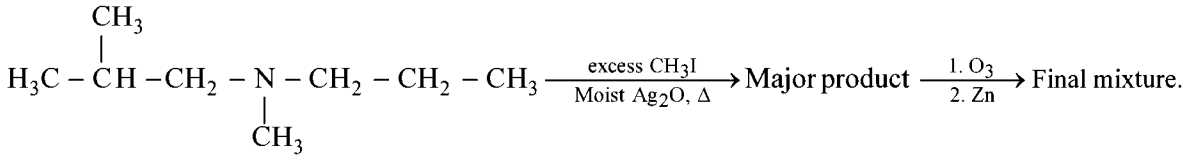
4. Benzene diazonium chloride on reaction with phenol in weakly basic medium gives and the reaction is:

(A) diphenyl ether, nucleophilic addition

(B) p-hydroxy azobenzene, electrophilic substitution

(C) chlorobenzene, electrophilic addition

(D) benzene, elimination

5. 

The final product mixture contains:

(A) $CH_3CHO + CH_3COCH_3$

(B) $2CH_2CHO + CH_3COCH_3 + HCHO$

(C) $CH_3CHO + HCHO$

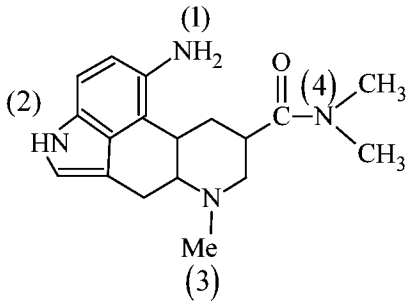
(D) $CH_3CHO + CH_3COCH_3 + 2HCHO$

6. All the molecules drawn below are natural compounds, which does not contain a formal positive charge and formal negative charge?

(A) $(CH_3)_3N— B(CH_3)_3$ **(B)** $(CH_3)_2N—OCH_3$

(C) $CH_2 = N = N$ **(D)** $(CH_3)_3N—O$

7. In the given compound, arrange the nitrogen according to their decreasing basic strength

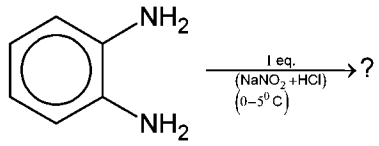


(A) 1 > 2 > 3 > 4

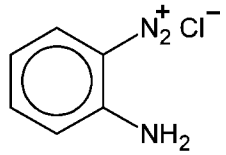
(B) 4 > 3 > 1 > 2

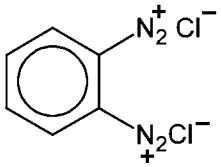
(C) 2 > 4 > 1 > 3

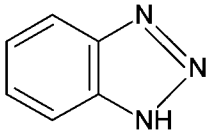
(D) 3 > 4 > 1 > 2

8. 

The product formed is:

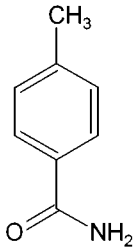
(A) 

(B) 

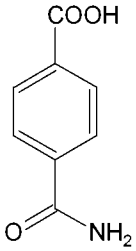
(C) 

(D) None of these

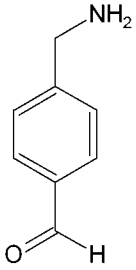
9. An organic compound C_8H_9NO is found to be insoluble in dilute acid and base. On treatment with $KMnO_4/H_2SO_4$, the compound formed is devoid of nitrogen and is soluble in $NaHCO_3$ and on nitration produces mono nitrosubstituted product, the organic compound C_8H_9NO is:



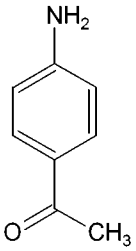
(A)



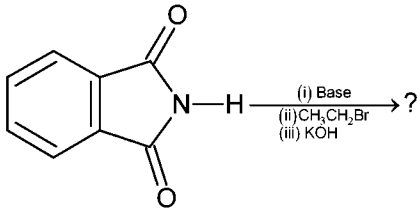
(B)



(C)



(D)

10.  The final major product is:

(A) $CH_3CH_2NH_2$ **(B)** $CH_2 = CH - NH_2$

(C) $CH_3 - CH = NH$ **(D)** $H_3C - \underset{\displaystyle OH}{\underset{|}{CH}} - NH_2$

11. $PhNH_2 \xrightarrow[KOH/\Delta]{CHCl_3} \xrightarrow[(ii)\ H_2O]{(i)\ LiAlH_4} ?$

(A) $PhCH_2CH_3$ **(B)** $PhNHCH_3$

(C) $Ph - CHO$ **(D)** $PhCH_2 - OH$

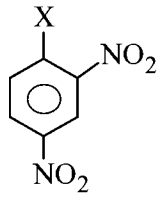
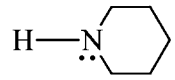
12. A basic volatile nitrogen compound (M.wt-59) gave a foul smelling gas when treated with chloroform and alcoholic potash. A sample of the substance dissolved in aqueous HCl and treated with HCl and $NaNO_2$ solution at 0°C liberated a colourless gas. After the evolution of gas was complete the aqueous solution was distilled to give an organic compound which does not contain nitrogen and which on warming with alkali and Iodine gave a yellow precipitate. Identify the original substance. Assume that it contains one N atom per molecule.

(A) $\underset{\displaystyle NH_2}{\underset{|}{CH_3 - CH - CH_3}}$ **(B)** $CH_3CH_2 - CH_2 - NH_2$

(C) $\underset{\displaystyle CH_3}{\underset{|}{CH_3 - N - CH_3}}$ **(D)** $\underset{\displaystyle CH_3 - N - CH_2 - CH_3}{\underset{|}{CH_3}}$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

13.  when treated with  Where X = F, Cl, Br, I

Which of the following statements are true:

(A) The order of reactivity is I > Br > Cl > F

(B) The order of reactivity is F > Cl > Br > I

(C) The rate limiting step of the reaction does not involve the cleavage of C – X bond

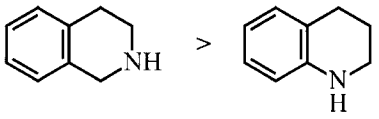
(D) When X = F, the rate of nucleophilic attack is maximum

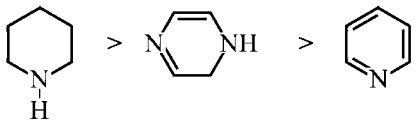
14. $(A) \xrightarrow[[H]]{\text{Reduction}}$ Primary amine. The compound (A) may be:

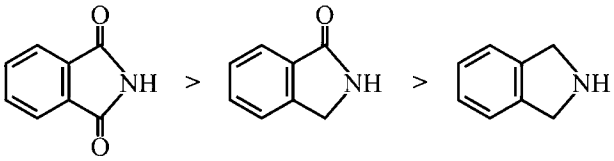
(A) alkyl isocyanide **(B)** alkyl cyanide

(C) acid amide **(D)** 1°-nitroalkane

15. Consider the following comparison of basic nature of amines

I. 

II. 

III. 

Correct comparisons are:

(A) I **(B)** II

(C) I and III **(D)** II and III

16. A compound (A) having molecular formula $C_9H_{13}N$ dissolved in dilute HCl and releases N_2 on treatment with HNO_2 the probable structure of (A) is:

(A) $PhCH_2CH_2NHCH_3$ **(B)** $PhCH_2-\underset{\displaystyle NH_2}{\underset{|}{CH}}-CH_3$

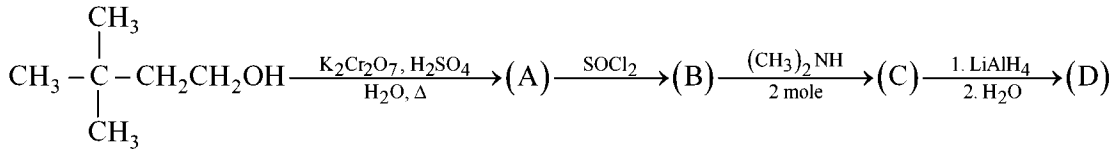
(C) $PhCH(NH_2)-CH_2CH_3$ **(D)** $Ph-\underset{\displaystyle NH_2}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}}-CH_3$

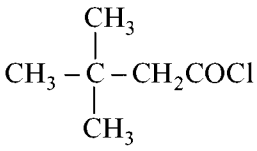
17. Which of the following aryl amines will not form a diazonium salt on reaction with sodium nitrite in hydrochloric acid?

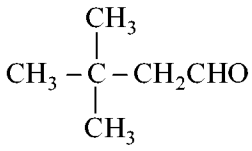
(A) m-Ethyl aniline **(B)** p-Amino acetophenone

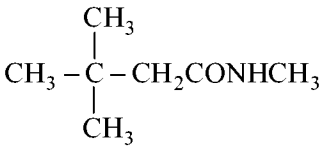
(C) 4-Chloro-N-Methyl aniline **(D)** N-Ethyl-2-Methyl aniline

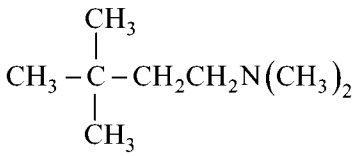
18. In the given reaction sequence,



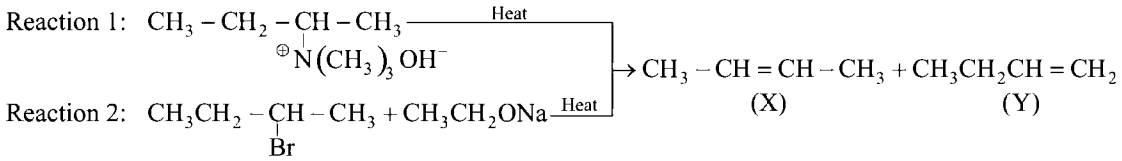
(A) Compound (B) is 

(B) Compound (A) is 

(C) Compound (C) 

(D) Compound (D) is 

19. In the given reactions,



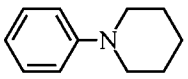
(A) The major product in reaction 1 is (X)

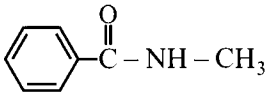
(B) The major product in reaction 1 is (Y)

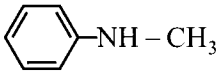
(C) The major product in reaction 2 is (X)

(D) The major product in reaction 2 is (Y)

20. Which compound yields an N – nitroso amine after treatment with nitrous acid $(NaNO_2 + HCl)$?

(A) 

(B) 

(C) 

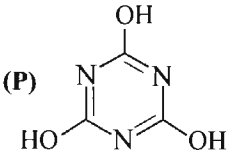
(D) $CH_3CH_2 - NH - CH_3$

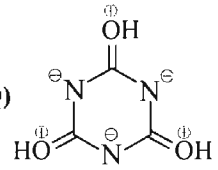
21. $PhCOCH_2CH_2NH_2$ and $PhNHCH_2COCH_3$ can be distinguished by:

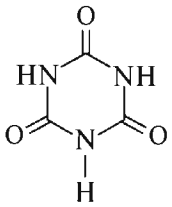
(A) Carbylamine test **(B)** Tollen's test

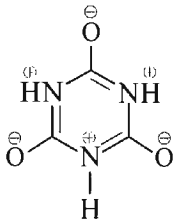
(C) Hinsberg's test **(D)** Iodoform test

22. The correct statement(s) concerning the structures P, Q, R & S is/are:

(P) 

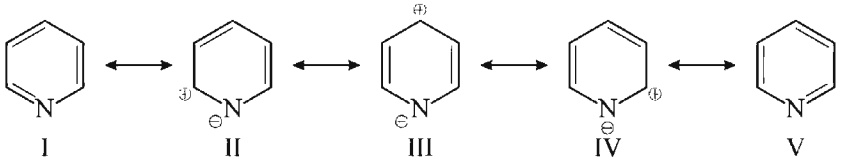
(Q) 

(R) 

(S) 

(A) Q & S are not resonating structures **(B)** R & S are resonating structures

(C) P & R are tautomers **(D)** P & Q are resonating structures

23. 

I II III IV V

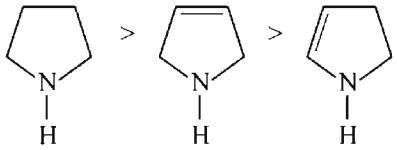
Among these canonical structures of pyridine, the correct order of stability is/are:

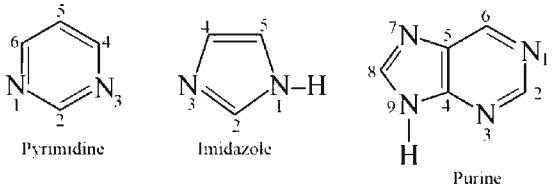
(A) (II = IV) > (I = V) **(B)** (I = V) > (II = IV)

(C) III > (II = IV) **(D)** (II = IV) > III

24. Which of the following is/are correct for basic strength:

(A) $(CH_3)_2NH > (CH_3)_3N > CH_3NH_2 > NH_3$ **(B)** $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2 > NH_3$

(C) $PhNH_2 > Ph_2NH > Ph_3N$ **(D)** 

25. 

Pyrimidine Imidazole Purine

Among the following which statement(s) is/are correct:

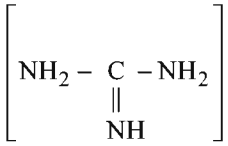
(A) Both N of pyrimidine are same basic strength

(B) In imidazole protonation take places on N-3

(C) In purine only lp of N is delocalised

(D) Pyrimidine, imidazole and purine all are aromatic

26. Which of the following is/are correct statement/statements?

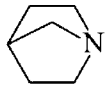
(A) Guanidine  is more basic than pyridine because conjugate acid of guanidine has three equal contributing resonating structure

(B) Diethylamine is stronger base than triethylamine in aqueous medium

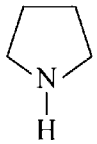
(C) Ortho-methyl aniline is weaker base than para-methyl aniline

(D) 2, 4, 6-Trinitro-N, N-dimethyl aniline is stronger base than 2, 4, 6-Trinitro aniline

27. In which compounds (II) is more basic than (I)

(A) $(C_2H_5)_3N$ (I) &  (II)

(B) $H_2N-\overset{\overset{O}{\|}}{C}-NH_2$ (I) & $H_2N-\overset{\overset{NH}{\|}}{C}-NH_2$ (II)

(C) $C_2H_5-NH-C_2H_5$ (I) &  (II)

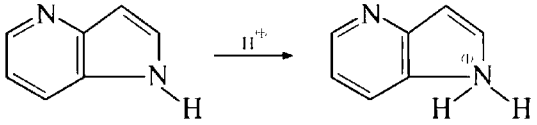
(D) CH_3NH_2 (I) & $(CH_3)_2NH$ (II)

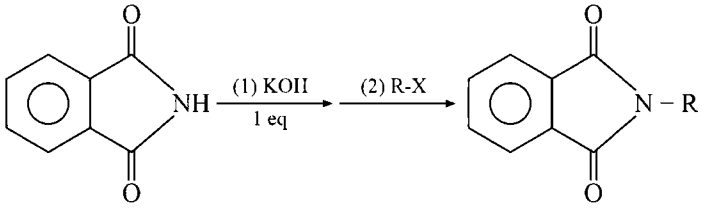
28. Which of the following reactions is/are not feasible:

(A) $CH_3COONa + HCOOH \longrightarrow CH_3COOH + HCOONa$

(B) $CH_3COONa + Ph-OH \longrightarrow CH_3COOH + PhONa$

(C) $NH_2-\overset{\overset{CH_2}{\|}}{C}-NH_2 + NH_2-\overset{\overset{\overset{\oplus}{NH_2}}{\|}}{C}-NH_2 \longrightarrow NH_2-\overset{\overset{CH_2}{\|}}{C}-\overset{\oplus}{N}H_3 + NH_2-\overset{\overset{NH}{\|}}{C}-NH_2$

(D) 

29. 

In which option correct rate for step 2 is given for the different $R-X$?

(A) $CH_3-CH_2-Br < CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

(B) $Ph-Cl > CH_3-Cl$

(C) $Ph-CH_2-Br > Ph-\underset{\underset{Br}{|}}{CH}-CH_3$

(D) $CH_2=CH-CH_2-Cl > CH_3-CH_2-CH_2-Cl$

30. $\underset{\text{excess}}{CH_3Br} + NH_3 \xrightarrow{\Delta} \underset{\text{salt}}{[(CH_3)_4N^{\oplus}]Br^{\ominus}}$

Correct statement for above reaction is/are:

(A) Obtained by S_N2 mechanism

(B) NH_3 is nucleophile

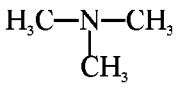
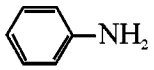
(C) Reaction is through S_N1 mechanism

(D) 4 equivalent of NH_3 is used during reaction

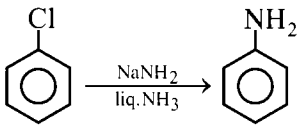
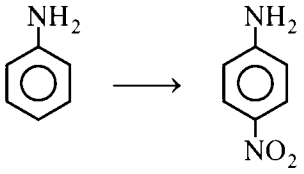
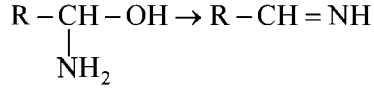
MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

31. MATCH THE FOLLOWING:

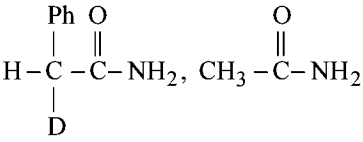
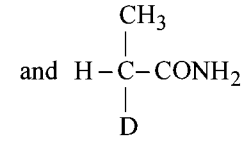
Column 1		Column 2	
(A)	$CH_3CH_2CH_2NH_2$	**(p)**	Treatment of $NaNO_2$, HCl gives nitroso compound
(B)	$CH_3CH_2NHCH_3$	**(q)**	Treatment of $NaNO_2$, HCl gives stable diazonium chloride at lower temperature
(C)		**(r)**	Treatment of CH_3I (excess) followed by AgOH, heat gives out alkene
(D)		**(s)**	Treatment with HCl and on heating gives dealkylation.
		(t)	Treatment of benzene sulphonyl chloride produces the compound soluble in alkali

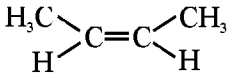
32. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)		**(p)**	Elimination
(B)		**(q)**	Oxidation
(C)	$R-CH_2NH_2 \rightarrow R-COOH$	**(r)**	Electrophilic substitution
(D)		**(s)**	Nucleophilic substitution

Numerical Value Type

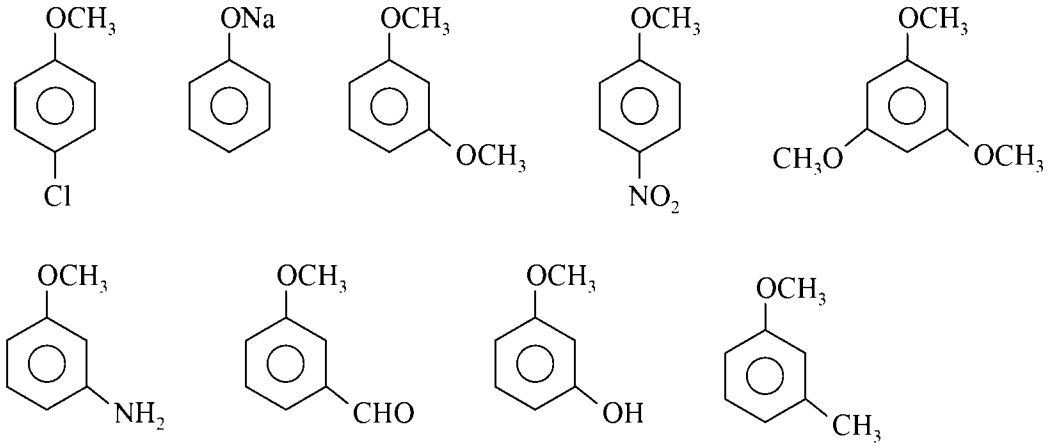
The Answer to the following questions are positive integers of 1/2/3 digits and zero

33. When  , and  are mixed and reacted with Br_2/KOH than how many products are obtained.

34.  + $CH_2N_2 \xrightarrow{h\nu}$ Total no. of possible products are

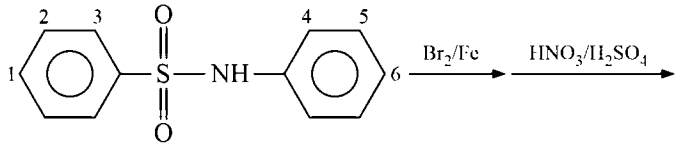
35. Nitrobenzene undergoes electrolytic reduction in acidic medium to produce phenylhydroxyl amine. How many electrons are involved in cathode half cell reaction per mole of nitrobenzene?

36. How many of the following compounds are more reactive toward coupling reaction with diazonium salt than anisole?

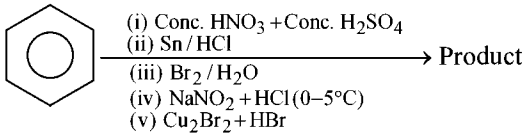


37. What is the percent of o-nitroaniline formed during nitration of aniline using nitrating mixture?

38. Complete the following reaction

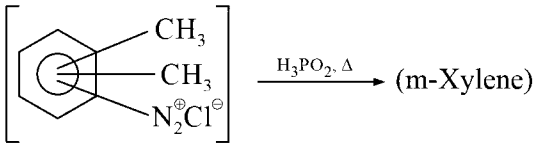


At which position nitration takes place?

39. 

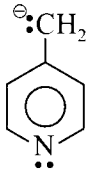
What is the number of halogen atoms in final product?

40. How many aromatic diazonium chlorides of xylene can be reduced to meta-xylene by H_3PO_2 ?

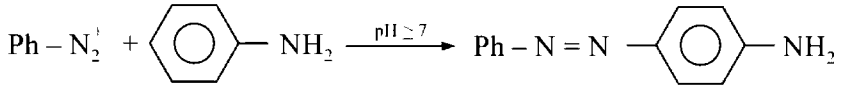


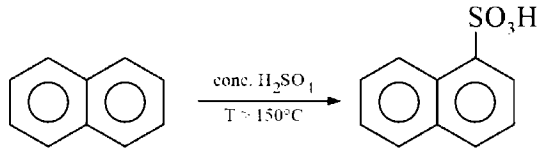
41. A mixture of 1° amides (benzenoid) having molecular formula (C_8H_9NO) reacted with Br_2 / NaOH . The number of 1° amines products formed will be:

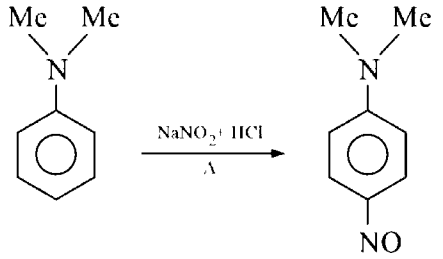
42. How many p-orbitals are parallel to each other in the following conjugated system?

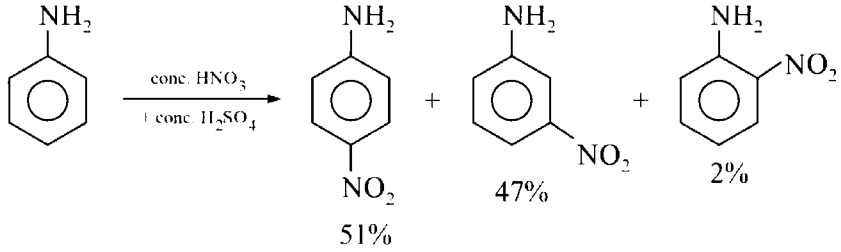


43. Identify reaction correctly matched with their major products.

(i) 

(ii) 

(iii) 

(iv) 

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Alcohols and phenols can be distinguished by:

(A) $NaHCO_3$ solution **(B)** neutral ferric chloride solution

(C) Tollen's test **(D)** ester test

2. 59 g of an amide obtained from a carboxylic acid, RCOOH on hydrolysis gave 17 g ammonia. The acid is:

(A) formic acid **(B)** acetic acid **(C)** propionic acid **(D)** butyric acid

3. A compound contains 38.7% carbon, 16.13% hydrogen and 45.17% nitrogen. The formula of the compound would be:

(A) CH_3NH_2 **(B)** CH_3CN **(C)** C_2H_5CN **(D)** $CH_2(NH_2)_2$

4. Benzoic acid and 2, 4-dinitrophenol can be distinguished by the reagent:

(A) aqueous $NaHCO_3$ **(B)** Fehling's solution

(C) litmus test **(D)** cerric ammonium nitrate solution

5. An organic compound weighing 20 g is subjected to combustion with oxygen and it gave 10 g of water. The percentage of hydrogen in the organic compound is:

(A) 67.2% **(B)** 33.33% **(C)** 2.85% **(D)** 5.55%

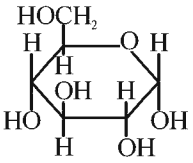
6. The percentage of sulphur in the organic compound, when 0.2595 g of a sulphur containing organic compound in a quantitative analysis by Carius method yielded 0.35 g of barium sulphate is:

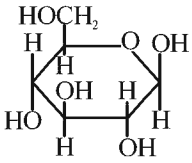
(A) 14.52% **(B)** 16.52% **(C)** 18.52% **(D)** 19.52%

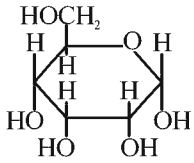
7. 6 g of the organic compound on heating with NaOH gave NH_3, which is neutralized by 200 ml of 1 N HCl. Percentage of nitrogen in the organic compound would be:

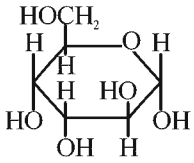
(A) 12% **(B)** 60% **(C)** 26.67% **(D)** 46.67%

8. Which of the following structures represents α-D-glucopyranose?

(A) 

(B) 

(C) 

(D) 

9. Which of the following monosaccharide is not oxidised with aqueous Br_2?

(A) D-glucose **(B)** D-mannose **(C)** D-fructose **(D)** D-galactose

10. Mutarotation is characteristic for all

(A) Sugars that can reduce Tollen's reagent and Fehling's reagent

(B) Sugars that are devoid of reducing properties

(C) Polysaccharides, that are insoluble in water

(D) Polyhydric aldehydes and ketones without asymmetric centres

11. D-glucose in dilute alkaline or acidic solution contains:

(A) 50% each of α-D-glucose and β-D-glucose

(B) 64% of α-D-glucose and 36% of β-D-glucose

(C) 36% of α-D-glucose and 64% of β-D-glucose

(D) 33% each of α-D-glucose, β-D-glucose and open structure

12. Denaturation of a native protein cannot be achieved by:

(A) adding urea to the protein solution **(B)** adding HCl to the protein solution

(C) heating the protein solution **(D)** adding NaCl to the solution

13. If K_{a_1} and K_{a_2} are the ionization constants of $H_3\overset{+}{N}CH(R)COOH$ and $H_3\overset{+}{N}CH(R)COO^-$, respectively, the pH of the solution at the isoelectric point is:

(A) $pH = pK_{a_1} + pK_{a_2}$ **(B)** $pH = \left(pK_{a_1} pK_{a_2}\right)^{1/2}$

(C) $pH = \left(pK_{a_1} + pK_{a_2}\right)^{1/2}$ **(D)** $pH = \left(pK_{a_1} + pK_{a_2}\right)/2$

14. Natural silk is a polymer of:

(A) Amino acids **(B)** Nucleoside **(C)** Nucleotide **(D)** Adipic acid

15. Vulcanised rubbers are polymers of the type .....

(A) linear **(B)** cross-linked **(C)** branch-chain **(D)** all of these

16. Which of the following compound cannot be a monomer?

(A) $CH_3 - CHOH - CH_2OH$ **(B)** $NH_2 - CH_2 - NH_2$

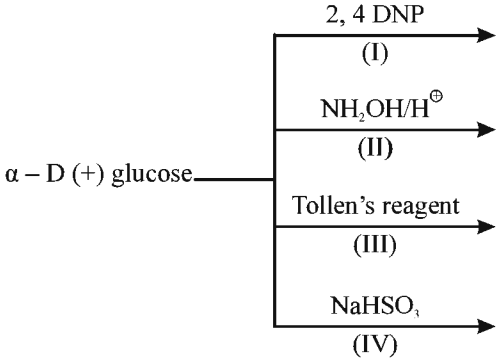
(C) $CH_3 - CH_2 - NH_2$ **(D)** $NH = CH - \underset{\displaystyle NH_2}{\underset{|}{CH}} - CH_2 - NH_2$

17. Which of the following sets contain only addition polymers?

(A) Polyethylene, polypropylene, terylene **(B)** Polyethylene, PVC, orlon

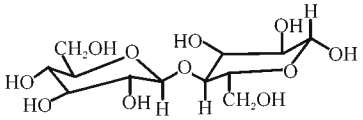
(C) Buna-S, nylon, polybutadiene **(D)** Bakelite, PVC, polyethylene

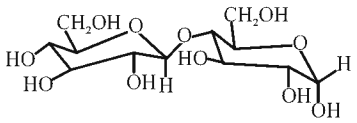
18. Observe the following laboratory tests for α-D(+) glucose and mention +ve or –ve fromthe code given below.

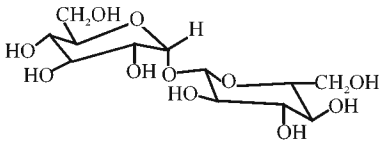


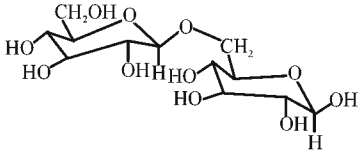
(A) + + + + **(B)** – + + – **(C)** + – + – **(D)** + + – –

19. Which of the following is a non-reducing sugar?

(A) 

(B) 

(C) 

(D) 

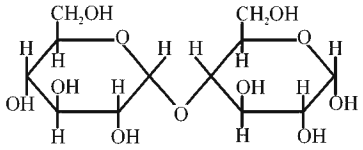
20. Basic solution of fructose contains:

(A) Only fructose **(B)** Only glucose

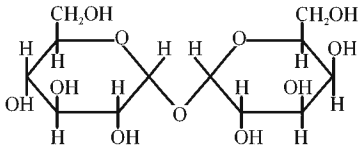
(C) Fructose and glucose **(D)** Glucose, fructose and mannose

21. Which of the following is an non-reducing sugar?

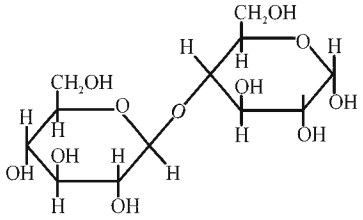
(A) $OHCH_2-\underset{\underset{O}{\|}}{C}-(CHOH)_3-CH_2OH$ **(B)**



(C)



(D)



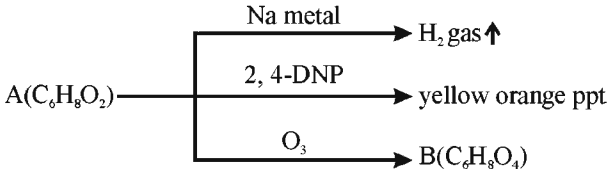
22. Compounds I and II can be distinguished by using reagent.

I. 4–Amino–2–methylbut–3–en–2–ol **II.** 4–Amino–2, 2–dimethylbut–3–yn–1–ol

(A) $NaNO_2$ / HCl **(B)** Br_2 / H_2O

(C) HCl / $ZnCl_2$ (anhydrous) **(D)** Cu_2Cl_2 / NH_4OH

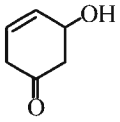
23. The compound A gives following reactions



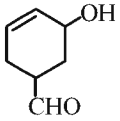
Its structure can be:

(A) $CH_2=CH-(CH_2)_2-\underset{\underset{O}{\|}}{C}-CH_2OH$ **(B)** $OHC-(H_2C)_2-HC=HC-COOH$

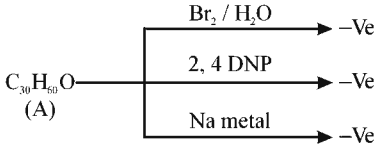
(C)



(D)



24. In compound $A(C_{30}H_{60}O)$ following tests are observed negatively, A can be:



(A) an unsaturated ether **(B)** an epoxide

(C) a cyclic ketone **(D)** a cycloalkanol

25. Softening of hard water is done using sodium aluminium silicate (zeolite). This causes:

(A) Adsorption of Ca^{2+} and Mg^{2+} ions of hard water replacing Na^+ ions

(B) Adsorption of Ca^{2+} and Mg^{2+} of hard water replacing Al^{3+} ions

(C) Both (A) and (B)

(D) None of these

26. Which of the following statements is not correct?

(A) A colloidal solution is a heterogeneous two-phase system

(B) Silver sol in water is an examples of lyophilic solution

(C) Metal hydroxides in water are examples of lyophobic solution

(D) Liquid-liquid colloidal solution is not stable system

27. A reddish brown sol (containing Fe^{3+}) is obtained by:

(A) the addition of small amount of $FeCl_3$ solution to freshly prepared $Fe(OH)_3$ precipitate

(B) the addition of $Fe(OH)_3$ to freshly prepared $FeCl_3$ solution

(C) the addition of NH_4OH to $FeCl_3$ solution dropwise

(D) the addition of NaOH to $FeCl_3$ solution dropwise

28. Which is not the example of coagulation?

(A) curdling of milk **(B)** purification of water by addition of alum

(C) rubber plating and chrome tanning **(D)** formation of deltas at the river beds

29. Gold number of some lyophilic sols are:

I.	Casein	:	0.01	**II.**	Haemoglobin	:	0.03
III.	Gum Arabic	:	0.15	**IV.**	Sodium oleate	:	0.40

Which has maximum protective power?

(A) I **(B)** II **(C)** III **(D)** IV

30. Which are not purely surface phenomena?

(A) viscosity, surface tension **(B)** adsorption, absorption

(C) absorption, viscosity **(D)** adsorption, viscosity

31. The diameter of colloidal particle is of the order:

(A) 10^{-3} m **(B)** 10^{-5} m **(C)** 10^{-15} m **(D)** 10^{-7} m

Paragraph for Questions 32 - 35

Carbohydrates are polyhydroxy aldehydes and ketones and those compounds which on hydrolysis give such compounds are also carbohydrates. The carbohydrates which are not hydrolysed are called monosaccharides. Other carbohydrates are oligosaccharides and polysaccharides. Monosaccharides with aldehydic group are called aldoses and those with free ketonic group are called ketoses. All carbohydrates are optically active. Number of optical isomer = 2^n

Where n = number of asymmetric carbons. Carbohydrates are mainly synthesized by plants during photosynthesis

32. Maximum number of monosaccharide units present in oligosaccharides is:

(A) 8 **(B)** 10 **(C)** 15 **(D)** 40

33. Aldose sugar present in nucleic acid is:

(A) arabinose **(B)** xylose **(C)** deoxyribose **(D)** all of these

34. First member of ketose sugar is:

(A) ketotriose **(B)** ketotetrose **(C)** ketopentose **(D)** ketohexose

35. In the molecule, $HOCH_2CH(OH)CH(OH)CH(OH)CH(OH)CHO$, the number of optical isomers will be:

(A) 16 **(B)** 8 **(C)** 32 **(D)** 4

Paragraph for Questions 36 - 37

In 1953, Karl Ziegler and Giulio Natta found that the structure of a polymer could be controlled if the growing end of the chain and the incoming monomer were co-ordinated with an aluminium-titanium intiator. These initiators are now called **Ziegler-Natta catalysts**. Long, unbranched polymers with either the isotactic or the syndiotactic depends on the particular Ziegler-Natta catalyst used. High-density polyethylene is prepared using a Ziggler-Natta process.

36. Which of the following statement is incorrect about Ziegler-Natta polymerisation?

(A) It is an example of condensation polymerisaiton

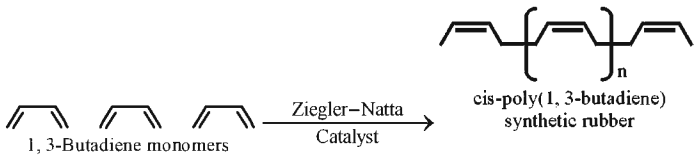
(B) It always give linear, stereo – regular polymers

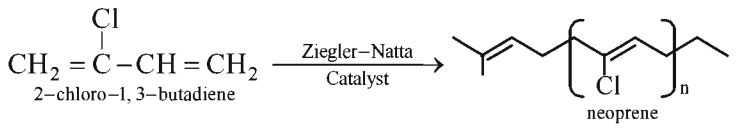
(C) They make stronger and stiffer polymers

(D) The polymers formed have great resistance to cracking and heat

37. Which of the following option correctly represent the polymerisation process?

(A) $\underset{\text{(acetylene)}}{HC \equiv CH} \xrightarrow[\text{Catalyst}]{\text{Ziegler–Natta}} -CH=CH-\underset{\text{(polyacetylene)}}{[CH=CH]_n}-CH=CH-$

(B) 

(C) 

(D) All of these

Paragraph for Questions 38 - 40

An amino acid is characterized by two pK_a values the one corresponding to the more acidic site is designated as pKa_1 and the other corresponding to the less acidic site is designated as pKa_2. The isoelectric point also called isoinoic point (pI) is the pH at which concentration of zwitter ion is maximum. pI is the average of pKa_1 and pKa_2. Generally the value of pI is slightly less than 7. Some amino acids have side chain with acidic or basic groups. These amino acids have pKa_3 value also for the side chain. Acidic amino acids have acidic side chains and basic amino acids have basic side chains. pI for acidic amino acid is average of pKa_1 and pKa_2 pI for basic amino acid is the average of pKa_2 and pKa_3

S.No.	Amino acid	pKa_1	pKa_2	pK_{a_3} (side chain)
I.	Aspartic acid	1.88	9.6	3.65
II.	Glutamic acid	2.19	9.67	4.25
III.	Lysine	2.18	8.95	10.53
IV.	Arginine	2.17	9.04	12.48

38. In the table given above the acidic amino acids are:

(A) I, II **(B)** I, III **(C)** II, III **(D)** I, II & IV

39. The isoelectric point (pI) of Aspartic acid will be:

(A) 6.62 **(B)** 5.74 **(C)** 2.77 **(D)** 9.74

40. The isoelectric point of lysine will be:

(A) 6.35 **(B)** 9.74 **(C)** 2.77 **(D)** 10.76

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

41. Which of the following are correct statements

(A) Spontaneous adsorption of gases on solid surface is an exothermic process as entropy decreases during adsorption.

(B) Formation of micelles takes place when temperature is below Kraft Temperature (T_k) and concentration is above critical micelle concentration (CMC).

(C) A colloid of $Fe(OH)_3$ is prepared by adding a little excess (required to completely precipitate Fe^{3+} ions as $Fe(OH)_3$)) of NaOH in $FeCl_3$ solution the particles of this sol will more towards cathode during electrophoresis.

(D) According to Hardy-Schulze rules the coagulation (flocculating) value of Fe^{3+} ion will be more than Ba^{2+} or Na^+.

42. Compound (X) $C_9H_{10}O$ is inert to Br_2 / CCl_4. Vigorous oxidation with hot alkaline $KMnO_4/\bar{O}H$ yields C_6H_5COOH. (X) gives precipitate with 2, 4-dinitrophenyl hydrazine. How can these isomers be distinguished by the usual chemical tests? Following are possible isomers of X .

I. $C_6H_5-CH_2-CH_2-CHO$ **II.** $C_6H_5-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CHO$

III. $C_6H_5-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3$ **IV.** $C_6H_5-\overset{\displaystyle O}{\overset{\|}{C}}-CH_2-CH_3$

(A) I gives red ppt. with Fehling solution and II and III can be distinguished by iodoform test

(B) I and II can be distinguished by simple chemical method

(C) I and II give red ppt. with Fehling solution and III and IV can be distinguished by iodoform test

(D) II give red ppt. with Fehling solution and I and IV can be distinguished by iodoform test

43. Which is /are the correct method for separating a mixture of benzoic acid, p-methyl aniline and phenol.

(A) $\xrightarrow{\text{aq. } NaHCO_3}$ $\xrightarrow{\text{aq. NaOH}}$ **(B)** $\xrightarrow{\text{aq. HCl}}$ $\xrightarrow{\text{aq. } NaHCO_3}$

(C) $\xrightarrow{\text{aq. NaOH}}$ $\xrightarrow{\text{aq. } NaHCO_3}$ **(D)** $\xrightarrow{\text{aq. NaOH}}$ $\xrightarrow{\text{aq. HCl}}$

44. Which of the following statements are true for physisorption?

(A) Extent of adsorption increases with increase in pressure **(B)** It needs activation energy

(C) It can be reversed easily **(D)** It occurs at high temperature

45. If Cl_2 gas is enclosed in presence of powdered charcoal in a closed vessel, the pressure of the gas decreases. It is because:

(A) the gas molecules are absorbed at the surface

(B) the gas molecules concentrate at the surface of the charcoal

(C) the gas molecules are adsorbed at the surface **(D)** the gas molecules are desorbed by the surface

46. When negatively charged colloids like As_2S_3 sol is added to positively charged $Fe(OH)_3$ sol in suitable amounts

(A) Both the sols are precipitated simultaneously **(B)** This process is called mutual coagulation

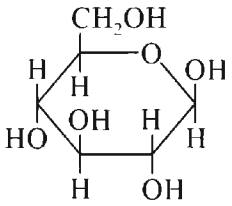
(C) They become positively charged colloids **(D)** They become negatively charged colloids

47. Which of the following are multimolecular colloids?

(A) Sulphur **(B)** Egg albumin in water **(C)** Gold sol **(D)** Soap solution

48. Which of the following are based on Tyndall effect?

(A) Ultra microscope **(B)** Deltas **(C)** Blue colour of sky **(D)** Coagulation

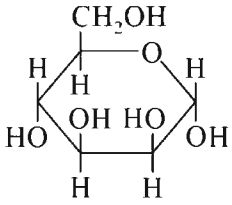
49.  Glucose

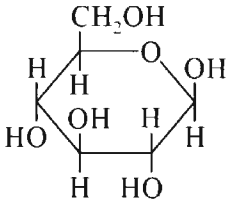
The correct statements about above structure of glucose are:

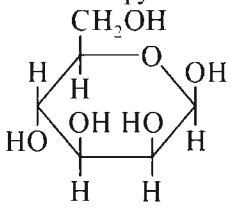
(A) It is a Pyranose form **(B)** It is a furanose form

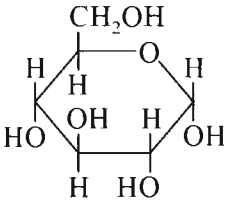
(C) It is a $\beta-$anomer **(D)** It is a D-sugar

50. D-Mannose differs from D-glucose in its stereochemistry at C-2. The pyranose form of D-Mannose is:


(A)


(B)


(C)


(D)

51. Which of the following is/are reducing sugar?

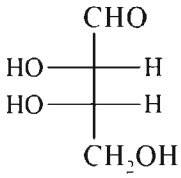
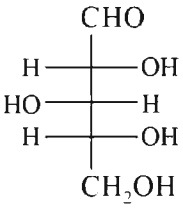
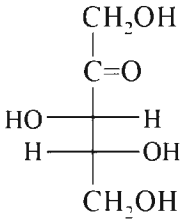
(A) Sucrose **(B)** Glucose

(C) Fructose **(D)** methylmaltoside

52. Which of these are polysaccharides of glucose?

(A) Starch **(B)** Cellulose

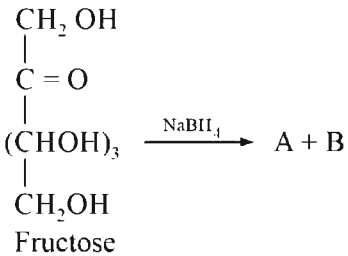
(C) Sucrose **(D)** Lactose

53. (I)  (II)  (III) 

The correct statement about the sugars given above are:

(A) I and II are L-Sugars **(B)** II and III are D-Sugar

(C) I and III are D-sugars **(D)** I is L-sugar

54. 

Fructose

The product A and B in the above reaction are:

(A) Diastereomers **(B)** C-2 epimers

(C) Anomers **(D)** Optically active hexahydroxy compounds

55. The correct statements about peptides are:

(A) A dipeptide has one peptide link between two amino acids

(B) By convention N-Terminus is kept at left and C-terminus at right in the structure of a peptide

(C) If only one amino group and one carboxylic acid group are available for reaction, then only one dipeptide can forms

(D) A polypeptide with more than hundred amino acid residues (mol. Mass > 10,000) is called a protein

56. Which of the following are polyamide polymer?

(A) protein **(B)** Nylon-6, 6

(C) Nylon-6 **(D)** Polystyrene

57. Preparation of nylon from hexamethylene diamine and adipic acid is an example of:

(A) addition polymerisation **(B)** homopolymerisation

(C) condensation polymerisation **(D)** copolymerisation

58. The correct statement(s) about starch:

(A) It is a pure single compound

(B) It is mixture of two polysaccharides of glucose

(C) it involves the $(C_1 - C_4)\ \alpha$ – glycosidic linkage between two $\alpha - D$ glucose units

(D) It involves branching by $(C_1 - C_6)$ glycosidic linkage

59. Which of the following pairs is (are) correctly matched

(A) $\alpha - D(+)$ glucose and $\beta - D(+)$ glucose → C-2 epimers

(B) Glucose and fructose → C-3 epimers

(C) Glucose → mutarotation

(D) Sucrose → Glucose + fructose

60. Structures of some common polymers are given. Which are correctly presented?

(A) Teflon $+(CF_2 - CF_2-)_n$

(B) Neoprene $\left(-CH_2 - \underset{\underset{Cl}{|}}{C} = CH - CH_2 - CH_2 -\right)_n$

(C) Terylene $+OC-C_6H_4-COOCH_2-CH_2-O-)_n$

(D) Nylon – 6, 6 $+NH(CH_2)_6NHCO(CH_2)_4-CO-]_n$

61. The correct structure of glycine at given pH are: (Isoelectric point is 6)

(A) $H_3\overset{\oplus}{N}CH_2-\underset{\underset{O}{\|}}{C}-OH$ at pH = 2.0 **(B)** $H_3\overset{\oplus}{N}CH_2-\underset{\underset{O}{\|}}{C}-O^{\ominus}$ at pH = 6.0

(C) $H_2NCH_2-\underset{\underset{O}{\|}}{C}-O^{\ominus}$ at pH = 9 **(D)** $H_2NCH_2-\underset{\underset{O}{\|}}{C}-OH$ at pH = 12

62. The correct statements about anomers are:

(A) Anomers have different stereochemistry at C-1(anomeric carbon)

(B) $\alpha-D$-glucopyranose and $\beta-D-$glucopyranose are anomers

(C) Both anomers of D-glucopyranose can be crystallised and purified

(D) When pure $\alpha-D-$glucopyranose is dissolved in water its optical rotation slowly changes

63. Which of the following are correctly matched?

(A) Nylon-6, 6 - Condensation **(B)** Cellulose triacetate - Natural polymer

(C) Polyisoprene - Homopolymer **(D)** Sucrose - Polysaccharide

64. Correct statement about peptide linkage in a protein molecule is/are correct?

(A) It is amide linkage **(B)** It has partial double bond character

(C) It is hydrophilic in nature **(D)** It connects protein molecules through H-bonds

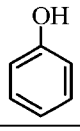
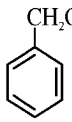
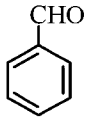
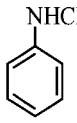
MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

65. **MATCH THE FOLLOWING:**

	Column 1 (Estimation / detection of elements		Column 2 (Methods)
(A)	Estimation of halogens	**(p)**	Kjeldahl's method
(B)	Estimation of carbon and hydrogen	**(q)**	Dumas method
(C)	Estimation of nitrogen	**(r)**	Carius method
(D)	Estimation of sulphur	**(s)**	Leibig's method

66. **MATCH THE FOLLOWING:**

	Column 1		Column 2
(A)		**(p)**	CAN test
(B)		**(q)**	Ester test
(C)		**(r)**	Oxidation test
(D)		**(s)**	Libermann's test

67. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	α-D-glucose and β-D-glucose	**(p)**	Reducing sugar
(B)	D-glucose and D-galactose	**(q)**	Non-reducing sugar
(C)	D-glucose and D-mannose	**(r)**	Anomer
(D)	Methyl α-D-glucoside and Methyl β-D-glucoside	**(s)**	Epimer
		(t)	Shows mutarotation

68. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	Glutamic acid	**(p)**	Neutral amino acid
(B)	Arginine	**(q)**	Acidic amino acid
(C)	Asparagine	**(r)**	Polar amino acid
(D)	Phenyl alanine	**(s)**	Optically active amino acid

69. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	Nylon 6, 10	**(p)**	Polyester
(B)	Glyptal	**(q)**	Polymide
(C)	Teflon	**(r)**	Condensation polymer
(D)	Bakelite	**(s)**	Addition polymer

70. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	Polythene	**(p)**	Addition polymer
(B)	Buna-S rubber	**(q)**	Condensation polymer
(C)	Melamine-formaldehyde resin	**(r)**	Homopolymer
(D)	Poly-hydroxy butyrate-co-β- Hydroxyvalerate	**(s)**	Copolymer

71. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	Ferric hydroxide	**(p)**	Lyophobic colloid
(B)	Micelles	**(q)**	Lyophilic colloid
(C)	Gelatin	**(r)**	Associated colloid
(D)	Arsenous sulphide	**(s)**	Irreversible

72. **MATCH THE FOLLOWING:**

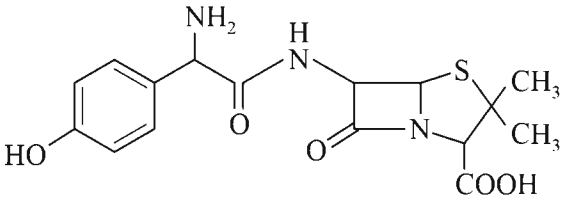
	Column 1		Column 2
(A)	Coagulation	**(p)**	Scattering of light
(B)	Dialysis	**(q)**	Washing of precipitates
(C)	Peptization	**(r)**	Purification of colloids
(D)	Tyndall effect	**(s)**	Electrolyte

SUBJECTIVE INTEGER TYPE

Each of the following question has an integer answer between 0 and 9.

73. Natural rubber is 1, 4-addition polymer of isoprene. Find out number of carbon atoms in longest continuous carbon chain of major product of reductive ozonolysis of natural rubber.

74. How many of the following observations are correct for amoxicillin (structure given below)?



(i) It's degree of unsaturation is equal to 9

(ii) It possess four chiral carbon atoms

(iii) It possess nine sp^2 hybridized carbon atoms

(iv) It produce blood red colour with neutral $FeCl_3$ solution in Lassaigne's test

(v) It produce different colouration when treated with neutral $FeCl_3$

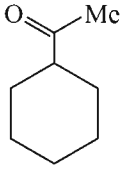
(vi) It produce brisk effervascence when reacts with $NaHCO_3$

(vii) It undergoes carbyl amine reaction

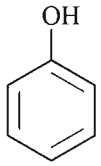
(viii) It produce four mole of CH_4 gas per mole of it on reaction with CH_3MgBr in dry ether

(ix) On complete hydrolysis it produce 2-amino-3(p-hydroxy phenyl) propanoic acid as one of the product.

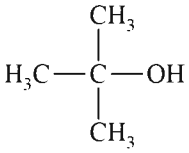
75. Observer the following compounds.



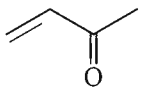
(I)



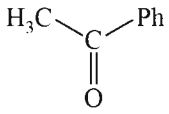
(II)



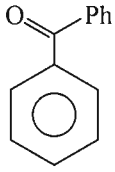
(III)



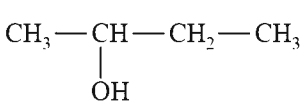
(IV)



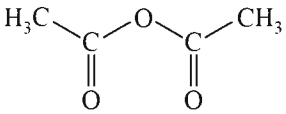
(V)



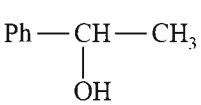
(VI)



(VII)



(VIII)

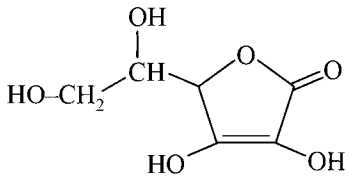


(IX)

Number of compounds which can give positive Haloform test = (x)

Number of compounds which can give positive Lucas reagent test = (y)

76. Structure of Ascorbic acid is represented as follows.



(Ascorbic acid)

How many of the following reagents can give positive test with ascorbic acid.

$Cu_2Cl_2 + NH_4OH$	2, 4-DNP	Na Metal	$HCl + ZnCl_2$	$FeCl_3$
(I)	**(II)**	**(III)**	**(IV)**	**(V)**
NaOH + Phenolpthalein	dil. $KMnO_4$	Br_2 / H_2O	$AgNO_3 + NH_4OH$	$I_2 + NaOH$
(VI)	**(VII)**	**(VIII)**	**(IX)**	**(X)**

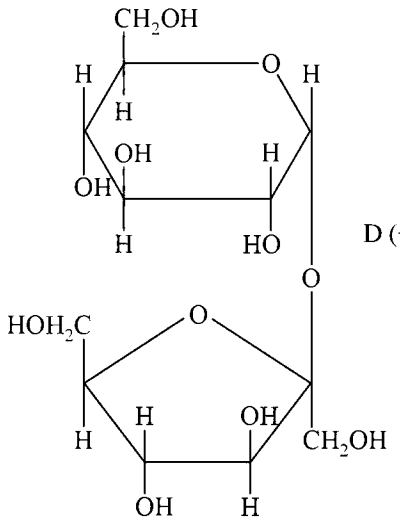
77. How many of the following compounds reacts with $NaHCO_3$ and liberate $CO_2(g)$.

1.	Salicylic acid	**2.**	Pthalic acid
3.	Picric acid	**4.**	Resorcinol
5.	Carbolic acid	**6.**	Aspirin
7.	Anisol	**8.**	Tarteric acid

78. Find the total number of tripeptides that can be formed by the combination of amino acids, glycine and alanine. (excluding stereoisomers)

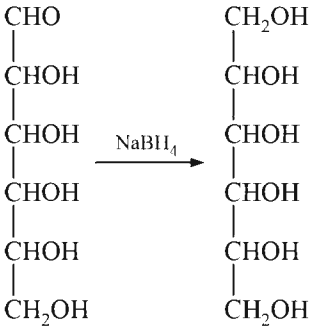
79. The condensation of two amino acids, glycine and (±) alanine yields total number of products x. Find value of x?

80. The number of chiral centres presents in the following compound is:

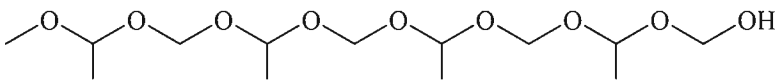


D (+) - Sucrose

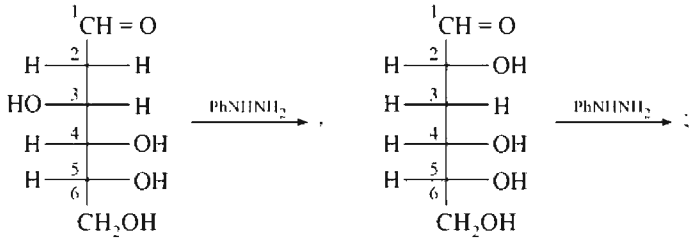
81. Observe the following reaction and find out that how many number of reactant stereoisomers can be reduced to optically inactive meso products.



82. How many moles of formaldehyde is formed by the complete hydrolysis of following compound with?



83.



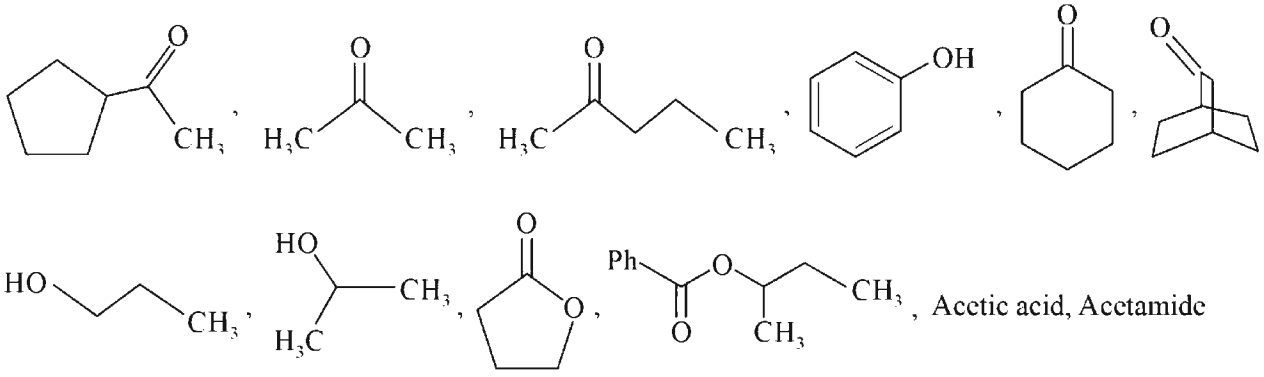
(A) D-2-Deoxy glucose (B) D-3-Deoxy glucose

The sum of total number of moles of $PhNHNH_2$ used with A & B _____ .

84. How many of these amino acid are negatively charged at pH = 7.0?

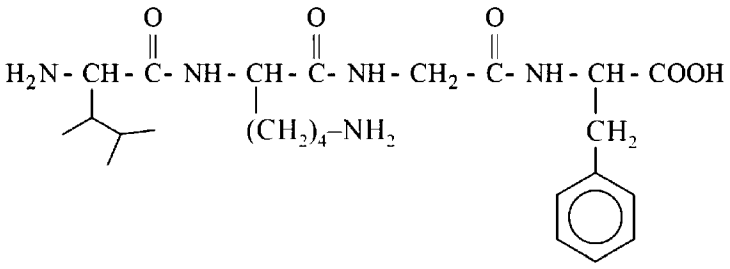
Alanine	Lysine	Cysteine	Glutamic acid
Glycine	Leucine	Aspartic acid	Arginine

85. Identify the total number of compounds that give 2, 4-DNP test



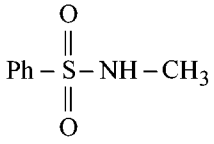
, Acetic acid, Acetamide

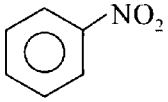
86. A polypeptide chain is given:



Number of optically active essential amino acids in this polypeptide chain is/are:

87. How many compound(s) gives blood red colour with $FeCl_3$ in Lassaigne test

(a) $PhNH_2$ **(b)** $PhSO_3H$ **(c)** 

(d) PhCl **(e)** PhBr **(f)** 

88. Graph between $\log\frac{x}{m}$ and log P is a straight line inclined at an angle 45°. When pressure of 0.5 atm and $\log k = 0.699$, the amount of solute adsorbed per g of adsorbent will be:

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. The pair in which both species have same magnetic moment [spin only]

(A) $\left[Cr(H_2O)_6\right]^{2+}, [CoCl_4]^{2-}$ **(B)** $\left[Cr(H_2O)_6\right]^{2+}, \left[Fe(H_2O)_6\right]^{2+}$

(C) $\left[Mn(H_2O)_6\right]^{2+}, \left[Cr(H_2O)_6\right]^{2+}$ **(D)** $[CoCl_4]^{2-}, \left[Fe(H_2O)_6\right]^{2+}$

2. An effective atomic number of $Co(CO)_4$ is 35 and hence is less stable. It attains stability by:

[Atomic number of Co = 27]

I. Oxidation of Co **II.** Reduction of Co

III. Dimerization **IV.** Trimerization

The correct option is :

(A) I, II **(B)** II, III **(C)** I, II, III **(D)** II, IV

3. Which of the following complexes exhibits geometrical isomerism? [gly = glycinato, en = ethylene diamine, Py = pyridine, ox = oxalate]

(A) $\left[Pt(gly)_2\right]^{2+}$ **(B)** $\left[Pt(en)_2\right]^{2+}$ **(C)** $\left[Pt(Py)_4\right]^{2+}$ **(D)** $\left[Pt(ox)_2\right]$

4. Which has maximum EAN of the underlined atoms? (Cr = 24, Co = 27, Fe = 26, Ni = 28)

(A) [Cr(EDTA)] **(B)** $[Co(en)_3]^{3+}$ **(C)** $[Fe(C_2O_4)_3]^{3-}$ **(D)** $[Ni(CN)_4]^{2-}$

5. Primary and secondary valency of Pt in $[Pt(en)_2Cl_2]Cl_2$ are:

(A) 2, 4 **(B)** 4, 6 **(C)** 6, 6 **(D)** 4, 4

6. Arrange the following in order of decreasing number of unpaired electrons:

(I) $[Fe(H_2O)_6]^{2+}$ (II) $[Fe(CN)_6]^{3-}$ (III) $[Fe(CN)_6]^{4-}$ (IV) $[Fe(H_2O)_6]^{3+}$

(A) IV, I, II, III **(B)** I, II, III, IV **(C)** III, II, I, IV **(D)** II, III, I, IV

7. Which of the following complex is diamagnetic?

(A) Sc^{3+} (aq) **(B)** Ti^{3+} (aq) **(C)** V^{3+} (aq) **(D)** Cr^{3+} (aq)

8. Consider the following complexes:

(I) K_2PtCl_6 (II) $PtCl_4 \cdot 2NH_3$ (III) $PtCl_4 \cdot 3NH_3$ (IV) $PtCl_4 \cdot 5NH_3$

Their electrical conductances in an aqueous solutions are:

(A) 256, 0, 97, 404 **(B)** 404, 0, 97, 256 **(C)** 256, 97, 0, 404 **(D)** 404, 97, 256, 0

9. If excess of $AgNO_3$ solution is added to 100 mL of a 0.024 M solution of Dichlorobis (ethylene diamine) cobalt (III) chloride, how many mol of AgCl be precipitated:

(A) 0.0012 **(B)** 0.0016 **(C)** 0.0024 **(D)** 0.0048

10. Which has maximum conductance?

(A) $PtCl_4 \cdot 6NH_3$ **(B)** $PtCl_4 \cdot 5NH_3$ **(C)** $PtCl_4 \cdot 4NH_3$ **(D)** equal

11. A compound has the empirical formula $CoCl_3 \cdot 5NH_3$. When an aqueous solution of this compound is mixed with excess silver nitrate, 2 mole of AgCl precipitate is obtained per mol of compound. On reaction with excess HCl, no NH_4^+ is detected. Hence, it is:

(A) $[Co(NH_3)_5Cl_2]Cl$ **(B)** $[Co(NH_3)_5Cl]Cl_2$ **(C)** $[Co(NH_3)_5Cl_3]$ **(D)** $[Co(NH_3)_4Cl_2]Cl \cdot NH_3$

12. 0.001 molal solution of a complex $[M(NH_3)_4Cl_4]$ in water has a freezing point depression of 0.0054°C. If K_f for water is 1.8, the correct formula of the complex is:

(A) $[M(NH_3)_4Cl_3]Cl$ **(B)** $[M(NH_3)_4Cl_2]Cl_2$ **(C)** $[M(NH_3)_4Cl]Cl_3$ **(D)** $[M(NH_3)_4Cl_4]$

13. Statement 1 : $[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$ exhibit ionization isomerism.

Statement 2 : Both compounds form chloride ions in solution.

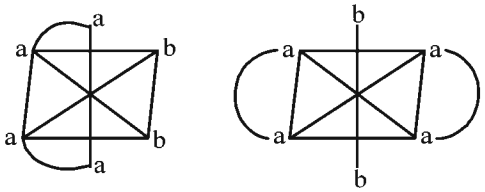
(A) If both the statement are true and statement 2 is the correct explanation of statement 1

(B) If both the statement are true but statement 2 is not the correct explanation of statement 1

(C) If statement 1 is true and statement 2 is false

(D) If statement 1 is false and statement 2 is true

14. Which of the following statements is correct regarding the chirality (optical isomerism) of the cis and trans isomers of the type $M(aa)_2b_2$ (M stands for a metal, a and b are achiral ligands and aa means bidentate ligands



(A) The trans form is achiral and optically inactive while the cis form is chiral and exists in two enantiomeric forms

(B) The cis as well as the trans form are achiral and optically inactive

(C) The trans form is chiral and exists in two enantiomeric forms while the cis form is achiral and optically inactive

(D) The cis as well as the trans form are chiral and each of them exists in two enantiomeric forms

15. Of the following statements, which one is correct?

(A) $[CoF_6]^{3-}$ is a high spin complex and $[Co(NH_3)_6]^{3+}$ is a low spin complex

(B) $[CoF_6]^{3-}$ is a low spin complex and $[Co(NH_3)_6]^{3+}$ is a high spin complex

(C) Both $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$ are low spin complexes

(D) Both $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$ are high spin complexes

16. The two compounds $[Cr(NH_3)_5Br]Cl$ and $[Cr(NH_3)_5Cl]Br$ can be distinguished by reagent A and the two compounds exhibit isomerism (B). Then (A) and (B) are:

(A) $AgNO_3$, ionization **(B)** $AgNO_3$, coordination

(C) $BaCl_2$, ionization **(D)** $BaCl_2$, coordination

17. A metal complex having composition $Cr(NH_3)_4Cl_2Br$ has been isolated in two forms A and B. The form A reacts with $AgNO_3$ to give a white precipitate readily soluble in dilute aqueous ammonia, where as B gives a pale yellow precipitate soluble in concentrated ammonia. The hybridization of Cr in A and magnetic moment in B are respectively:

(A) d^2sp^3, 2.8 BM **(B)** sp^3d^2, 3.8 BM **(C)** d^2sp^3, 3.8 BM **(D)** sp^3d^2, 2.8 BM

18. The complex $\left[M(CrO_4)Cl_2(NH_3)_2\right]$ forms two types of coloured crystals viz, red **(A)** and blue **(B)**. A or B reacts with 1 mole of $AgNO_3$ to give $\frac{1}{2}$ mole of a red precipitate. Further, 1 mole of A reacts slowly with 1 mole of $Ag_2C_2O_4$ to form 2 moles of a white precipitate but B does not react with $Ag_2C_2O_4$. Hence, which of the following could be incorrect?

(A) The central atom is dsp^2hybridised **(B)** Red form is trans isomer and blue form is cis

(C) Blue form is trans isomer and red form is cis **(D)** Oxalate is bidentate ligand

19. The ratio of the value of any colligative property of $K_4[Fe(CN)_6]$ solution to that of $Fe_4[Fe(CN)_6]_3$ (Prussian blue) solution is nearly (assume 100% dissociation of both):

(A) 0.62 **(B)** 0.71 **(C)** 1.4 **(D)** 1.2

20. Which of the following statements is(are) correct?

I. $[Cu(NH_3)_4]^{2+}$ complex ion has tetrahedral geometry and paramagnetic

II. $[Ni(CN)_4]^{2-}$ complex ion has square planar geometry

III. $[CoF_6]^{3-}$ is an outer orbital complex ion

IV. $[Fe(CN)_6]^{3-}$ is an inner orbital complex ion

The correct option is:

(A) I, II **(B)** I, II, III **(C)** II, III, IV **(D)** I, II, III, IV

21. The following are octahedral and tetrahedral complexes and their characteristics.

I. $\left[Fe(H_2O)_6\right]^{+3}$ **II.** $\left[Cr(NH_3)_6\right]^{+3}$ **III.** $[CoCl_4]^{-2}$

(i) All high spin d^5 complexes in octahedral system has CFSE = 0

(ii) Complex I is high spin d^5 octahedral complex

(iii) Number of unpaired electrons in II and III are 3 each

(iv) All Cr (III) octahedral complexes are high spin complexes like II

The wrong statements are:

(A) Only (i) **(B)** Only (ii) **(C)** (i), (ii), (iii), (iv) **(D)** None of these

22. A solution containing 0.319 gm of complex $CrCl_3.6H_2O$ was passed through cation exchanger and the solution given out was neutralized by 28.5 ml of 0.125 M NaOH. The correct formula of the complex will be: [mol. Wt. of complex = 266.5]

(A) $[CrCl(H_2O)_5]Cl_2.H_2O$ **(B)** $[Cr(H_2O)_6]Cl_3$

(C) $[CrCl_2(H_2O)_4]Cl.2H_2O$ **(D)** All are correct

23. The correct order for the CFSE (numerical value) for the following complexes is:

Complex	P	Q	R	S
Formula	$[CoF_6]^{3-}$	$[Co(CN)_6]^{3-}$	$[Co(NH_3)_6]^{3+}$	$[Co(H_2O)_6]^{3+}$

(A) P > Q > R > S **(B)** Q > R > S > P **(C)** S > R > P > Q **(D)** R > Q > P > S

24. Which of the following is true about the complex $[PtCl_2(NH_3)(H_2O)]$; [Atomic no. of Pt = 78]

(i) It will have two geometrical isomeric forms, cis and trans

(ii) The hybridization state of Pt (II) is sp^3

(iii) It is a square planar complex

(iv) It is a diamagnetic complex

(v) It can show hydrate isomerism

(vi) It is a tetrahedral complex

(A) (i), (iii), (iv) **(B)** (ii), (iv), (v) **(C)** (ii), (v), (vi) **(D)** (i), (v), (vi)

25. Amongst the following the most stable complex is:

(A) $[Fe(H_2O)_6]^{3+}$ **(B)** $[Fe(C_2O_4)_3]^{3-}$ **(C)** $[Fe(H_2O)_5NO]^{2+}$ **(D)** $[FeF_6]^{3-}$

26. Which one of the following high-spin complexes has the largest CFSE (Crystal field stabilization energy)?

(A) $[Mn(H_2O)_6]^{2+}$ **(B)** $[Cr(H_2O)_6]^{2+}$ **(C)** $[Mn(H_2O)_6]^{3+}$ **(D)** $[Cr(H_2O)_6]^{3+}$

27. IUPAC name of complex $K_3[Al(C_2O_4)_3]$ is:

(A) Potassium alumino-oxalate **(B)** Potassium trioxalatoaluminate (III)

(C) Potassium aluminium (III) oxalate **(D)** Potassium trioxalatoaluminate (IV)

28. Which one of the following square planar complex will be able to show geometrical isomerism?

(A) MA_3B **(B)** $M(AA)_2$ **(C)** MABCD **(D)** MA_4

29. A complex of platinum, ammonia and chloride produces four ions per molecule in the solution. The structure consistent with the observation is:

(A) $[Pt(NH_3)_4]Cl_4$ **(B)** $[Pt(NH_3)_2Cl_4]$ **(C)** $[Pt(NH_3)_5Cl]Cl_3$ **(D)** $[Pt(NH_3)_4Cl_2]Cl_2$

30. Which complex is likely to show optical activity?

(A) $\text{Trans} - \left[Co(NH_3)_4Cl_2\right]^+$ **(B)** $\left[Cr(H_2O)_6\right]^{3+}$

(C) $\text{Cis} - \left[Co(NH_3)_2(en)_2\right]^{3+}$ **(D)** $\text{Trans} - \left[Co(NH_3)_2(en)_2\right]^{3+}$

31. How many moles of AgCl would be obtained, when 100 ml of 0.1 M $Co(NH_3)_5Cl_3$ is treated with excess of $AgNO_3$?

(A) 0.01 **(B)** 0.02 **(C)** 0.03 **(D)** none of these

32. Which of the following statements is correct?

(A) Geometrical isomerism is not observed in complexes of coordination number 4 having tetrahedral geometry

(B) Square planar complexes generally do not show geometrical isomerism

(C) The square planar complex of general formulae Ma_3b or Mab_3 exhibits cis-trans isomerism

(D) The platinum glycinato complex, $\left[Pt(Gly)_2\right]$ does not show geometrical isomerism

33. How many isomers are possible for the complex ion $\left[Cr(NH_3)(OH)_2Cl_3\right]^{2-}$?

(A) 2 **(B)** 3 **(C)** 4 **(D)** 5

34. A complex of certain metal has the magnetic moment of 4.91 BM whereas another complex of the same metal with same oxidation state has zero magnetic moment. The metal ion could be:

(A) Co^{2+} **(B)** Mn^{2+} **(C)** Fe^{2+} **(D)** Fe^{3+}

35. On treatment of $[Ni(NH_3)_4]^{2+}$ with concentrated HCl, two compounds I and II having the same formula, $[Ni(NH_3)_2Cl_2]$ are obtained, I can be converted into II by boiling with dilute HCl. A solution of I reacts with oxalic acid to form $[Ni(NH_3)_2(C_2O_4)]$ whereas II does not react. Point out the correct statement of the following:

(A) I cis, II trans ; both tetrahedral **(B)** I cis, II trans ; both square planar

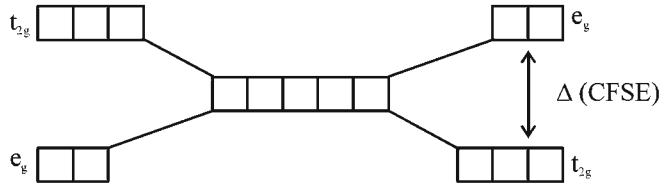
(C) I trans, II cis ; both tetrahedral **(D)** I trans, II cis ; both square planar

36. Which of the following complex shows ionization isomerism:

(A) $\left[Cr(NH_3)_6\right]Cl_3$ **(B)** $\left[Co(en)_3\right]Cl_2$ **(C)** $\left[Cr(en)_3\right]Cl_3$ **(D)** $\left[Co(NH_3)_5Br\right]SO_4$

Paragraph for Questions 37 - 39

When the degenerate orbitals of d sub-shell of an isolated atom / ion come under influence of magnetic field of ligands, the degeneracy is lost. The two sets t_{2g} (d_{xy}, d_{yz}, d_{xz}) and $e_g\left(d_{z^2}, d_{x^2-y^2}\right)$ are either higher or lower energetic depending upon the nature of magnetic field.



Tetrahedral field **Octahedral field**

Value of CFSE depends upon nature of ligand and spectrochemical series has been made experimentally. For tetrahedral complexes, Δ_t is about 4 / 9 times to Δ_0. This energy lies in visible region and that is why electronic transitions are responsible for colour. Such transitions not possible with d^0 and d^{10} configuration.

37. The values of CFSE (Δ_0) for complexes given below follow the order:

(I) $\left[Co(NH_3)_6\right]^{3+}$ **(II)** $\left[Rh(NH_3)_6\right]^{3+}$ **(III)** $\left[Ir(NH_3)_6\right]^{3+}$

(A) I < II < III **(B)** I > II > III **(C)** I < II > III **(D)** I = II = III

38. The d – orbitals which are lower energetic in an octahedral magnetic field are:

(A) d_{xy} and d_{z^2} **(B)** $d_{x^2-y^2}$ and d_{z^2} **(C)** d_{xy}, d_{xz} and d_{yz} **(D)** d_{z^2} only

39. Ti^{3+} (aq) is purple while Ti^{4+} (aq) is colourless because:

(A) There is no crystal field effect in Ti^{4+}

(B) The energy difference between t_{2g} and e_g of Ti^{4+} is quite high and does not fall in the visible region

(C) Ti^{4+} has d^0 configuration

(D) Ti^{4+} is very small in comparison to Ti^{3+} and hence does not absorb any radiation

Paragraph for Questions 40 - 42

Square planar complexes are formed by d^8 ions with strong field ligands. The crystal field splitting Δ_0 is larger for second and third row transition elements and for more highly charged species. All the complexes having $4d^8$ and $5d^8$ configurations are mostly square planar including those with weak field ligands such as halide ions. Square planar complexes can show geometrical isomerism but they do not show optical isomerism due to the presence of plane of symmetry.

40. Which of the following statements is/are true for the complex $[Ni(PPh_3)_2Br_2]$?

(A) Hybridisation is the same as found with strong field ligands like CN^- (with +II oxidation state)

(B) Hybridisation is the same as found with strong field ligands like CO (with zero oxidation state)

(C) Hybridisation is the same as found with weak field ligands like halide ions (with + II oxidation states)

(D) **(B)** and **(C)** both

41. Amongst the following complexes which has square planar geometry?

(A) $[RhCl(CO)(PPh_3)_2]$ **(B)** $K_3[Cu(CN)_4]$

(C) $K_2[Zn(CN)_4]$ **(D)** $[Ni(CO)_4]$

42. Which one of the following square planar complexes will show geometrical isomerism?

(A) $[Pt(en)_2]^{2+}$ **(B)** $[Pt(gly)_2]$

(C) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ **(D)** **(B)** and **(C)** both

Paragraph for Questions 43 - 45

In metal carbonyls, there is synergic bonding interaction between metal and carbon monoxide. This leads to increase in strength of metal-ligand bond and decrease in bond order of CO in carbonyl complex as compared to bond order in carbon monoxide.

Simple carbonyls are invariable spin-paired complexes except for vanadium metal.

43. Which of the following statement is false for Nickel carbonyl $[Ni(CO)_4]$?

(A) It is a colourless compound

(B) The Ni – C – O group is linear

(C) The four carbonyl group are lying at the corners of a regular tetrahedron

(D) The metal – carbon bond length (for σ bond) does not alter

44. Which amongst the following metal carbonyls are inner orbital complexes with diamagnetic property

(I) $Ni(CO)_4$ (II) $Fe(CO)_5$ (III) $V(CO)_6$ (IV) $Cr(CO)_6$

Select the correct answer from the codes gives below:

(A) I and II only **(B)** II, III and IV only **(C)** II and IV only **(D)** I, II and IV only

45. Which of the following statement is correct for metal carbonyls?

(A) In general, the effective atomic number for a stable monomeric carbonyl is equal to the atomic number of the next inert gas except $[V(CO)_6]$

(B) The metal-carbon bond in metal carbonyls possess double bond character

(C) The C – O bond length in $[Cr(CO)_6]$ is greater than that in $\left[Ni(CO)_4\right]$

(D) All of these

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

46. Select correct statement(s):

(A) $Mn_3(CO)_{12}$ is Dodecacarbonyltrimanganese (0)

(B) EDTA is a polydentate, flexidentate and chelating ligand

(C) $[Co(H_2O)_6]^{+2}$ is more stable than $[Ni(H_2O)_6]^{+2}$

(D) $[Cu(NH_3)_4]^{+2}$ is having dsp^2hybridisation

47. Correct statement(s) in the following is(are):

(A) Coordination number of a central metal cation in (3d series) is twice its valency

(B) Octahedral complexes of Ma_3b_3 type have only two geometrical isomers

(C) $[Mg(EDTA)]^{-2}$ complex anion contains 5 chelated rings

(D) [M ABCD] type of tetrahedral complexes always possess two stereo isomers

48. In which pairs, both the compounds show geometrical isomerism?

(A) $\left[Pt(NH_3)_2Cl_2\right]$ and $\left[Co(en)_2Cl_2\right]$ **(B)** $\left[Fe(NH_3)_2(CN)_4\right]^{2-}$ and $\left[CoCl_2(OX)_2\right]^{3-}$

(C) $\left[Co(NH_3)_5Cl\right]SO_4$ and $\left[Cr(en)_3\right]^{3+}$ **(D)** $\left[Co(NH_3)_4Cl_2\right]^{+}$ and $\left[Co(NH_3)_3(NO_2)_3\right]$

49. Select the correct statements:

(A) Chelation effect is more important for penta and hexadented ligands for stability of complex

(B) Greater the charge on the central metal cation, greater the value of Δ (CFSE)

(C) In complex ion $[CoF_6]^{3-}$, F^- is a weak field ligand, so that $\Delta_{oct} < P$ (Pairing energy) and it is low spin complex

(D) $[CoCl_2(NH_3)_2(en)]^+$ complex ion will have four different stereoisomer

50. Which of the following ionic species will not impart colour to an aqueous solution?

(A) Ti^{4+} **(B)** Cu^+ **(C)** Zn^{2+} **(D)** Cr^{3+}

51. Which of the following can show coordination isomerism?

(A) $[Cu(NH_3)_4][PtCl_4]$ **(B)** $\left[Fe(NH_3)_6\right]_2\left[Pt(CN)_6\right]_3$

(C) $\left[Co(NH_3)_6\right]\left[Cr(C_2O_4)_3\right]$ **(D)** $\left[Pt(en)_3\right](SO_4)_2$

52. Which statement(s) is/are correct?

(A) $\left[Ag(NH_3)_2\right]^+$ is linear with sp hybridization of Ag^+ ion

(B) $NiCl_4^{2-}$, VO_4^{3-}, MnO_4^- have tetrahedral geometry

(C) $\left[Cu(NH_3)_4\right]^{2+}$, $\left[Pt(NH_3)_4\right]^{2+}$, $\left[Ni(CN)_4\right]^{2-}$ have dsp^2 hybridization of the metal ion

(D) $Fe(CO)_5$ have bipyramidal structure with dsp^3 hybridization of iron

53. Which of the following complexes is / are paramagnetic?

(A) $[Fe(CN)_6]^{4-}$ **(B)** $[Cu(NH_3)_4]^{2+}$ **(C)** $[Ti(H_2O)_6]^{3+}$ **(D)** $[Ni(en)_2]^{2+}$

54. The complex $[Fe(H_2O)_5NO]^{2+}$ is formed in the brown ring test for nitrate when freshly prepared $FeSO_4$ solution is added to aqueous solution of NO_3^- followed by addition of conc. H_2SO_4. Select correct statements about this complex:

(A) colour change is due to charge transfer

(B) it has iron in +1 oxidation state and nitrosyl as NO^+

(C) it has magnetic molent of 3.87 B.M. confirming three unpaired electrons in Fe

(D) It has octahedral geometry

55. In the compound $CoCl_3 \cdot 5NH_3$

(A) all the Cl show primary valency (PV)

(B) two Cl show (PV) and one Cl secondary valency (SV)

(C) two Cl show (PV) and one Cl (PV) as well as (SV)

(D) all the NH_3 show secondary valency

56. Identify the correct statements:

(A) Δ_0 increasing order is $[CrCl_6]^{3-} < [Cr(NH_3)_6]^{+3} < [Cr(CN)_6]^{3-}$

(B) CFSE for $[Ti(H_2O)_6]^{3+}$ is $-0.4\Delta_0$

(C) $[NiCl_4]^{2-}$ as well as $[Ni(CO)_4]$ are paramagnetic

(D) The halide ions are arranged as $I^- < Br^- < Cl^- < F^-$ in the spectro chemical series.

57. Aqueous solution of which of the following complexes impart certain colour?

(A) $[Ti(H_2O)_3Cl_3]Cl$ **(B)** $[Cu(NH_3)_4]Cl$ **(C)** $Na_2[Zn(CN)_4]$ **(D)** $[Cr(H_2O)_5Cl]Cl_2$

58. Which of the following statements is(are)correct?

(A) $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$ and $[Co(NO_2)_6]^{3-}$ are diamagnetic, involving d^2sp^3hybridisation

(B) $[Zn(NH_3)_4]^{2+}$, $[FeCl_4]^-$ and $[Ni(CO)_4]$ are diamagnetic, involving sp^3hybridisation

(C) The magnetic moment of $[Fe(H_2O)_6]^{3+}$ is 5.92 BM and that of $[Fe(CN)_6]^{3-}$ is 1.73 BM

(D) The magnetic moment of $K_4[MnF_6]$ and $K_3[FeF_6]$ are same

59. Which of the following statement is (are) correct with respect to the crystal field theory?

(A) It considers only the metal ion d-orbitals and gives no consideration at all to other metal orbitals.

(B) It cannot account for the π bonding in complexes.

(C) The ligands are point charges which are either ions or neutral molecules

(D) The magnetic properties can be explained in terms of splitting of d-orbitals in different crystal fields

60. A complex compound of one cobalt (III) ion, two ethylene diamine molecules, two chloride ions and one nitrite ion will show

(A) linkage isomerism **(B)** ionization isomerism

(C) geometrical isomerism **(D)** optical isomerism

61. Consider the following statements

S_1 : Generally square planar complexes show geometrical isomerism but do not exhibit optical isomerism because they do not possess plane of symmetry.

S_2 : $\Delta_t = \frac{4}{9}\Delta_o$

S_3 : In octahedral complexes each electron entering the t_{2g} orbitals stabilizes the complex ion by 0.4 Δ_o and each electron entering the e_g orbital destabilizes the complex by an amount of 0.6 Δ_o .

And select the correct statement from the codes given below:

(A) S_1 and S_3 are correct **(B)** S_2 and S_3 are correct

(C) S_1 is incorrect **(D)** S_2 and S_3 are incorrect

62. Select the correct comparison of complexes on the basis of magnitude of Δ_o:

(A) $\left[Co(CN)_6\right]^{3-} > \left[Co(H_2O)_6\right]^{3+}$ **(B)** $\left[Co(H_2O)_6\right]^{2+} < \left[Co(H_2O)_6\right]^{3+}$

(C) $\left[Co(H_2O)_6\right]^{3+} > \left[Rh(H_2O)_6\right]^{3+}$ **(D)** $\left[Co(NH_3)_6\right]^{3+} < \left[CoF_6\right]^{3-}$

63. In which of the following pairs both the complexes show optical isomerism?

(A) $cis-\left[Cr(en)_2Cl_2\right]$ and $cis-\left[Co(NH_3)_4Cl_2\right]$

(B) $\left[Co(gly)_3\right]$ and $cis-\left[Co(en)_2Cl_2\right]$

(C) $cis\left[Pt(en)_2Cl_2\right]$ and $\left[Ni(NH_3)_3Cl_3\right]$

(D) $\left[Co(NO_3)_3(NH_3)_3\right]$ and $cis-\left[Pt(en)_2Cl_2\right]$

64. Which of the following statement(s) is/are true?

(A) The order of magnitude of Δ_o in the following complexes is $[Co(H_2O)(NH_3)_5]^{3+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

(B) The order of the stability of the complexes in aqueous solution is $[Cu(CN)_4]^{2-} > [Cu(NH_3)_4]^{2+} > [Cu(H_2O)_6]^{2+}$

(C) Irving William's order of stability is $Mn^{2+} < Fe^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+} < Zn^{2+}$

(D) The order of magnetic moments of the complex is $[Fe(H_2O)_6]^{3+} > [CoF_6]^{3-} > [Cr(CN)_6]^{3-}$

65. Which statement(s) is/are correct?

(A) $[Ni(PPh_3)_2Cl_2]$ – tetrahedral and paramagnetic

(B) $[Ni(CO)_4]$ – tetrahedral and diamagnetic

(C) $[Ni(CN)_4]^{2-}$ square planar and diamagnetic

(D) $[Ni(CO)_4]$ – square planar and diamagnetic

66. Which of the following statement(s) is / are incorrect?

(A) Both $[Co(Ox)_3]^{3-}$ and $[CoF_6]^{3-}$ are paramagnetic

(B) $CoCl_3 \cdot 3NH_3$ complex is non-conductor of electricity

(C) The number of possible geometrical isomers for complex $[Pt(NO_2)(Py)(OH)(NH_3)]$ is six

(D) The oxidation state of iron in brown ring complex $[Fe(H_2O)_5NO]SO_4$ is + II where NO is NO^+

67. Which of the following complexes can exist as diastereoisomers?

(A) $\left[Cr(NH_3)_2Cl_4\right]^-$ **(B)** $\left[Co(NH_3)_5Br\right]^{2+}$ **(C)** $\left[FeCl_2(NCS)_2\right]^{2-}$ **(D)** $\left[PtCl_2Br_2\right]^{2-}$

68. Select the correct statements from the following

(A) $[Sc(H_2O)_6]^{3+}$ and $[Ti(H_2O)_6]^{3+}$ both are colourless

(B) $Co(NH_3)_4Br_2Cl$ show ionization and geometrical isomerism.

(C) $[Pd(NO_2)_2(NH_3)_2]$ is square planar and shows geometrical as well as linkage isomerism.

(D) $[PtCl_4]^{2-}$ is a square planar complex

69. Which of the following complexes does show stereo isomerism?

(A) $[Co(NH_3)_4Cl_2]^+$ **(B)** $[Co(NH_3)_3(NO_2)_3]$ **(C)** $[Cr(en)_3]^{3+}$ **(D)** $[Pt(gly)_2]$

70. The complex $[Fe(H_2O)_5NO]^{2+}$ is formed in 'brown ring test' for nitrates. Choose the correct statements for the complex:

(A) Its magnetic moment is approximately 3.9 BM

(B) The oxidation state of iron is + I

(C) The hybridization of central metal ion is sp^3d^2

(D) The brown colour of the ring is due to d – d transition

71. Select the correct statements:

(A) Potassium ferrocyanide and potassium ferricyanide can be differentiated by measuring the solid state magnetic moment

(B) The complex $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$ can be differentiated by adding aqueous solution of barium chloride

(C) The complex $[Co(NH_3)_5Cl]Br$ and $[Co(NH_3)_5Br]Cl$ can be differentiated by adding aqueous solution of silver nitrate

(D) $\left[Co(NH_3)_6\right]Cl_3$ and $\left[Co(NH_3)_5Cl\right]Cl_2$ can be differentiated by electrical conductivity of respective aqueous solutions

72. $[Fe(en)_2(H_2O)_2]^{2+}$ + en $\rightarrow$ complex (X). The correct statements about the complex (X) is:

(A) It is low spin complex **(B)** It is diamagnetic

(C) It shows geometrical isomerism **(D)** It shows optical isomerism

73. Which of the following are bidentate monoanion ligands?

(A) Acetyl acetonato **(B)** Oxalato ion

(C) Dimethyl glyximato **(D)** None of these

74. Which amongst the following are organometallic compounds?

(A) $Al_2(CH_3)_6$ **(B)** $K[PtCl_3C_2H_2]$ **(C)** $N(CH_3)_3$ **(D)** $B(CH_3)_3$

75. Complexes $\left[Co(NH_3)_5SO_4\right]Br$ and $\left[Co(NH_3)_5Br\right]SO_4$ can be distinguished by:

(A) conductance measurement **(B)** using $BaCl_2$

(C) using $AgNO_3$ **(D)** dipole moment measurement

76. Which of the following statements are true?

(A) $MnCl_4^{2-}$ ion has tetrahedral geometry and is paramagnetic

(B) $[Mn(CN)_6]^{2-}$ ion has octahedral geometry and is diamagnetic

(C) $[Cu(CN)_4]^{3-}$ has square planar geometry and is diamagnetic

(D) $[Ni(Ph_3P)_2Br_3]$ has trigonal bipyramidal geometry and is paramagnetic

77. Other than the X-ray diffractions, how could be the following pairs of isomers be distinguished from the another by:

$[Cr(NH_3)_6][Cr(NO_2)_6]$ and $[Cr(NH_3)_4(NO_2)_2][Cr(NH_3)_2(NO_2)_4]$

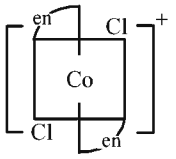
(A) dipole moment measurement

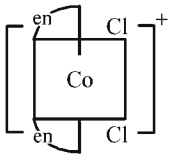
(B) measurement of molar conductance

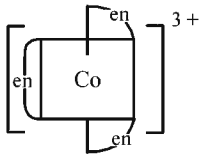
(C) measuring magnetic moments

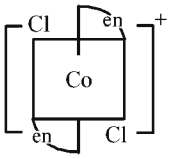
(D) observing their colours

78. Which of the following ions are optically active?

(A) 

(B) 

(C) 

(D) 

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Set 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Set 2 can be matched with Set 1.

79. MATCH THE FOLLOWING:

Set – 1 (Complex Compound)		**Set – 2 (Type of Isomerism Shown)**	
(1)	$[Co(H_2O)_3F_3]$	**(P)**	Geometrical isomerism
(2)	$[Co(en)_3]Cl_3$	**(Q)**	Optical isomerism
(3)	$[Co(en)_2(NO_2)_2]Cl$	**(R)**	Linkage isomerism
(4)	$K_3[Cr(CN)_6]$	**(S)**	Ionisation isomerism

(A) 1 – P, 2 – Q, 3 – R, 4 – S **(B)** 1 – Q, 2 – P, 3 – S, 4 – R

(C) 1 – P, 2 – Q, 3 – P,Q,R,S 4 – R **(D)** 1 – R, 2 – Q, 3 – S, 4 – P

80. MATCH THE FOLLOWING:

Set – 1 (Complex compound)		**Set – 2 (Related property)**	
(1)	$[Co(NH_3)_4(H_2O)_2]Cl_2$	**(P)**	Give precipitate by the action of $AgNO_3$(aq)
(2)	$[Pt(NH_3)_2Cl_2]$	**(Q)**	Paramagnetic in nature
(3)	$[Co(H_2O)_5Cl]Cl$	**(R)**	Exhibit geometrical isomerism
(4)	$[Ni(H_2O)_6]Cl_2$	**(S)**	Does not conduct electricity in its aqueousstate

(A) 1 – P, 2 – S, 3 – R, 4 – Q **(B)** 1 – P,Q,R 2 –R,S 3 – P,Q 4 –P,Q

(C) 1 – S, 2 – R, 3 – Q, 4 – P **(D)** 1 – R, 2 – P, 3 – S, 4 – Q

81. MATCH THE FOLLOWING:

Set – 1		Set – 2	
(1)	$[MnCl_6]^{2-}$	**(P)**	contain one unpaired electron
(2)	$[Fe(CN)_6]^{3-}$	**(Q)**	d^2sp^3
(3)	$[Co(NH_3)_6]^{3+}$	**(R)**	outer orbital complex
(4)	$[Fe(H_2O)_6]^{2+}$	**(S)**	involve electron rearrangement

(A) 1 – Q, 2 – P, 3 – R, 4 – S **(B)** 1 – P, 2 – Q, 3 – S, 4 – R
(C) 1 – Q, 2 – S, 3 – P, 4 – R **(D)** 1 – Q 2 – P,Q,S 3 –Q,S 4 – R

82. MATCH THE FOLLOWING:

Set – 1 (Ligand)		Set – 2 (Related Character)	
(1)	Triphenyl phosphine	**(P)**	Ambidentate
(2)	Ethylene diamine	**(Q)**	Monodentate
(3)	SCN^-	**(R)**	Chelating ligand
(4)	Dimethyl glyoximate	**(S)**	Bidentate

(A) 1 – Q, 2 – P, 3 – S, 4 – R **(B)** 1 – Q, 2 – R,S 3 – P,Q 4 – R,S
(C) 1 – P, 2 – S, 3 – Q, 4 – R **(D)** 1 – Q, 2 – R, 3 – S, 4 – P

83. MATCH THE FOLLOWING:

Set – 1		Set – 2	
(1)	$[Fe(H_2O)_5NO]SO_4$	**(P)**	$\sqrt{3}$ BM, d^2sp^3
(2)	$[Mn(CN)_6]^{-4}$	**(Q)**	zero BM, dsp^2
(3)	$[Fe(CO)_5]$	**(R)**	$\sqrt{15}$ BM, sp^3d^2
(4)	$[Ni(CN)_4]^{2-}$	**(S)**	zero BM, dsp^3

(A) 1 – P, 2 – R, 3 – S, 4 – Q **(B)** 1 – R, 2 – S, 3 – P, 4 – Q
(C) 1 – R, 2 – P, 3 – Q, 4 – S **(D)** 1 – R, 2 – P, 3 – S, 4 – Q

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

84. Find out the numbers of isomers (structural and stereo) produced by the complex $[Pt(NH_3)_2(NO_2)Cl_3]$

85. What is the number of stereoisomers possible for the octahedral complex ion $[Co(CH_3NH_2)_2(Py)_2(C_2O_4)]^{+1}$

86. During of 'Fixing of image' in the photography process the following reaction takes place $AgBr + xNa_2S_2O_3 \rightarrow Na_y[Ag(S_2O_3)_x]$ (water soluble). The value of (x + y) is _____ .

87. The molecular formula of an octahedral complex is $Cr(Cl)(Br)(I).4H_2O$. How many ionization isomer(s) is/are possible for the complex?

88. In the reaction $\underset{(CiS)}{[CoCl_2(NH_3)_4]^+} + Cl^- \rightarrow [CoCl_3(NH_3)_3] + NH_3$. How many isomers of the products (co-complex) is obtained.

89. Effective atomic number of complex of $_{42}Mo$ is 54. The formula of its carbonyl complex is $Mo(CO)_x$. The value of 'x' is _____.

90. Number of isomers possible for the complex compound $\left[Co(en)_2Cl(NO_2)\right]Cl$ are _____.

91. How many of the following complexes can exist as 'd' and '*l*' isomers

$\left[Co(NH_3)_4Cl_2\right]^+$, $\left[Co(NH_3)_3Cl_3\right]$, trans $\left[Co(en)_2Cl_2\right]^+$,

Cis $\left[Co(en)_2Cl_2\right]^+$, $\left[Cr(Ox)_3\right]^{3-}$, $\left[Cr(en)_3\right]^{3+}$, $\left[Pt(en)_2Cl_2\right]$

92. Find the number of paramagnetic compound(s) with octahedral anion.

$K_2[CoF_6]$:	$O_2[AsF_6]$:	$K_2[CoCl_4]$:	$K_3[Co(CN)_6]$:
$K_3[CoF_6]$:	$[Ni(NH_3)_6]SO_4$:	$[Pt(NH_3)_6][Fe(CN)_6]$:	$Na_2[Fe(CN)_5NO]$

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Froth floatation process is used for the concentration of:
(A) Oxide ores **(B)** Sulphide ores **(C)** Chloride ores **(D)** Amalgams

2. In metallurgical processes the flux used for removing acidic impurities is:
(A) Silica **(B)** Sodium chloride **(C)** Lime stone **(D)** Sodium carbonate

3. The main function of roasting is:
(A) to remove the volatile matter **(B)** oxidation of ore
(C) Both A and B **(D)** to make slag

4. Which of the following metals is obtained by leaching its ore with dilute cyanide solution?
(A) Silver **(B)** Titanium **(C)** Vanadium **(D)** Zinc

5. Electrolytic reduction method is used in the extraction of:
(A) Highly electronegative elements **(B)** High electropositive elements
(C) Transition metals **(D)** Noble metals

6. In electro refining of metal the pure metal is made the anode and a strip of pure metal as cathode during the electrolysis of an aqueous solution of a complex metal salt. This method cannot be used for refining of:
(A) Silver **(B)** Copper **(C)** Aluminium **(D)** Gold

7. Zone refining process is used for the:
(A) Concentration of an ore **(B)** Reduction of a metal oxide
(C) Purification of metal **(D)** Purification of an ore

8. The ignition mixture in alumino thermite process contains a mixture of:
(A) Magnesium powder and BaO_2 **(B)** Magnesium powder, aluminium and BaO_2
(C) Magnesium and aluminium powders **(D)** Magnesium and aluminium oxide

9. Which of the following is not employed for refining of metal?
(A) Poling **(B)** Leaching **(C)** Electrolysis **(D)** Liquation

10. The purpose of smelting an ore is:
(A) to oxidise it **(B)** to reduce it
(C) to separate volatile impurities **(D)** to obtain an alloy

11. Roasting is done generally in case of the:
(A) oxide ores **(B)** silicate ores **(C)** sulphide ores **(D)** carbonate ores

12. Cupellation process is used in the metallurgy of:
(A) Cu **(B)** Ag **(C)** Zn **(D)** Al

13. The slag obtained during the extraction of copper pyrites is composed mainly of:
(A) Au_2S **(B)** $FeSiO_3$ **(C)** $CuSiO_3$ **(D)** SiO_2

14. Which one of the following benefication processes is used for the minerals $Al_2O_3.2H_2O$?

(A) Froth floatation **(B)** Leaching **(C)** Liquation **(D)** Magnetic separation

15. Among the following statements, the incorrect one is:

(A) Calamine and siderite are carbonates **(B)** Argentite and cuprite are oxides

(C) Zinc blende and iron pyrites are sulphides **(D)** Malachite and azurite are basic carbonates

16. The metal extracted by cyanide process is:

(A) Silver **(B)** Copper **(C)** Iron **(D)** Sodium

17. Malachite is an ore of:

(A) Iron **(B)** Zinc **(C)** Copper **(D)** Mercury

18. Heating an ore in the absence of air below its melting point is called:

(A) Leaching **(B)** Roasting **(C)** Smelting **(D)** Calcination

19. In the commercial electrochemical process for aluminium extraction the electrolyte used is:

(A) $Al(OH)_3$ in NaOH solution

(B) an aqueous solution of $Al_2(SO_4)_3$

(C) a molten mixture of Al_2O_3 and Na_3AlF_6

(D) a molten mixture of Al_2O_3 and $Al(OH)_3$

20. The most electropositive metals are isolated from their ores by:

(A) high temperature reduction with C

(B) self reduction

(C) thermal decomposition

(D) electrolysis of fused ionic salts

21. In order to refine blister copper it is melted in a furnace and is stirred with green logs of wood. The purpose is:

(A) to expel the dissolved gases in blister copper

(B) to bring the impurities to surface and oxidise them

(C) to increase carbon content of copper

(D) to reduce the metallic oxide impurities with hydrocarbon gases liberated from the wood

22. ΔG° v/s T plot in Ellingham diagram slopes downward for the reaction:

(A) $Mg_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow MgO_{(s)}$ **(B)** $2Ag_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow Ag_2O_{(s)}$

(C) $C_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)}$ **(D)** $CO_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{2(g)}$

23. Which of the following is an important ore of uranium?

(A) Zinc blende **(B)** Pitch blende **(C)** Galena **(D)** Malachite

24. By which process Cu and Ag are extracted respectively:

(A) Carbon reduction; Self-reduction

(B) Self-reduction; Carbon reduction

(C) Electrolytic reduction; cyanide process

(D) Self-reduction; Cyanide process

Paragraph for Questions 25 - 27

Copper is the most noble of the first row transition metals and occurs in small deposits in several countries. The main ores of copper include cuprite (Cu_2O), copper glance (Cu_2S) malachite ($Cu_2(OH)_2CO_3$) and chalcopyrite ($CuFeS_2$). However 80% of the world copper production comes from the ore chalcopyrite. The extraction of copper from chalcopyrite involves partial roasting, removal of iron, self-reduction, poling and electrolytic refining.

25. Partial roasting of chalcopyrite produces:

(A) Cu_2S and FeO **(B)** Cu_2O and FeO **(C)** CuS and Fe_2O_3 **(D)** Cu_2O and Fe_2O_3

26. Iron is removed from chalcopyrite as:

(A) FeO **(B)** FeS **(C)** Fe_2O_3 **(D)** $FeSiO_3$

27. In self-reduction the reducing species is:

(A) S **(B)** O^{2-} **(C)** S^{2-} **(D)** SO_2

28. Poling process is used:

(A) for the removal of Cu_2O from Cu **(B)** for removal of S from Cu_2S

(C) for the removal of FeO from Cu **(D)** None of these

29. In electro refining process impure copper acts as:

(A) Anode **(B)** Cathode **(C)** Both **(D)** None of these

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

30. Which of the following is(are) a carbonate mineral:

(A) Trona **(B)** Dolomite **(C)** Malachite **(D)** Siderite

31. Which of the following ore(s) is(are) concentrated by forth floatation process?

(A) Galena (PbS) **(B)** Copper pyrite ($CuFeS_2$)

(C) Cinnabar (HgS) **(D)** Argentite (Ag_2S)

32. Which of the following reactions occurs during calcination?

(A) $CaCO_3 \cdot MgCO_3 \rightarrow CaO + MgO + CO_2$ **(B)** $FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$

(C) $2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$ **(D)** $Cu_2S + 2CuO \rightarrow 4Cu + SO_2$

33. Self-reduction process is used for the extraction of:

(A) Cu **(B)** Hg **(C)** Pb **(D)** Zn

34. Which of the following ores contains more than one metals?

(A) Copper pyrite **(B)** Dolomite **(C)** Carnalite **(D)** Cryolite

35. Consider the following statements related to roasting and identify **correct** statement(s).

(A) Roasting is carried out to convert sulphide into oxide.

(B) Roasting is carried out to melt the ore.

(C) Roasting is carried out to remove moisture, water of crystallization and to expel organic matter.

(D) Roasting is carried out to remove volatile impurities.

36. Magnesium oxide is used for the lining in steel making because it remove impurities of which of the following through slag formation?

(A) S **(B)** Si **(C)** P **(D)** None of these

37. Which of the following ores of copper is roasted not calcined during recovery of copper?

(A) Copper pyrite **(B)** Chalcocite **(C)** Malachite **(D)** Cuprite

38. Metals are usually extracted by reduction. The concentrated ores is converted to oxides for reduction to metal. In which of the following case concentrated ore is directly used for reduction?

(A) Rutile **(B)** Bauxite **(C)** Haematite **(D)** Cassiterite

39. Which of the following minerals of aluminium is an ore of aluminium?

(A) Cryolite; Na_3AlF_6 **(B)** Feldspar; $KAlSi_3O_8$

(C) Bauxite; $Al_2O_3 \cdot 2H_2O$ **(D)** China clay; $Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$

40. Identify correctly matched ores and method of their concentration.

(A) Galena; Froth floatation process **(B)** Bauxite; Leaching

(C) Cassiterite; Gravity separation **(D)** Magnetite; Electromagnetic separation

41. In the equation $4M + 8CN^- + 2H_2O + O_2 \rightarrow 4[M(CN)_2]^- + 4OH^-$. The metal M is:

(A) Al **(B)** Ag **(C)** Au **(D)** Fe

42. Which of the following is correctly matched?

(A) Mond's process; Refining of Nickel

(B) Van Arkel's process; Ultrapure metal

(C) Cyanide process; Extraction of silver

(D) Froth-Floatation process; Concentration of sulphide ores.

43. In the cyanide extraction process of silver from argentite (Ag_2S) ore:

(A) O_2 acts as oxidizing agent

(B) $Na[Ag(CN)_2]$ is formed as soluble complex

(C) Zn acts as reducing agent

(D) Ore is concentrated by froth floatation process

44. Leaching is often used for concentration of ore if the ore is soluble in some suitable solvent. Identify ore and solvent used for leaching of the ore?

(A) Bauxite; NaOH **(B)** Silver; NaCN

(C) Gold; KCN **(D)** Pitch blende; H_2SO_4

45. Which of the following is correctly matched?

(A) Lead; self-reduction

(B) Boron; Decomposition of iodide

(C) Nickel; Decomposition of carbonyl complex

(D) Silver; Complex formation and displacement by metal

46. Thermal decomposition is used for purification of:

(A) Ni **(B)** B **(C)** Ti **(D)** Pb

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

47. MATCH THE FOLLOWING:

Column 1 (metallurgical process)		Column 2 (ore)	
(A)	Smelting	**(p)**	Copper glance
(B)	Self reduction	**(q)**	Silver glance
(C)	Electrolytic reduction	**(r)**	Haematite
(D)	Hydrometallurgy	**(s)**	Bauxite

48. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Au	**(p)**	Self reduction
(B)	Al	**(q)**	Liquation
(C)	Pb	**(r)**	Electrolysis
(D)	Sn	**(s)**	Baeyer's process

49. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Mond's process	**(p)**	Purification of silver
(B)	Van Arkel method	**(q)**	Purification of zinc
(C)	Cupellation	**(r)**	Purification of nickel
(D)	Distillation	**(s)**	Purification of titanium
		(t)	Ultra pure metals

50. MATCH THE FOLLOWING:

Column 1		Column 2 (Method of reduction)	
(A)	Iron & Tin	**(p)**	Carbon reduction method
(B)	Copper & Lead	**(q)**	Self-reduction method
(C)	Magnesium & Aluminium	**(r)**	Electrolytic reduction method
(D)	Silver & Gold	**(s)**	Cyanide process

51. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Electrolytic reduction	**(p)**	Aluminium
(B)	Electrolytic oxidation	**(q)**	Chlorine
(C)	Chemical reduction	**(r)**	Iron
(D)	Chemical oxidation	**(s)**	Silver
		(t)	Sulphur

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

52. The number of valence electrons in the most abundant element in earth's crust is _____?

53. How many of the following are sulphide ores?
Copper pyrites, Argentite, Zinc blende, cinnabar, galena, Iron pyrite, Haematite, Malachite, Dolomite.

54. How many of the following are oxide ores?
Bauxite, Cuprite, Cassiterite, Haematite, Magnetite, Chromite, Cryolite, galena, Limestone, Rutile, Pyrolusite.

55. What is the number of valence shell electrons in the most abundant metal?

56. What is the numerical value of oxidation state of sulphur in an ore of iron known as Fool's gold?

57. How many of the following metals are extracted by the electrolysis of their fused salts: Na, K, Mg, Ca, Al, Ag, Cu, Fe

58. What is the numerical value of oxidation state of the metal in the minerals cassiterite?

59. How many of the following metals and method of their reduction are correctly matched?

1.	Al;	Electrolytic reduction	**2.**	Pb;	Self reduction
3.	Sn;	Carbon reduction	**4.**	Mg;	Electrolytic reduction
5.	Hg;	Self reduction	**6.**	Cu;	Self reduction
7.	Ag;	Chemical reduction	**8.**	Fe;	Carbon reduction
9.	Zn;	Carbon reduction			

60. Extraction of iron from magnetite ore involves how many of the following step(s) process(es) among given?

(i) Gravity separation (ii) Roasting (iii) Smelting (iv) Reduction by CO
(v) Removal of impurity in form of slag
(vi) Collection of molten pig iron at bottom of blast furnace
(vii) Oxidation of carbon (viii) Reduction of MnO (ix) Reduction of SiO_2

61. How many of the following ores are carbonate ores:

(i) Siderite (ii) Limonite (iii) Zincite (iv) Dolomite
(v) Calamine (vi) Malachite

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. In context with the industrial preparation of hydrogen from water gas ($CO + H_2$) which of the following is the correct statement.

(A) CO and H_2 are fractionally separated using differences in their densities

(B) CO is removed by absorption in aqueous Cu_2Cl_2 solution

(C) H_2 is removed through occlusion with Pd

(D) CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali

2. The normality of 30 volume H_2O_2 is:

(A) 2.68 N **(B)** 5.36 N **(C)** 8.04 N **(D)** 6.65 N

3. When hydrogen peroxide is added to ice cold acidified potassium dichromate, a blue colour is produced due to formation of:

(A) CrO_3 **(B)** Cr_2O_3 **(C)** CrO_5 **(D)** CrO_4^{2-}

4. Moist hydrogen peroxide cannot be dried over conc. H_2SO_4 because:

(A) it can catch fire **(B)** it is reduced by H_2SO_4

(C) it is oxidized by H_2SO_4 **(D)** it is decomposed by H_2SO_4

5. The correct order of solubility of the sulphates of alkaline earth metals in water is:

(A) Be > Ca > Mg > Ba > Sr **(B)** Mg > Be > Ba > Ca > Sr

(C) Be > Mg > Ca > Sr > Ba **(D)** Mg > Ca > Ba > Be > Sr

6. On strong heating $MgCl_2 \cdot 6H_2O$, the product obtained is:

(A) $MgCl_2$ **(B)** MgO **(C)** $MgCl_2 \cdot 2H_2O$ **(D)** $MgCl_2 \cdot 4H_2O$

7. Which one of the following reactions represents the oxidizing property of H_2O_2?

(A) $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

(B) $2K_3[Fe(CN)_6] + 2KOH + H_2O_2 \longrightarrow 2K_4[Fe(CN)_6] + 2H_2O + O_2$

(C) $PbO_2 + H_2O_2 \longrightarrow PbO + H_2O + O_2$

(D) $2KI + H_2SO_4 + H_2O_2 \longrightarrow K_2SO_4 + I_2 + 2H_2O$

8. The critical temperature of water is much higher than that of CO_2 because water molecule has:

(A) Less number of o-atoms **(B)** No double bond

(C) High dipole moment **(D)** None of these

9. Which of the following statements is correct? Dielectric constant of H_2O_2

(A) Increases with dilution **(B)** Decreases with dilution

(C) In unaffected on dilution **(D)** None of the above

10. A metal M forms water soluble MSO_4 and inert MO. MO in aqueous solution forms insoluble $M(OH)_2$ soluble in NaOH. Metal M is:

(A) Be **(B)** Mg **(C)** Ca **(D)** Si

11. The product obtained on fusion of $BaSO_4$ and Na_2CO_3 is:

(A) $BaCO_3$ **(B)** BaO **(C)** $Ba(OH)_2$ **(D)** $BaHSO_4$

12. Which of the following carbonates decomposes at lowest temperature?

(A) $MgCO_3$ **(B)** $CaCO_3$ **(C)** $SrCO_3$ **(D)** $BaCO_3$

13. Decomposition of H_2O_2 is prevented by:

(A) KOH **(B)** MnO_2 **(C)** acetanilide **(D)** oxalic acid

14. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in:

(A) Exhibiting maximum covalency in compounds

(B) Forming polymeric hydrides

(C) Forming covalent halides

(D) Exhibiting amphoteric nature in their oxides

15. Which one of the following processes is used for the manufacture of calcium?

(A) Reduction of CaO with carbon

(B) Reduction of CaO with hydrogen

(C) Electrolysis of a mixture of anhydrous $CaCl_2$ and KCl

(D) Electrolysis of molten $Ca(OH)_2$

16. Calgon used as water softner is:

(A) $Na_2[Na_4(PO_3)_6]$ **(B)** $Na_4[Na_2(PO_3)_6]$ **(C)** $Na_2[Na_4(PO_4)_5]$ **(D)** None of these

17. Electrolysis of X gives Y at anode. Vacuum distillation of Y gives H_2O_2. The number of peroxy (O–O) bonds present in X and Y respectively are:

(A) 1, 1 **(B)** 1, 2 **(C)** Zero, 1 **(D)** Zero, zero

18. The pH of a solution of H_2O_2 is 6.0. Some chlorine gas is bubbled into this solution. Which of the following is correct?

(A) The pH of resultant solution becomes 8.0

(B) Hydrogen gas is liberated from resultant solution

(C) The pH of resultant solution becomes less than 6.0 and oxygen gas is liberated

(D) Cl_2O is formed in the resultant solution

19. Water is oxidized to oxygen by:

(A) ClO_2 **(B)** $KMnO_4$ **(C)** H_2O_2 **(D)** F_2

20. NaOCl is used as a bleaching agent and sterilizing agent. It can be synthesized by the action of:

(A) NaCl with H_2O **(B)** NH_4Cl with NaOH

(C) Cl_2 with cold and dilute NaOH **(D)** Cl_2 with hot and concentrated NaOH

21. A fire of lithium, sodium and potassium can be extinguished by:

(A) H_2O **(B)** nitrogen **(C)** CO_2 **(D)** asbestose blanket

22. The hydride ion H^- is stronger base than hydroxide ion OH^-. Which of the following reactions will occur if sodium hydride (NaH) is dissolved in water?

(A) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow H_3O^-_{(aq)}$ **(B)** $H^-_{(aq)} + H_2O_{(l)} \longrightarrow OH^-_{(aq)} + H_{2(g)}$

(C) $H^-_{(aq)} + H_2O_{(l)} \longrightarrow$ no reaction **(D)** None of these

23. Compared with the alkaline earth metals, the alkali metals exhibit

(A) Smaller ionic radii **(B)** Higher boiling points

(C) Greater hardness **(D)** Lower ionization energy

24. Which will show highest lattice energy?

(A) RbF **(B)** CsF **(C)** NaF **(D)** KF

25. Which of the following has minimum value of cation/anion radius ratio?

(A) NaCl **(B)** KCl **(C)** $MgCl_2$ **(D)** CaF_2

26. Sodium chloride imparts golden yellow colour to the Bunsen flame. This can be interpreted due to:

(A) low ionization potential of sodium **(B)** Photosensitivity of sodium

(C) Sublimation of metallic sodium to give yellow vapour

(D) Emission of energy absorbed as a radiation in the ultraviolet region

27. Which of the following imparts violet colouration to the Bunsen burner nonluminous flame?

(A) NaCl **(B)** $BaCl_2$ **(C)** $CaCl_2$ **(D)** KCl

28. The molecular formula of potash alum is:

(A) $KAl_2S_4H_{48}O_{40}$ **(B)** $K_2Al_2S_4H_{48}O_{39}$ **(C)** $K_2Al_2S_4H_{48}O_{40}$ **(D)** $KAl_2S_4H_{48}O_{40}$

29. Microcosmic salt is:

(A) $Na(NH_4)HPO_4.4H_2O$ **(B)** $Na(NH_4)_2PO_4 \cdot H_2O$

(C) $Na(NH_3)HPO_4.4H_2O$ **(D)** $K(NH_4)HPO_3.2H_2O$

30. Which of the following compounds on reaction with NaOH and H_2O_2 gives yellow colour?

(A) $Cr(OH)_3$ **(B)** $Zn(OH)_2$ **(C)** $Al(OH)_3$ **(D)** none of these

31. The metal extracted by electrolysis of its fused salt is:

(A) iron **(B)** sodium **(C)** copper **(D)** lead

32. The stability of the following alkali metal chlorides follows the order?

(A) LiCl > KCl > NaCl > CsCl **(B)** CsCl > KCl > NaCl > LiCl

(C) NaCl > KCl > LiCl > CsCl **(D)** KCl > CsCl > NaCl > LiCl

33. Identify the incorrect statement:

(A) Elemental sodium can be prepared and isolated by electrolyzing an aqueous solution of sodium chloride

(B) Elemental sodium is a strong oxidizing agent

(C) Elemental sodium is soluble in liquid ammonia

(D) Elemental sodium is easily oxidized

34. Chemical (A) is used for water softening to remove temporary hardness. (A) reacts with sodium carbonate to give caustic soda and when CO_2 is bubbled through (A), it turns cloudy. What is the chemical formula of (A)?

(A) $CaCO_3$ **(B)** CaO **(C)** $Ca(OH)_2$ **(D)** $Ca(HCO_3)_2$

35. Which of the following has correct increasing basic strength?

(A) $MgO < BeO < CaO < BaO$ **(B)** $BeO < MgO < CaO < BaO$

(C) $BaO < CaO < MgO < BeO$ **(D)** $CaO < BaO < BeO < MgO$

36. Amongst the following hydroxide NaOH, KOH, $Ca(OH)_2$ and $Zn(OH)_2$, the weakest base is:

(A) NaOH **(B)** KOH **(C)** $Ca(OH)_2$ **(D)** $Zn(OH)_2$

37. Electrolysis of $KCl.MgCl_2.6H_2O$ gives:

(A) Potassium only **(B)** Magnesium only

(C) Magnesium and chlorine **(D)** Potassium and magnesium

38. An important ore of magnesium is:

(A) Malachite **(B)** Cassiterite **(C)** Carnallite **(D)** Galena

39. Beryllium is placed above magnesium in the second group. Beryllium dust, therefore, when added to $MgCl_2$ solution will:

(A) Have no effect **(B)** Will form polymeric beryllium chloride

(C) Precipitate Mg **(D)** Leads to the dissolution of beryllium metal

40. Amongst the metals Be, Mg, Ca and Sr of group II of the periodic table, the least ionic chloride would be formed by:

(A) Mg **(B)** Be **(C)** Ca **(D)** Sr

41. Magnesium burns in air to give:

(A) MgO **(B)** Mg_3N_2 **(C)** $MgCO_3$ **(D)** MgO and Mg_3N_2

42. Which of the following is super phosphate of lime?

(A) $Ca_3(PO_4)_2$ **(B)** $CaHPO_4$

(C) $Ca(HPO_3)$ **(D)** $Ca(H_2PO_4)_2 \cdot 2CaSO_4 \cdot 2H_2O$

43. Halides of alkaline earth metals forms hydrates such as $MgCl_2.6H_2O, CaCl_2.6H_2O, BaCl_2.2H_2O$ and $SrCl_2.2H_2O$. This shows that halides of group 2 elements:

(A) are hygroscopic in nature **(B)** act as dehydrating agent

(C) can absorb moisture from air **(D)** all the above

44. Calcium is obtained by:

(A) Roasting of lime stone

(B) Electrolysis of solution of calcium chloride in water

(C) Reduction of calcium chloride with carbon

(D) Electrolysis of molten anhydrous fused calcium chloride

45. The metallic luster exhibited by sodium is explained by:

(A) Diffusion of sodium ions **(B)** Oscillation of mobile valence electrons

(C) Excitation of free protons **(D)** Existence of body centered cubic lattice

46. A solution of sodium metal in liquid ammonia is strongly reducing due to the presence of:

(A) Sodium atoms **(B)** Sodium hydride

(C) Sodium amide **(D)** Solvated electrons

47. Which halide has highest melting point?

(A) NaCl **(B)** NaBr **(C)** NaF **(D)** NaI

48. When CO is passed over solid NaOH heated to 200°C, it forms:

(A) Na_2CO_3 **(B)** $NaHCO_3$ **(C)** HCOONa **(D)** All

49. The pair of compounds which cannot exist together is:

(A) $NaHCO_3$ and NaOH **(B)** Na_2CO_3 and $NaHCO_3$

(C) Na_2CO_3 and NaOH **(D)** $NaHCO_3$ and NaCl

50. Sodium carbonate reacts with SO_2 in aqueous medium to give:

(A) $NaHSO_3$ **(B)** $Na_2S_2O_3$ **(C)** $NaHSO_4$ **(D)** Na_2SO_4

51. When CO_2 is bubbled into an aqueous solution of Na_2CO_3 the following is formed:

(A) NaOH **(B)** $NaHCO_3$ **(C)** H_2O **(D)** OH^-

52. A deliquescent white crystalline hydroxide X reacts with a nitrate Y to form another hydroxide which decomposes to give a insoluble brown layer of its oxide. X is a powerful cautery and breaks down the proteins of skin flesh to a pasty mass. X and Y are:

(A) NaOH, $AgNO_3$ **(B)** NaOH, $Zn(NO_3)_2$

(C) NaOH, $Al(NO_3)_3$ **(D)** $Ca(OH)_2$, $HgNO_3$

53. Bleaching action of bleaching powder is due to the liberation of:

(A) O_2 **(B)** OCl^- **(C)** Cl_2 **(D)** Cl^-

54. Sodium is heated in air at 300°C to form X.X absorbs CO_2 and forms Na_2CO_3 and Y? Which of the following is Y?

(A) H_2 **(B)** O_2 **(C)** H_2O_2 **(D)** O_3

55. Calcium cyanamide on treatment with steam under pressure gives NH_3 and

(A) Calcium carbonate **(B)** Calcium hydroxide

(C) Calcium oxide **(D)** Calcium bicarbonate

56. When standard solution of NaOH is left in air for few hours:

(A) A precipitate will be formed **(B)** The strength of the solution will increase

(C) The strength of the solution will decrease **(D)** The concentration of sodium ions will remain constant

57. Consider the following abbreviations for hydrated alkali ions.

$X = [Li(H_2O)_n]^+$ $Y = [K(H_2O)_n]^+$ $Z = [Cs(H_2O)_n]^+$

What is the correct order of size of these hydrated alkali ions?

(A) X > Y > Z **(B)** Z > Y > X **(C)** X = Y = Z **(D)** Z > X > Y

58. Based on lattice energy and other considerations which one of the following alkali metal chlorides is expected to have the highest melting point?

(A) RbCl **(B)** KCl **(C)** NaCl **(D)** LiCl

59. When a substance (A) reacts with water it produces a combustible gas (B) and a solution of a substance (C) in water. When another substance (D) reacts with this solution of (C), it also produces the same gas (B). (A) imparts a deep golden yellow colour to a smokeless flame of Bunsen burner. A, B, C, and D respectively are:

(A) Na, H_2, NaOH and Zn **(B)** K, H_2, KOH and Al

(C) Ca, H_2, $Ca(OH)_2$ and Sn **(D)** CaC_2, C_2H_2, $Ca(OH)_2$ and Fe

60. In the following reaction : $NaOH + S \longrightarrow A + Na_2S + H_2O$; A is:

(A) Na_2SO_4 **(B)** Na_2SO_3 **(C)** Na_2S **(D)** $Na_2S_2O_3$

61. Which property of $Na_2S_2O_3$ makes it useful in photography?

(A) Photochemical property **(B)** Complex formation property
(C) Oxidizing agent **(D)** Reducing agent

62. Which sequence of reactions shows correct chemical relation between sodium and its compounds?

(A) $Na + O_2 \longrightarrow Na_2O \xrightarrow{HCl_{(aq)}} NaCl \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{\Delta} Na$

(B) $Na \xrightarrow{O_2} Na_2O \xrightarrow{H_2O} NaOH \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{\Delta} Na$

(C) $Na + H_2O \longrightarrow NaOH \xrightarrow{HCl} NaCl \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{\Delta} Na$

(D) $Na + H_2O \longrightarrow NaOH \xrightarrow{CO_2} Na_2CO_3 \xrightarrow{HCl} \underset{(molten)}{NaCl} \xrightarrow{Electrolysis} Na + Cl_2$

63. Aqueous solution of $Na_2S_2O_3$ on reaction with Cl_2 gives:

(A) $Na_2S_4O_6$ **(B)** $NaHSO_4$ **(C)** NaCl **(D)** NaOH

64. One of the elements present in carnallite shows flame colouration. The colour of the flame is:

(A) orange **(B)** green **(C)** yellow **(D)** lilac

65. What are the products formed when an aqueous solution of magnesium bicarbonate is boiled?

(A) MgO, H_2O, CO_2 **(B)** $Mg(HCO_3)_2, H_2O$
(C) $Mg(OH)_2, H_2O$ **(D)** Mg, CO_2, H_2O

66. When KI is added to acidified solution of sodium nitrite then:

(A) NO gas is liberated and I_2 is set free **(B)** N_2 gas is liberated and HI is produced
(C) N_2O gas is liberated and I_2 is set free **(D)** N_2 gas is liberated and HOI is produced

67. The ionic conductance is least for:

(A) Cs^+ **(B)** Rb^+ **(C)** K^+ **(D)** Na^+

Paragraph for Questions 68 - 70

All alkali metals dissolve in anhydrous liquid ammonia to give blue colour solution. It is the ammoniated electron which is responsible for the blue colour of the solution, and the electrical conductivity is due to the ammoniated cation, $[M(NH_3)_x]^+$ as well as the ammoniated electron, $[e(NH_3)_y]^-$, values of x and y depend on the extent of solvation by NH_3. Dilute solutions are paramagnetic due to free ammoniated electrons.

68. What happens if alkali metal is allowed to react with concentrated liquid ammonia?

(A) Paramagnetic character of solvated electrons is retained
(B) Solvated electrons associated to form electron-pairs and paramagnetic character decreases
(C) Reducing character is increased
(D) Reducing character is not affected

69. Which of the following statement about solution of alkali metals in liquid ammonia is correct?

(A) The solution have strong oxidizing properties

(B) Both the dilute solution as well as conc. solution are equally paramagnetic in nature

(C) Charge transfer is responsible for the colour of the solution

(D) None of these

70. Ammoniated solutions of alkali metals are reducing agents due to the presence of free ammoniated or solvated electrons that can reduce

I. O_2 to O_2^{2-} **II.** $K_2[Ni(CN_4)]$ to $K_4[Ni(CN)_4]$

III. Aromatic ring **IV.** Non-terminal alkyne

Choose the correct code:

(A) III and IV **(B)** II and III **(C)** I, II, III and IV **(D)** I, III and IV

Paragraph for Questions 71 - 75

The thermal stability of the salts of the s-block elements is dependent upon three main factors. Firstly, the greater the charge of the ions involved, the stronger the interionic attraction and the more stable the salt. Also, the smaller the ions become in terms of their ionic radii the close they approach each other in the crystal lattice of their salts and the more stable the salt. Thirdly, if the ions in the lattice are of comparable size, the crystal lattice is arranged in a more uniform fashion and thus possesses greater thermal stability.

There is other factor that affects thermal stability. The larger the anions in the crystal become, for example CO_3^{2-}, unless the cation is of comparable size, the anions decompose on heating to give smaller anions such as O^{2-}. This point is especially important when considering the thermal stability of the carbonates, nitrates and hydroxides of the s-block elements.

71. Which groups of the periodic table comprise the s-block elements?

(A) Groups I, II and III **(B)** Groups I and III

(C) Groups, II and III **(D)** Groups I and II

72. Given that the CO_3^{2-} anion is approximately the same size as the early Group I cations, what would occur if Na_2CO_3 were heated?

(A) It would decompose to yield Na_2O.

(B) It would decompose to yield Na_2O and CO_2.

(C) It would decompose to yield $NaHCO_3$ and CO_2.

(D) No decomposition would occur

73. Comparing calcium oxide and magnesium oxide, which of the two would be more stable?

(A) Magnesium oxide would be more stable because the magnesium cation is smaller.

(B) Magnesium oxide would be more stable because magnesium has a lower atomic mass than calcium.

(C) Calcium oxide would be more stable because the calcium anion is smaller than the magnesium cation.

(D) Calcium oxide would be more stable because calcium has a greater atomic mass than magnesium.

74. The nitrates of the Group I elements decompose to give nitrite (NO_2^-) and not oxide although O^{2-} is smaller than NO_2^-. Why?

(A) Because only doubly charged anions like CO_3^{2-} decompose to the oxide.

(B) Because the double charge on the oxygen would make the salt less stable than a singly charged nitrite anion.

(C) Because the nitrite anion contains two oxygen atoms while the oxide anion contains only one.

(D) Because the nitrite anion is probably about the same size as the Group I cations

75. Li_2O is often considered to be covalent in nature because of the unusually high electronegativity of lithium. Which of the following would be a plausible Lewis dot structure for the compound?

(A) $Li-Li-\ddot{\underset{\cdot\cdot}{O}}$ **(B)** $Li-\ddot{\underset{\cdot\cdot}{O}}-Li$ **(C)** $Li=O=Li$ **(D)** $Li-\ddot{O}\rightarrow Li$

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

76. Which one of the following reaction form gaseous product?

(A) $PbO_2 + H_2O_2 \longrightarrow$ **(B)** Acidified $KMnO_4 + H_2O_2 \longrightarrow$

(C) $PbS + H_2O_2 \longrightarrow$ **(D)** $Cl_2 + H_2O_2 \longrightarrow$

77. Which of the following statements is(are) **true** regarding saline hydrides?

(A) In the molten state they conduct electricity

(B) They dissolve in water giving off hydrogen

(C) They are used as reducing agents

(D) They are covalent in nature

78. Sodium sulphate is soluble in water but barium sulphate is insoluble because

(A) The hydration energy of Na_2SO_4 is more than its lattice energy

(B) The lattice energy of $BaSO_4$ is more than its hydration energy

(C) The lattice energy has no role to play in solubility

(D) The lattice energy of Na_2SO_4 is more than its hydration energy

79. When zeolite, which is hydrated sodium aluminium silicate, is treated with hard water, the sodium ions are exchanged with:

(A) H^+ ions **(B)** Ca^{2+} ions **(C)** SO_4^{2-} ions **(D)** Mg^{2+} ions

80. Which of the following is(are) **correct**?

(A) Mg burn in air releasing dazzling light rich in UV rays

(B) $CaCl_2.6H_2O$ when mixed with ice gives freezing mixture

(C) Mg cannot forms complexes

(D) Be can forms complexes due to its very small size

81. Which one of the following salts does impart a colour to the flame or the flame test is/are shown by:

(A) LiCl **(B)** KI **(C)** $MgCl_2$ **(D)** $CaCl_2$

82. Which one of the following is(are) false?

(A) NaOH is used in the concentration of bauxite ore

(B) NaOH is a primary standard in volumetric analysis

(C) Manganous hydroxide is soluble in excess of NaOH solution

(D) NaOH solution does not react with Cl_2

83. Which of the following illustrate the anamolous properties of Li?

(A) The melting and boiling points of Li are comparatively high

(B) Li is much softer than the other Group I metals

(C) Li forms nitride Li_3N unlike Group I metals

(D) The ion of Li and its compounds are more heavily hydrated than those of the rest of the group

84. Which of the following is/are **correct**?

(A) In the Castner's process of sodium extraction, NaCl is used as an electrolyte.

(B) Sodium reduces CO_2 to carbon.

(C) Mg reacts with cold water and liberate hydrogen gas.

(D) Magnalium is an alloy of Mg and Al.

85. Which of the following statements is/are **correct** for alkali metal compounds?

(A) Superoxides are paramagnetic in nature.

(B) The basic strength of hydroxides increases down the group.

(C) The conductivity of chlorides in their aqueous solutions increases down the group.

(D) The basic nature of carbonates in aqueous solutions is due to cationic hydrolysis.

86. Which of the following reactions liberate gaseous product?

(A) $AlCl_3 + NaOH \longrightarrow$

(B) $NaOH + P(white) + H_2O \longrightarrow$

(C) $Al + NaOH \xrightarrow{\Delta}$

(D) $Zn + NaOH \xrightarrow{\Delta}$

87. Which one of the following statements is not true for all the alkali metals?

(A) Their nitrates decompose on heating to give NO_2 and O_2.

(B) Their carbonates decompose on heating to give CO_2 and the metal oxide.

(C) They react with oxygen to give mainly the oxide M_2O.

(D) They react with nitrogen to give nitrides.

88. In which of the following reactions, MgO is formed?

(A) $Mg + CO_2 \longrightarrow$

(B) $Mg + dil.HNO_3 \longrightarrow$

(C) $MgCl_2 \cdot 6H_2O \xrightarrow{\Delta}$

(D) $Mg + B_2O_3 \longrightarrow$

89. Which is(are) true in respect of beryllium chemistry?

(A) Beryllium is amphoteric

(B) It forms unusual carbide Be_2C

(C) $Be(OH)_2$ is basic

(D) Beryllium halides are electron deficient

90. In which of the following reactions, H_2O_2 is acting as an oxidizing agent?

(A) $SO_2 + H_2O_2 \longrightarrow H_2SO_4$

(B) $2KI + H_2O_2 \longrightarrow 2KOH + I_2$

(C) $PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$

(D) $Ag_2O + H_2O_2 \longrightarrow 2Ag + H_2O + O_2$

91. Which of the following is/are correct regarding the electrolytic preparation of H_2O_2?

(A) Peroxodisulphuric acid is formed at anode. **(B)** 50% H_2SO_4 is used

(C) Hydrogen is liberated at anode **(D)** Sulphuric acid undergoes oxidation

92. Which of the following can exist in different conformeric form?

(A) C_2H_6 **(B)** H_2O_2 **(C)** N_2H_4 **(D)** B_2H_6

93. Which is/are true about H_2O_2?

(A) Acts as redox substance **(B)** Two O—H bonds lie in different plane

(C) Pale blue liquid **(D)** Can be oxidized by O_3

94. Which can be oxidized by H_2O_2?

(A) Na_2SO_3 **(B)** PbS **(C)** KI **(D)** O_3

95. Which one of the following processes will produce hard water?

(A) Saturation of water with $Ca(HCO_3)_2$ solution **(B)** Saturation of water with $MgCO_3$

(C) Saturation of water with $CaSO_4$ **(D)** Addition of Na_2SO_4 to water

96. Hydrogen can reduce:

(A) heated cupric acid **(B)** heated ferric oxide

(C) heated stannic oxide **(D)** heated aluminium oxide

97. Phosphine, acetylene and ammonia can be formed by treating water with

(A) Ca_3P_2, Al_4C_3, Li_3N **(B)** Ca_3P_2, CaC_2, Mg_3N_2

(C) $Ca_3P_2, CaC_2, CaCN_2$ **(D)** Ca_3P_2, Mg_2C, NH_4NO_3

98. Which of the following pairs of substances would give same gaseous product on reaction with water?

(A) Na and Na_2O_2 **(B)** Ca and CaH_2 **(C)** Ca and CaO **(D)** Mg_3N_2 and $NaNH_2$

99. Which of the following exists in polymeric form?

(A) $AlCl_3$ **(B)** $BeCl_2$ **(C)** BeH_2 **(D)** LiH

100. The property of hydrogen which resembles with alkali metals is(are):

(A) Its electropositive character **(B)** Its affinity for non metal

(C) Its reducing character **(D)** Electronic configuration

101. The alkali metals:

(A) Form salt like hydrides. **(B)** Form salts which are predominantly ionic.

(C) Show increased chemical reactivity with dry oxygen in going from Li to Cs.

(D) Show increasing metallic nature from Li to Cs.

102. The compound(s) soluble in acetic acid is(are):

(A) Calcium oxide **(B)** Calcium carbonate **(C)** Calcium oxalate **(D)** Calcium hydroxide

103. A combustible gas is liberated when caustic soda solution is heated with:

(A) S **(B)** NH_4Cl **(C)** Al **(D)** Zn

104. A metal is burnt in air and the ash on moistening smells of ammonia. The metal is(are):

(A) Na **(B)** Li **(C)** Mg **(D)** Al

105. In Down's method for the extraction of sodium, the melting point of the electrolyte is lowered by adding

(A) potassium chloride **(B)** calcium chloride

(C) potassium fluoride **(D)** potassium fluoride and sodium carbonate

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

106. **MATCH THE FOLLOWING:**

Column 1 (Prop. of metals)		**Column 2** (Metals)	
(A)	Imparts colouration to flame	**(p)**	Ca
(B)	Most reactive (in aqueous solution)	**(q)**	Mg
(C)	Gives carbide when heated with 'C'	**(r)**	Na
(D)	Metal nitrate $\xrightarrow{\Delta}$ metal oxide $+NO_2 + O_2$	**(s)**	Li

107. **MATCH THE FOLLOWING:**

Column 1 (Chemical Prop.)		**Column 2** (Metals)	
(A)	Metal sulphate $\xrightarrow{\Delta}$ metal oxide $+SO_2 + O_2$	**(p)**	Ba
(B)	Metal cation $+K_2CrO_4 \longrightarrow$ yellow ppt.	**(q)**	Sr
(C)	Metal $+NH_{3(l)} \longrightarrow$ blue solution	**(r)**	Na
(D)	MCl_2 + conc. $H_2SO_4 \longrightarrow$ white ppt.	**(s)**	Mg

108. **MATCH THE FOLLOWING:**

Column 1 (Chemical eq. related to compounds)		**Column 2** (Compound in excess amount)	
(A)	$S \longrightarrow S_2O_3^{2-} + S^{2-}$	**(p)**	$Na_2S_2O_3$
(B)	Ag^+ salt $\longrightarrow$ soluble compound	**(q)**	NaOH
(C)	$Fe^{3+} \longrightarrow$ precipitate	**(r)**	Na_2S
(D)	$FeCl_3 \longrightarrow FeCl_2$	**(s)**	Na_2SO_3

109. **MATCH THE FOLLOWING:**

Column 1		**Column 2**	
(A)	Complex formation	**(p)**	Be
(B)	Formation of covalent compounds	**(q)**	Mg
(C)	High solubility of salts	**(r)**	Ca
(D)	Explosive reaction with acids	**(s)**	Sr

110. MATCH THE FOLLOWING:

Column 1 (Hydride)		Column 2 (Type of hydride)	
(A)	BeH_2	**(p)**	Complex
(B)	AsH_3	**(q)**	Lewis acid
(C)	B_2H_6	**(r)**	Covalent
(D)	$LiAlH_4$	**(s)**	Polymeric
		(t)	Ionic

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

111. 0.789 g of crystalline barium hydroxide is dissolved in water. For the neutralization of this solution, 20 ml of $\frac{N}{4}HNO_3$ is required. How many molecules of water are present in one g mole of this base.

112. How many mole of H_2O molecules are formed on heating one mole of $MgCl_2 \cdot 6H_2O$ to make it anhydrous?

113. Trona, a natural hydrated mixed carbonate and bicarbonate of sodium is found in nature. In one molecule, how many sodium bicarbonate molecules are present?

114. Alkali metals are paramagnetic but their ions are diamagnetic. Decide how many of the following are paramagnetic due to the presence of unpaired electrons in anion?

$Na_2O_2, KO_2, K_2Cr_2O_7, K_2MnO_4, KMnO_4, NaNO_2, NaHCO_3$

115. How many of the following compounds of s-block elements are used as bleaching agent?

$NaOH, Na_2O_2, NaOCl, CaOCl_2, KNO_2, Na_2S_2O_3, NaCN, Na_2SO_4, KO_2$

116. How many of the following can show flame test?

Caustic potash, Glauber's salt, Alum, Microcosmic salt, Hypo, Rock salt, Washing soda, Epsom salt, Carnallite, Lime stome.

117. How many of the following on heating evolve an acidic gaseous substance?

$LiNO_3, NaNO_3, Mg(NO_3)_2, CaCO_3, NaHCO_3, MgCl_2 \cdot 6H_2O, Na_2CO_3, Li_2CO_3.$

118. Consider the following sequential process.

$$Na_2CO_3 \xrightarrow{SO_2} (A) \xrightarrow{Na_2CO_3} (B) \xrightarrow[S]{\text{Elemental}} (C) \xrightarrow{Cl_2} (D).$$

What is numerical value of oxidation state of sulphur in (D)?

119. How many of the following chemical reagents imparts brick red colouration to the flame during flame test?

Lime stone, Dolomite, Carnallite, Bleaching powder, Alum, Gypsum, Rock salt, Hydrolith, Nitrolim.

120. How many of the following are double salts containing s-block element(s)?

Dolomite, Carnallite, Bleaching powder, Alum, Gypsum, Microcosmic salt.

121. Lime stone(X) $\xrightarrow{\Delta}$ Solid (A) + gas (B)

Other Binary Compound of Calcium(Y) $\xrightarrow{H_2O}$ Solution (C) + Gas (D)

Gas (B) turns solution (C) milky but does not react with $KMnO_4 / H^+$

Gas (D) produce white ppt. in Tollen's reagent and it also produce benzene when passed through red hot iron tube

The difference of oxidation state of same central atom in (B) & (D) is _____.

122. Number of non-radioactive alkali metals forming superoxide as major product on heating with excess O_2 = x

Number of II-A metals of periodic table whose hydrated halides suffer hydrolysis on heating = y

Number of non radio active alkali metals which dissolve in liquid ammonia and produce blue colour solution = u

The value of (x + y – u) would be _____.

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. $AlCl_3$ fumes in moist air because:

(A) It is very volatile **(B)** It is covalent

(C) HCl is formed in moist air **(D)** It is highly hygroscopic

2. $AlCl_3$ exist as dimer because:

(A) Al has greater ionization potential **(B)** Al has larger radius

(C) High nuclear charge **(D)** Incomplete octet

3. Reactivity of Borazole is greater than of Benzene because:

(A) Borazole is nonpolar compound **(B)** Borazole is polar compound

(C) Borazole is electron deficient compound **(D)** Of localized electrons in borazole

4. Which of the following statements is **correct**?

(A) BCl_3 and $AlCl_3$ are both Lewis acids and BCl_3 is stronger than $AlCl_3$

(B) BCl_3 and $AlCl_3$ are both Lewis acids and $AlCl_3$ is stronger than BCl_3

(C) BCl_3 and $AlCl_3$ are both equally strong Lewis acids

(D) Both BCl_3 and $AlCl_3$ are not Lewis acids.

5. Which of the following is a **correct** statement?

(A) The hydroxide of aluminium is more acidic than that of boron.

(B) The hydroxide of boron is basic, while that of aluminium is amphoteric.

(C) The hydroxide of boron is acidic, while that of aluminium is amphoteric.

(D) The hydroxide of aluminium and boron are amphoteric.

6. In diborane B_2H_6:

(A) 4 bridge hydrogens and two terminal hydrogens are present

(B) 2 bridged hydrogens and four terminal hydrogens are present

(C) 3 bridged and three terminal hydrogen are present

(D) None of these

7. The type of hybridization of boron in diborane is:

(A) sp-hybridization **(B)** sp^2 - hybridization

(C) sp^3 - hybridization **(D)** sp^3d^2 - hybridization

8. In graphite electrons are:

(A) Localized on every third carbon atom **(B)** Present in antibonding orbitals

(C) Localized on each carbon atom **(D)** Spread out between the structure

9. Which of the following combines with haemoglobin of the blood to form carboxyhaemoglobin?

(A) CO **(B)** CO_2 **(C)** $COCl_2$ **(D)** PbO

10. The ability of a substance to assume two or more crystalline structures is called:

(A) Isomerism **(B)** Polymorphism **(C)** Isomorphism **(D)** Amorphism

11. Which of the following is a tetrabasic acid?

(A) Orthophosphoric acid **(B)** Hypophosporic acid

(C) Metaphosphoric acid **(D)** Pyrophosphoric acid

12. In P_4O_6 the number of oxygen atoms bonded to each phosphorus atom is:

(A) 1.5 **(B)** 2 **(C)** 3 **(D)** 4

13. Nitric acid on standing becomes brownish in colour which may be attributed to the presence of:

(A) NO_2^+ ion **(B)** NO_3^- ion **(C)** NO_2 **(D)** HNO_2

14. Group 15 of the periodic table consists of the elements N, P, As, Sb and Bi. On passing from N to Bi the oxides of the elements of general formula M_2O_3 become:

(A) Stronger reducing agents **(B)** More ionic

(C) More basic **(D)** More volatile

15. The basic character of hydrides of the V(15) group elements decreases in the order:

(A) $SbH_3 > PH_3 > AsH_3 > NH_3$ **(B)** $NH_3 > SbH_3 > PH_3 > AsH_3$

(C) $NH_3 > PH_3 > AsH_3 > SbH_3$ **(D)** $SbH_3 > AsH_3 > PH_3 > NH_3$

16. Which of the following species has the highest dipole moment?

(A) NH_3 **(B)** PH_3 **(C)** AsH_3 **(D)** SbH_3

17. Which of the following is isoelectronic as well as has same structure as that of N_2O?

(A) N_3H **(B)** H_2O **(C)** NO_2 **(D)** CO_2

18. The compound having lowest boiling point is:

(A) NH_3 **(B)** PH_3 **(C)** AsH_3 **(D)** SbH_3

19. Which of the following bonds will be the most polar?

(A) N–Cl **(B)** O–F **(C)** N–F **(D)** N–N

20. Which of the following is in the increasing order of the ionic character?

(A) $PbCl_4 < PbCl_2 < CaCl_2 < NaCl$ **(B)** $PbCl_2 < PbCl_4 < CaCl_2 < NaCl$

(C) $PbCl_2 < PbCl_4 < NaCl < CaCl_2$ **(D)** $PbCl_4 < PbCl_2 < NaCl < CaCl_2$

21. Pure nitrogen gas is obtained from:

(A) $NH_3 + NaNO_2$ **(B)** $NH_4Cl + NaNO_2$

(C) $N_2O + Cu$ **(D)** $(NH_4)_2Cr_2O_7$

22. Which of the following evolve hydrogen on reacting with cold dilute nitric acid?

(A) Mg **(B)** Al **(C)** Fe **(D)** Cu

23. Which of the following is manufactured from the molecular nitrogen by bacteria?

(A) Nitrates **(B)** Nitrites **(C)** Amino acids **(D)** Ammonia

24. The correct order of the decreasing oxidizing powers of ClO_4^-, BrO_4^-, IO_4^- is:

(A) $ClO_4^- > BrO_4^- > IO_4^-$ **(B)** $BrO_4^- > ClO_4^- > IO_4^-$

(C) $IO_4^- > BrO_4^- > ClO_4^-$ **(D)** $IO_4^- > ClO_4^- > BrO_4^-$

25. When air is passed over red-hot coke, the outgoing gas contains:

(A) Producer gas **(B)** Water gas **(C)** Coal gas **(D)** Oil gas

26. P_4O_{10} is treated with water to give:

(A) Hypophophorus acid **(B)** Ortho phosphorus acid

(C) Hypophophoric acid **(D)** Ortho phosphoric acid

27. $PH_4I + NaOH$ on reaction forms:

(A) PH_3 **(B)** NH_3 **(C)** P_4O_6 **(D)** P_4O_{10}

28. The most stable allotropic form of phosphorus is:

(A) Yellow P **(B)** Red P **(C)** White P **(D)** Black P

29. Orthoboric acid on strong heating to red hot gives:

(A) Metaboric acid **(B)** Borax **(C)** Boron trioxide **(D)** Tetraboric acid

30. In Borax bead test for quantitative analysis which component of the bead reacts with basic radical to form metaborate?

(A) $NaBO_3$ **(B)** B_2O_3 **(C)** $Na_2B_4O_7$ **(D)** $Na_2B_4O_7.10H_2O$

31. Ultrapure silicon is prepared by:

(A) Fractional distillation **(B)** Zone-refining

(C) Crystallization **(D)** None of the above

32. White phosphorus reacts with caustic soda. The products are PH_3 and NaH_2PO_2. This reaction is an example of:

(A) Oxidation **(B)** Reduction

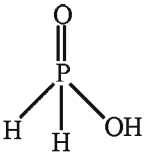
(C) Reduction and oxidation **(D)** Neutralization

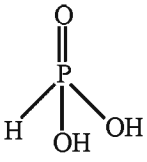
33. Sodium tripolyphosphate used in industrial detergent and softening of water is obtained by the hydrolysis of:

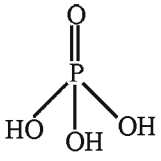
(A) Sodium dihydrogen phosphate **(B)** Triphosphate

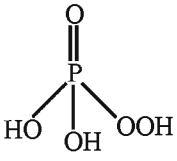
(C) Orthophosphate **(D)** None of the above

34. The structural formula of Hypophosphorus acid is:

(A) 

(B) 

(C) 

(D) 

35. Which of the following reaction does **NOT** give H_3PO_4 ?

(A) $Ca_3(PO_4)_2 + H_2SO_4 \longrightarrow$ **(B)** $P_4O_6 + H_2O \longrightarrow$

(C) $PCl_5 + H_2O \longrightarrow$ **(D)** $P_4S_{10} + H_2O \longrightarrow$

36. In the thermite process, iron oxide is reduced to molten iron by aluminium powder because:

(A) The melting point of iron is low **(B)** The reaction is highly endothermic

(C) Large amount of heat is liberated in the formation of Al_2O_3

(D) Aluminium is an amphoteric element

37. Egyptian blue $CaCuSi_4O_{10}$ is an example of:

(A) Sheet silicate **(B)** cylic silicate **(C)** Pyrosilicate **(D)** Chain silicate

38. Calgon used for water softening is $Na_2[Na_4(PO_3)_6]$ and it is prepared by heating microcosmic salt. The microcosmic salt is:

(A) Na_2HPO_3 **(B)** NaH_2PO_4 **(C)** $Na_2HPO_4.4H_2O$ **(D)** $Na(NH_4)HPO_4.4H_2O$

39. Which one of the following is an electron-deficient molecule according to the octet rule?

(A) CH_4 **(B)** $H_3N:BH_3$ **(C)** AlH_3 **(D)** GeH_4

40. In the structure of $B_4O_5(OH)_4^{2-}$:

(A) All four B atoms are trigonal planar

(B) One B atom is tetrahedral and the other three are trigonal planar

(C) Three B atoms are tetrahedral and one is trigonal planar

(D) Two B atoms are tetrahedral and the other two are trigonal planar

41. Hydrolysis of $(CH_3)_2SiCl_2$ and CH_3SiCl_3 leads to:

(A) Linear chain and cross-linked silicones, respectively

(B) Cross-linked and linear chain silicones, respectively

(C) Linear chain silicones only

(D) Cross-linked silicones only

42. Fluorine is more electronegative than either boron or phosphorus. What conclusion can be drawn from the fact that BF_3 has no dipole moment but PF_3 does?

(A) BF_3 is not spherically symmetrical, PF_3 is spherically symmetrical.

(B) BF_3 molecule must be linear.

(C) The atomic radius of P is larger than the atomic radius of B.

(D) The BF_3 molecule must be planar triangular.

43. The bonds present in borazole are:

(A) $12\sigma, 3\pi$ **(B)** $9\sigma, 6\pi$ **(C)** $6\sigma, 6\pi$ **(D)** $9\sigma, 9\pi$

44. From B_2H_6 all the following can be prepared except:

(A) B_2O_3 **(B)** H_3BO_3 **(C)** $B_2(CH_3)_6$ **(D)** $NaBH_4$

45. Which compound has more Lewis acid character?

(A) Al_2Cl_6 **(B)** Al_2Me_6 **(C)** $AlCl_3 \cdot 6H_2O$ **(D)** None of these

For Questions 46 - 48

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 is a not a correct explanation for Statement-1

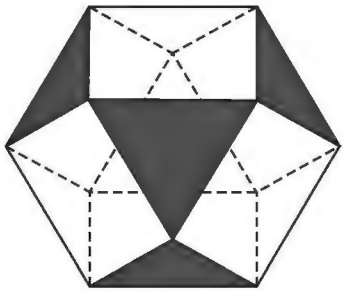
(C) Statement-1 is True, Statement-2 is False **(D)** Statement-1 is False, Statement-2 is True

46. **Statement-1 :** Boric acid acts as a strong acid in the presence of a cis-diol.
Statement-2 : A cis-diol forms hydrogen bonding with oxygen of boric acid.

47. **Statement-1 :** White phosphorus is a reactive allotrope of phosphorus.
Statement-2 : White phosphorus exists as monatomic solid.

48. **Statement-1 :** Pyrophosphoric acid $(H_4P_2O_7)$ is a reducing tetrabasic acid.
Statement-2 : The reducing property of acids of phosphorus is due to hydrogen atom attached to phosphorus atom.

Paragraph for Questions 49 - 51


Cuboctahedron

Phosphorus exists as a number of allotropes, the most reactive being white phosphorus. This was first prepared from the reduction of the phosphate present in urine.

Solid white phosphorus contain P_4 molecules, with each P atom at the vertex of a regular tetrahedron. White phosphorus spontaneously ignites in air to form a mixture of phosphorus (III) oxide and phosphorus (V) oxide.

The structure of each oxide is also based on a regular tetrahedron. The phosphorus atoms remain at the vertices but are no longer bounded to each other. Instead the P atoms are joined by bridging oxygens.

Phosphorus (V) oxide has a further oxygen atom bounded to each phosphorus atom at the vertex of the tetrahedron.

Each oxide reacts with water to form an acid. Phosphorus (V) oxides forms phosphorus (V) acid, H_3PO_4.

A quantitative method for determining phosphate levels in aqueous solution involves adding ammonium molybdate, $(NH_4)_2MoO_4$, to form a precipitate of ammonium molybdophosphate. The structure of this solid is based on a cuboctahedron (shown in figure). A molybdenum atom lies at each vertex of the cuboctahedron and these are joined by oxygen atoms with every edge of the cuboctahedron being bridged by an oxygen atom. A further oxygen atom is joined to every vertex. A single phosphate unit lies at the centre of the structure with each of its four oxygen atoms coordinating to three molybdenum atoms.

49. The **incorrect** statement about structure of white phosphorus is:

(A) It has six P—P single bonds. **(B)** It has four P—P single bonds.

(C) It has four lone pairs of electrons. **(D)** It has PPP angle of 60°

50. Which statement is **wrong** about structure of phosphorus (V) oxide?

(A) It has 6 P—O—P bonds. **(B)** Each 'P' atom is sp^3 hybridised.

(C) It has two types of P—O bond lengths **(D)** It has POP angle of 180°

51. The number of molybdenum atoms and oxygen atoms in the molybdophosphate ion respectively, are:

(A) 9, 15 **(B)** 12, 40 **(C)** 12, 36 **(D)** 12, 24

Paragraph for Questions 52 - 54

Nitric acid acts as an oxidizing agent especially in concentrated solution. In solution more dilute then 2M the oxidizing power of nitrate group is greatly diminished and only the protons of dissociated acid reacts with the active metals. This behaviors should not be too surprising since the power of NO_3^- ion as an oxidant is very sensitive to the concentration of acid. During oxidation HNO_3 is reduced successively as $HNO_3 \rightarrow NO_2 \rightarrow HNO_2 \rightarrow NO \rightarrow N_2O \rightarrow N_2 \rightarrow NH_2OH \rightarrow NH_3$.

52. When FeS is dissolved in conc. HNO_3 than the oxidation product obtained is/are:

(A) H_2S and $Fe(NO_3)_3$ **(B)** $FeSO_4$

(C) $Fe_2(SO_4)_3$ **(D)** only H_2S

53. When Sn metal is treated with dilute nitric acid then the products obtained are:

(A) $Sn(NO_3)_4$ and NO_2 **(B)** $Sn(NO_3)_2$ and NO_2

(C) $Sn(NO_3)_2$ and NH_4NO_3 **(D)** $Sn(NO_3)_2$ and NO

54. Which of the following metal becomes passive on treatment with nitric acid?

(A) Cr **(B)** Mg **(C)** Mn **(D)** Pb

Paragraph for Questions 55 - 58

There are some deposits of nitrates and phosphates in earth's crust. Nitrates are more soluble in water. Nitrates are difficult to reduce under the laboratory conditions but microbes do it easily. Ammonia forms large number of complexes with transition metal ions. Hybridization easily explains the ease of sigma donation capability of NH_3 and PH_3. Phosphine is a flammable gas and is prepared from white phosphorus.

55. Among the following, the correct statements is:

(A) Phosphates have no biological significance in humans

(B) Between nitrates and phosphates, phosphates are less abundant in earth's crust

(C) Between nitrate and phosphates, nitrates are less abundant in earth's crust

(D) Oxidation of nitrates is possible in soil

56. Among the following, the correct statement is:

(A) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies spherical 's' orbital and is less directional

(B) Between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional

(C) Between NH_3 and PH_3, NH_3 is a better electron donor because the lone pair of electrons occupies sp^3 orbital and is more directional

(D) Between NH_3 and PH_3, PH_3 is a better electron donor because the lone pair of electron occupies spherical 's' orbital and is less directional

57. White phosphorus on reaction with NaOH give PH_3 as one of the products. This is a:

(A) Dimerization reaction **(B)** Disproportionation reaction

(C) Condensation reaction **(D)** Precipitation reaction

58. Which of the following is **correct**?

(A) Bond angle in NH_3 is 109.5° **(B)** Bond angle in NH_3 is 107°

(C) Bond angle in NH_3 is 120° **(D)** None of these

Paragraph for Questions 59 - 61

It is well known that there are two major forms of carbon, that is, carbon has two main allotropes: graphite and diamond. These differ greatly from each other with respect to the physical properties as shown in table. The physical properties of silicon are also shown in Table 1 for comparison as carbon and silicon belong to the same group in the periodic table.

Physical properties	Graphite	Diamond	Silicon
Density (g cm^{-3})	2.26	3.51	2.33
Enthalpy of combustion to yield CO_2 (kJ/mol)	–393.3	–395.3	–910
Melting point (°C)	2820	3730	1410
Boiling point (°C)		4830	2680
Conductivity (electrical)	Fairly good	Non-conductor	Good
Conductivity (thermal)	Good	Fairly good	Good

Graphite possesses what is commonly known as a layer structure: carbon atoms from three covalent bonds with each other. These layers are held together via weak Van der Waals' forces which permit some movement of the layers relative to one another.

The most common compound of carbon is carbon dioxide which makes up 0.03% of the atmosphere. The triple point of carbon dioxide occurs at 217 K and 515 kP_a. One of the unique properties of carbon is that it can form multiple bonds between itself and other atoms, including other atoms. Thus, large polymers involving carbon atoms are possible.

59. It is possible to convert graphite into diamond via various chemical processes. Based on the information in the passage, which of the following would facilitate increased amounts of diamond assuming that the system is in equilibrium?

(A) High pressures **(B)** High temperatures

(C) A catalyst **(D)** Through set of chemical reactions

60. The properties of the layer-like structure of solid graphite stated in the passage would lend it to which of the following industrial uses?

(A) Insulator **(B)** Structural **(C)** Corrosive **(D)** Lubricant

61. Using the information in the table, calculate the enthalpy change for the following process: $C_{graphite} \longrightarrow C_{diamond}$

(A) $+1.8\ kJ\ mol^{-1}$ **(B)** $-1.8\ kJ\ mol^{-1}$ **(C)** $+1.0\ kJ\ mol^{-1}$ **(D)** $-1.0\ kJ\ mol^{-1}$

Paragraph for Questions 62 - 64

Borates and silicates are having similarity in their various forms where they exist as ortho, pyro, chain & sheet types. Orthobrates (BO_3^{3-}) have trigonal planar shape while orthosilicates (SiO_4^{4-}) have a tetrahedral shape.

62. Borax ($Na_2B_4O_7.10H_2O$) has:

(A) 2 triangular units **(B)** 2 tetrahedral units **(C)** four –OH units **(D)** All of these

63. Pyroborates have:

(A) No corner shared **(B)** One corner shared

(C) Two corners shared **(D)** A linear chain structure

64. The chain silicates have the general formula:

(A) $(SiO_3)_n^{2n-}$ **(B)** $Si_2O_7^{6-}$ **(C)** $(Si_2O_5)_n^{2n-}$ **(D)** $(Si_4O_{11})_n^{6n-}$

Paragraph for Questions 65 - 67

In addition to the two most common oxides carbon monoxide and carbon dioxide a few other compounds may be formed containing carbon and oxygen only. Each oxide may be prepared by the dehydration of the appropriate acid.

Carbon dioxide may be prepared by simply protonating the carbonate salt to yield unstable carbonic acid, which readily loses water to form carbon dioxide.

Carbon monoxide may be prepared by dehydrating methanoic acid with concentrated sulfuric acid at about 140°C.

Diiodine pentoxide I_2O_5, is a white crystalline powder that has the useful property of reacting quantitatively with carbon monoxide to yield iodine and one other product. 'Carbon suboxide' is a foul–smelling gas obtained by fully dehydrating propane–1, 3–dioic acid.

A fourth oxide of carbon has the formula $C_{12}O_9$ and may be obtained by fully dehydrating mellitic acid [benzene hexacarboxylic acid $-C_6(COOH)_6$].

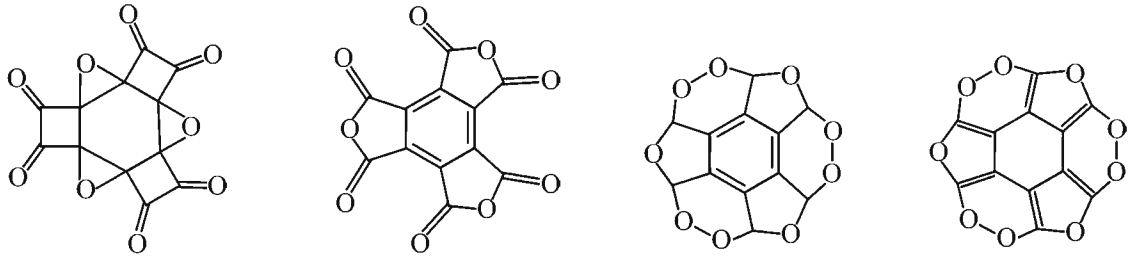
65. A 150 cm^3 sample of gas (at room temperature and pressure, r.t.p.) that was known to contain carbon monoxide was heated over excess I_2O_5 at 170°C. The iodine generated required exactly 8.00 cm^3 of 0.100 mol dm^{-3} sodium thiosulfate solution to react with it. The percentage by volume of carbon monoxide present in the sample of gas is (assume 1 mole of any gas occupies 24.0 dm^3 at r.t.p.):

(A) 42% **(B)** 32% **(C)** 24% **(D)** 64%

66. Which of the following formulation represents the correct ground state Lewis structure for carbon suboxide?

(A) :Ö:C:C:C::Ö: **(B)** :Ö::C:C:C::Ö: **(C)** :Ö::C::C::C::Ö: **(D)** :Ö:C:C:C:Ö:

67. The structural formula of $C_{12}O_9$ is:



(A) **(B)** **(C)** **(D)**

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

68. Among the following the correct statement(s) is/are:

(A) Diamond and graphite are two allotropes of carbon.

(B) Graphite shows high electrical conductivity in one direction only.

(C) Density of diamond is more than the density of graphite.

(D) Graphite has higher C–C bond order than diamond.

69. Which of the following reaction will give anhydrous $AlCl_3$?

(A) By heating $AlCl_3.6H_2O$

(B) By passing dry HCl on heated aluminium powder

(C) By passing dry chlorine on heated aluminium powder

(D) By passing dry chlorine over heated mixture of aluminium and coke

70. A gas which cannot be collected over water is:

(A) N_2 **(B)** O_2 **(C)** SO_3 **(D)** PH_3

71. Which one of the following statement is/are correct:

(A) Ammonia is more poisonous than phosphine **(B)** Ammonia is more basic than phosphine

(C) Ammonia is more stable than phosphine **(D)** Ammonia is more soluble in water than phosphine

72. Which of the following is/are correctly matched?

(A) Trona : $Na_3(CO_3)(HCO_3).2H_2O$ **(B)** Borax : $Na_2[B_4O_5(OH)_4].8H_2O$

(C) Graham's salt : $Na_2[Na_4(PO_3)_6]$ **(D)** Alum : $[K(H_2O)_6]_2SO_4.[Al(H_2O)_6]_2(SO_4)_3$

73. In which of the following reaction HNO_3 behave as a base?

(A) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$ **(B)** $4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$

(C) $HNO_3 + H_2SO_4 \longrightarrow NO_2^+ + HSO_4^- + H_2O$ **(D)** None of these

74. Which of the following ionic compounds when dissolves in water, it reacts to make two moles of H_3O^+ per mole of compound?

(A) $NO_2^+BF_4^-$ **(B)** $NO_2^+NO_3^-$ **(C)** $NO_2^+ClO_4^-$ **(D)** $NH_4^+NO_3^-$

75. Which of the following compound reacts with nitrobenzene to give m-dinitrobenzene?

(A) $NO_2BF_{4(s)}$ **(B)** $NO_2ClO_{4(s)}$ **(C)** $N_2O_{5(s)}$ **(D)** HNO_3 & H_2SO_4

76. A colourless, gaseous, paramagnetic nitrogen oxide (A), is allowed to react with excess O_2 and the mixture passed through a trap at –120°C, in which condenses a colourless solid (B). Identify compounds (A) and (B).

(A) NO and NO_2 respectively **(B)** NO and N_2O_4 respectively

(C) NO and N_2O_3 respectively **(D)** NO_2 and N_2O_4 respectively

77. Which of the following oxides of nitrogen is responsible for photochemical degradation of ozone?

(A) N_2O **(B)** NO **(C)** NO_2 **(D)** None of these

78. A colourless, diamagnetic solid nitrogen oxide (X) reacts with F_2 to form a colourless gas (Y). Compound (Y) reacts with gaseous boron trifluoride to form a colourless solid (Z). When compound (Z) is dissolved in water, it reacts to make two moles of H_3O^+ per mole of (Z). Ideantify compound (X), (Y) and (Z).

(A) X = NO_2 ; Y = NO_2F ; Z = $NO_2^+BF_4^-$ **(B)** X = N_2O_4 ; Y = NO_2F ; Z = $NO_2^+BF_4^-$

(C) X = NO ; Y = N_2F_4 ; Z = $F_3N^+–BF_3^-$ **(D)** X = N_2O_5 ; Y = NF_3 ; Z = $F_3N^+–BF_3^-$

79. Which of the following is due to H-bonding?

(A) H_3PO_4 is a syrupy liquid **(B)** Boiling point of H_2O is more than HF

(C) Boiling point of PH_3 is less than NH_3. **(D)** None of these

80. Which of the following hydride of nitrogen is/are acidic in nature?

(A) NH_3 **(B)** N_2H_4 **(C)** N_3H **(D)** NH_2OH

81. In which of the following reaction $POCl_3$ is formed?

(A) $PCl_5 + CH_3COOH \longrightarrow$ **(B)** $PCl_5 + H_2SO_4 \longrightarrow$

(C) $PCl_5 + P_4O_{10} \longrightarrow$ **(D)** $PCl_5 + SO_2 \longrightarrow$

82. In which of the silicate there is Si—O—Si linkage.

(A) Orthosilicates **(B)** Pyrosilicates **(C)** Ring silicates **(D)** Chain silicates

83. Which of the following is correct regarding N_2O ?

(A) It is called laughing gas **(B)** It support combustion

(C) It is used as propellant gas in whipped cream **(D)** It is isoelectronic with CO_2

84. Which of the following reaction is used for preparation of N_2O ?

(A) $NH_4NO_3 \xrightarrow{\Delta}$ **(B)** $NO + SO_2 + H_2O \xrightarrow{\Delta}$

(C) $Zn + HNO_3(dil) \longrightarrow$ **(D)** $NH_2OH + HCl + NaNO_2 \longrightarrow$

85. On the basis of molecular orbital theory which of the following is/are paramagnetic?

(A) B_2 (vapour) **(B)** C_2 (vapour) **(C)** S_2 (vapour) **(D)** O_2

86. Which of the following is/are **correct**?

(A) Graphite is thermodynamically most stable allotropic form of carbon.

(B) Black phosphorous is thermodynamically most stable allotropic form of phosphorous.

(C) Rhombic sulphur is thermodynamically most stable allotropic form of sulphur.

(D) White tin is stable at high temperature.

87. Ammonium compound which on heating give NH_3 is/are

(A) $(NH_4)SO_4$ **(B)** $(NH_4)_2CO_3$ **(C)** NH_4NO_2 **(D)** NH_4Cl

88. With respect to graphite and diamond, which of the following statement(s) given below is/are **correct**?

(A) Graphite is softer than diamond

(B) Graphite has layer structure while diamond is a network solid.

(C) Graphite has sp^2 hybridized carbon atoms

(D) Diamond has sp^3 hybridized carbon atoms

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

89. **MATCH THE COLUMN:**

	Column 1 (Mixtures)		**Column 2 (Solution used for separation)**
(A)	N_2 and CO	**(p)**	Water
(B)	N_2 and O_2	**(q)**	H_2SO_4
(C)	N_2 and NH_3	**(r)**	Ammonical Cu_2Cl_2
(D)	PH_3 and NH_3	**(s)**	Pyrogallol

90. **MATCH THE COLUMN:**

	Column 1 (Reaction of Metal with HNO_3)		**Column 2 (Main product)**
(A)	Mg + very dil. HNO_3	**(p)**	NO
(B)	Zn + dil. HNO_3	**(q)**	H_2
(C)	Sn + dil. HNO_3	**(r)**	N_2O
(D)	Pb + dil. HNO_3	**(s)**	NH_4NO_3

91. MATCH THE COLUMN:

	Column 1		Column 2
(A)	Hypo phosphoric acid	**(p)**	All hydrogen are ionizable in water
(B)	Pyro phosphoric acid	**(q)**	Lewis acid
(C)	Boric acid	**(r)**	Monobasic in water
(D)	Hypo phosphorus acid	**(s)**	sp^3 hybridized central atom
		(t)	Reducing agent

92. MATCH THE COLUMN:

	Column 1		Column 2
(A)	CO_2	**(p)**	Acidic oxide
(B)	SO_2	**(q)**	Colourless
(C)	NO_2	**(r)**	Paramagnetic
(D)	N_2O	**(s)**	Coloured

93. MATCH THE COLUMN:

	Column 1		Column 2
(A)	$Na_2B_4O_7.10H_2O$	**(p)**	Basic solution
(B)	Na_2CO_3	**(q)**	Acidic solution
(C)	$K_2SO_4.Al_2(SO_4)_3.24H_2O$	**(r)**	Can react with NaOH
(D)	NH_4Cl	**(s)**	Swells up on heating

94. MATCH THE COLUMN:

	Column 1		Column 2
(A)	$B(OH)_3$	**(p)**	Acidic
(B)	$Al(OH)_3$	**(q)**	Amphoteric
(C)	$Ga(OH)_3$	**(r)**	Insoluble in water
(D)	$Tl(OH)_3$	**(s)**	Basic

95. MATCH THE COLUMN:

	Column 1		Column 2
(A)	Orthosilicate	**(p)**	Co-ordination number of Si is four
(B)	Pyrosilicate	**(q)**	One or more oxygen atoms are shared
(C)	Single chain silicate	**(r)**	SiO_4^{4-}
(D)	Ring silicate	**(s)**	$Si_2O_7^{6-}$
		(t)	$(SiO_3^{2-})_n$

96. **MATCH THE COLUMN:**

	Column 1 (Reagent)		**Column 2 Reaction)**
(A)	O_3	**(p)**	$SnCl_2 \rightarrow SnCl_4$
(B)	H_2O_2	**(q)**	Arsenite $\rightarrow$ Arsenate
(C)	HNO_3	**(r)**	$PbS \rightarrow PbSO_4$
(D)	H_3PO_3	**(s)**	$MnO_4^- \rightarrow Mn^{2+}$
		(t)	$AgNO_3 \longrightarrow Ag$

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

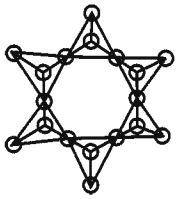
97. The number of $R_2Si(OH)_2$ units required to prepare a linear silicone polymer containing eight Si–O–Si linkages, is _____.

98. Asbestos $\left[CaMg_3O(Si_4O_{11})\right]$ is an example of "amphiboles", which is a special type of chain silicates in which two strands are cross-linked. The magnitude of charge on silicate anion is_____.

99. How many of the following amines can be used for the symmetrical cleavage of diborane? $B_2H_6 + 2L \rightarrow 2BH_3 \leftarrow L$

CH_3NH_2, $(CH_3)_2NH$, $(C_2H_5)_3N$, $(CH_3)_3N$, $(C_2H_5)_2NH$,
$C_2H_5NH_2$, C_5H_5N, $(i\text{-}Pr)_3N$, quinuclidine

100. The number of oxygen atoms in empirical formula of the silicate having structure as shown in figure, is _____.



101. How many of the following ammonium salts on dry heating evolve ammonia gas?
NH_4NO_3, NH_4NO_2, NH_4HS, NH_4Cl, NH_4COONH_2, $(NH_4)_2Cr_2O_7$, $(NH_4)_2CO_3$, $(NH_4)_2C_2O_4$, NH_4ClO_4

102. Each B–H–B bridge in B_2H_6 is formed by the sharing of x electrons. The numerical value of x is _____.

103. What is the number of free electrons present on each carbon atom in graphite?

104. In pyrophosphoric acid, $H_4P_2O_7$ number of $d\pi - p\pi$ bonds are _____.

105. The brown complex obtained in the detection of nitrate radical is formulated as $[Fe(H_2O)_5NO]SO_4$. What is the oxidation number of Fe in this complex.

106. How many moles of CO are obtained when one mole of potassium ferrocyanide is heated with conc. sulphuric acid?

107. The number of P–P bonds in a molecule of white phosphorus (P_4) are _____.

108. Methylchlorosilanes, Me_nSiCl_{4-n}, can be hydrolysed to form a silicone Polymer. What should be the valve of n to obtained a cross linked polymer?

109. The number of π-bonds in $(B_3N_3H_6)$ borazine are _____.

110. The number of P–O–P bonds in cyclic trimeric metaphosphoric acid are _____.

111. What is the co-ordination number of aluminium in dimeric structure of anhydrous aluminium chloride?

112. Beryl, $Be_3Al_2Si_6O_{18}$ is a silicate. How many oxygen atom of structural unit SiO_4^{4-} are shared with neighboring unit in Beryl.

113. The number of acidic ionizable hydrogen atom(s) in acidic nitrogen hydride is (are) _____.

114. 0.01 mol of an ionic compound nitronium tetrafluoroborate dissolved in water and titrated with xM NaOH to a phenolphthalein end point, which requires 20 ml of the titrant. What is the numerical value of x.

115. What is the co-ordination number of silicon in silica (SiO_2)?

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is:

(A) Cl_2O **(B)** Cl_2O_7 **(C)** ClO_2 **(D)** Cl_2O_6

2. H_2S does not produce metallic sulphide with:

(A) $CdCl_2$ **(B)** $ZnCl_2$ **(C)** $COCl_2$ **(D)** $CuCl_2$

3. Amongst H_2O, H_2S, H_2Se and H_2Te, the one with highest boiling point is:

(A) H_2O because of hydrogen bonding **(B)** H_2Te because of higher molecular weight

(C) H_2S because of hydrogen bonding **(D)** H_2Se because of lower molecular weight

4. Which of the following has greatest reducing power?

(A) HI **(B)** HBr **(C)** HCl **(D)** HF

5. As the atomic number of halogen increases, the halogens:

(A) Lose their outermost electrons less readily **(B)** Become lighter in colour

(C) Gain electron less easily **(D)** Become less dense

6. Which one of the following oxyacids of chlorine is the least oxidizing in nature?

(A) HOCl **(B)** HCO_2 **(C)** $HClO_3$ **(D)** $HClO_4$

7. Which one of the following oxides of chlorine is obtained by passing dry chlorine over silver chlorate at 90°?

(A) Cl_2O **(B)** Cl_2O_6 **(C)** ClO_2 **(D)** Cl_2O_7

8. Which of the following hydrogen halide is most volatile?

(A) HF **(B)** HCl **(C)** HBr **(D)** HI

9. The outermost electronic configuration of the element which does not show positive oxidation state at all pertains to:

(A) $2s^2 2p^3$ **(B)** $2s^2 2p^4$ **(C)** $2s^2 2p^5$ **(D)** $2s^2 2p^6$

10. A greenish yellow gas reacts with an alkali metal hydroxide to form a halate, which can be used in fire works and safety matches. The gas and halate respectively are:

(A) $Br_2, KBrO_3$ **(B)** $Cl_2, KClO_3$ **(C)** $I_2, NaIO_3$ **(D)** $Cl_2, NaClO_3$

11. Reduction of thiosulphate with iodine gives:

(A) Sulphate ion **(B)** Sulphite ion **(C)** Tetrathionate ion **(D)** Sulphide ion

12. The bond energies of F_2, Cl_2, Br_2 and I_2 are 155, 244, 193 and 151 kJ/mol. The weakest bond will be in:

(A) Br_2 **(B)** Cl_2 **(C)** F_2 **(D)** I_2

13. The solution of which of the following has maximum pH?

(A) NaClO **(B)** $NaClO_2$ **(C)** $NaClO_3$ **(D)** $NaClO_4$

14. The correct order of acidic strength is:

(A) $Cl_2O_7 > SO_3 > P_4O_{10}$ **(B)** $CO_2 > N_2O_5 > SO_3$

(C) $Na_2O > MgO > Al_2O_3$ **(D)** $K_2O > CaO > MgO$

15. Anhydrous mixture of KF and HF contains which ions:

(A) K^{+1}, H^+, F^- **(B)** $(KF)^+, (HF)^-$ **(C)** KH^+, F^- **(D)** K^+, HF_2^-

16. Which of the following statement is not true about noble gases?

(A) Their ionization energies are very high **(B)** Their electron affinities are nearly zero

(C) They don't form any chemical compounds **(D)** They are not easily liquefied

17. Which of the following statements is false:

(A) Radon is obtained from the decay of radium **(B)** Helium is an inert gas

(C) Xenon is the most reactive among the rare gases

(D) The most abundant rare gas found in the atmosphere is helium

18. Which is planar molecule?

(A) XeO_4 **(B)** XeF_4 **(C)** $XeOF_4$ **(D)** XeO_2F_2

19. The most abundant inert gas in the atmosphere is:

(A) He **(B)** Ne **(C)** Ar **(D)** Kr

20. When same amount of zinc is treated separately with excess of sulphuric acid and excess of sodium hydroxide solution, the ratio of volumes of hydrogen evolved is:

(A) 1 : 1 **(B)** 1 : 2 **(C)** 2 : 1 **(D)** 9 : 4

21. An inorganic compound first melts, then resolidifies and then liberates a gas. It may be:

(A) $KClO_3$ **(B)** K_2SO_3 **(C)** Al_2O_3 **(D)** MnO_2

22. Detection/test of ozone can be done by:

(A) Hg **(B)** Ag **(C)** Na **(D)** None of these

23. What is formed when KI is heated with conc. H_2SO_4 :

(A) HI **(B)** I_2 **(C)** HIO_3 **(D)** conc. H_2SO_4

24. Which of the following reactions is possible:

(A) $3Br_2 + 5NaF \longrightarrow BrF_5 + 5NaBr$ **(B)** $I_2 + NaCl \longrightarrow ICl + NaI$

(C) $I_2 + 2NaCl \longrightarrow Cl_2 + 2NaI$ **(D)** $Cl_2 + 2NaBr \longrightarrow Br_2 + 2NaCl$

25. The bleaching action of moist chlorine is due to the formation of:

(A) HCl **(B)** HOCl **(C)** $HClO_3$ **(D)** $HClO_4$

26. Sodium thiosulphate $(Na_2S_2O_3.5H_2O)$ is used in photography to:

(A) Reduce AgBr to metallic silver

(B) Convert Ag to Ag salt

(C) To remove undecomposed AgBr as a soluble silver thiosulphate complex

(D) To remove Ag

27. The geometry of ICl_2^- is:

(A) Trigonal **(B)** Trigonal bipyramidal

(C) Octahderal **(D)** Square planar

28. A one litre flask is full of brown bromine vapour. The intensity of brown colour of vapour will not decrease appreciably on adding to the flask some:

(A) Pieces of marble **(B)** Animal charcoal powder

(C) Carbon tetrachloride **(D)** Carbon disulphide

29. A white solid reacts with dil. HCl to give colourless gas that decolourises aqueous bromine. The solid is most likely to be:

(A) Sodium carbonate **(B)** Sodium chloride

(C) Sodium acetate **(D)** Sodium thiosulphate

30. There is S—S single bond in:

(A) $H_2S_2O_7$ **(B)** $H_2S_2O_8$ **(C)** $H_2S_2O_6$ **(D)** $H_2S_2O_3$

31. Which of the following oxide of chlorine is paramagnetic?

(A) Cl_2O **(B)** ClO_2 **(C)** Cl_2O_6 **(D)** Cl_2O_7

32. Inter halogen compounds are:

(A) Ionic compound **(B)** Co-ordinate compound

(C) Nonpolar molecular compounds **(D)** Covalent compounds

33. Hydrolysis of one mole of peroxo dilsulphuric acid produces:

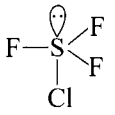
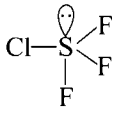
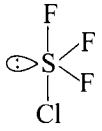
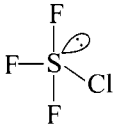
(A) Two moles of sulphuric acid

(B) Two moles of peroxo monosulpuric acid

(C) One mole of sulphuric acid and one mole of peroxy mono sulphuric acid

(D) One mole of sulphuric acid, one mole of peroxy mono sulphuric acid and one mole of hydrogen peroxide

34. Which of the following structure of highly reactive molecule SF_3Cl is **most** stable?

(A)  **(B)**  **(C)**  **(D)** 

35. Which of the following molecular species having 16th group element as central atom is **NOT** known?

(A) SF_3Cl **(B)** SeF_3Cl **(C)** TeF_3Cl **(D)** OF_3Cl

36. The oxidation of SO_2 to H_2SO_4 in acid rain is thought to occur by the following mechanism.

$$SO_2(aq) + 2H_2O(l) \longrightarrow HSO_3^-(aq) + H_3O^+(aq)$$

$$2HSO_3^-(aq) + O_2(aq) \longrightarrow S_2O_7^{2-}(aq) + H_2O(l)$$

$$S_2O_7^{2-}(aq) + 3H_2O(l) \longrightarrow 2SO_4^{2-}(aq) + 2H_3O^+(aq)$$

Which species in this mechanism can be given the following designation?

	Reactant	**Catalyst**	**Intermediate**
(A)	$SO_2(aq)$	$H_2O(l)$	$HSO_3^-(aq), H_3O^+(aq)$
(B)	$SO_2(aq)$	$HSO_3^-(aq)$	$S_2O_7^{2-}(aq)$
(C)	$SO_2(aq), H_2O(l)$	$S_2O_7^{2-}(aq)$	$HSO_3^-(aq)$
(D)	$SO_2(aq), H_2O(l)$	none	$HSO_3^-(aq), S_2O_7^{2-}(aq)$

37. Moist air is less dense than dry air at the same temperature and barometric pressure. Which is the best explanation for this observation?

(A) H_2O is a polar molecular but N_2 and O_2 are not

(B) H_2O has a higher boiling point than N_2 or O_2

(C) H_2O has a lower molar mass than N_2 or O_2

(D) H_2O has a higher heat capacity than N_2 or O_2

38. Which element is used to form cross links between the strands of latex rubber?

(A) Fe **(B)** N **(C)** P **(D)** S

39. Which of the following is a photoconductor?

(A) Graphile **(B)** Selenium **(C)** Silicon **(D)** caesium

40. Which of the following are isostructural?

(I) Ring silicate $Si_3O_9^{6-}$ **(II)** Trimeric cyclic metaphosphate, $P_3O_9^{3-}$

(III) Trimeric cyclic sulphur trioxide, S_3O_9 **(IV)** Inorganic benzene, borazine $B_3N_3H_6$.

(A) I, II and III **(B)** II, III and IV **(C)** I, II and IV **(D)** All

Paragraph for Questions 41 - 44

It has been known for a number of years that the noble gas atoms form strong bonds to certain other atoms. In 1962 M. Bartlett found that molecular oxygen forms a compound with PtF_6 that can be represented as $O_2^+ PtF_6^-$, since xenon has nearly the same ionization energy as oxygen. Bartlett observed a reaction between xenon & PtF_6 and be demonstrated that xenon is not totally an inert gas. The most stable and best characterized of the noble-gas compounds are the xenon fluorides, oxyflourids and oxides. The oxygen compounds of xenon are obtained by hydrolysis of the fluorides. XeO_3 is easy to synthesize but it is very explosive when dry. In aqueous solution however it is well behaved and have large positive enthalpy of formation. The structures of the xenon compounds fit the patterns established by other isoelectronic species, so far as is known for example, XeO_3 is isoelectronic with the IO_3^- ion and has the same trigonal pyramidal structure.

41. $XeO_3(aq.) + OH^- \rightarrow X + Y$

The compounds (X) and (Y) are respectively:

(A) Xe and XeO_2 **(B)** XeO and XeO_2 **(C)** XeO_2 & XeO_6^{4-} **(D)** Xe & XeO_6^{4-}

42. XeF_6 can act as:

(A) Flouride ion donor **(B)** Flouride ion acceptor

(C) Reducing agent **(D)** All of these

43. Which of the following can be used as general oxidizer due to lack of extra complication of oxidation reactions.

(A) $K_2Cr_2O_7$ **(B)** XeF_2 **(C)** XeO_3 **(D)** XeO_6^{4-}

44. $XeOF_4$ is isoelectronic with compound 'A'. The compound 'A' and shape of $XeOF_4$ are respectively:

(A) BrF_5 & square pyramidal **(B)** XeO_6^{4-} & octahedral

(C) XeO_6^{4-} & square pyramidal **(D)** BrF_5 & octahedral

Paragraph for Questions 45 - 49

Several features of sulfuric acid are given below.

Preparation of sulfuric acid:

Sulfuric acid is commonly prepared by the combustion of elemental sulfur to sulfur dioxide, followed by the catalytic oxidation of sulfur dioxide to sulfur trioxide. Sulfur trioxide is then absorbed into a 98% aqueous solution of H_2SO_4 and water is added to maintain a 98% concentration. SO_3 reacts with the water in the aqueous solution according to reaction-1

$SO_3(g) + H_2O \longrightarrow H_2SO_4(l)$ ..... Reaction -1

Properties of sulfuric acid: Concentrated sulfuric acid is 98% H_2SO_4 and 2% water by mass. It has a density of 1.84 g/ml and a boiling point of 338°C.

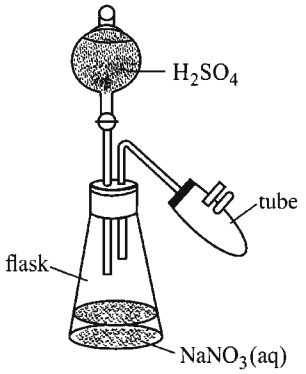
Preparation of other acids: HCl(g) and HNO_3 may be prepared by the reaction between sulfuric acid and the sodium salt of the corresponding conjugate base (Cl^- or NO_3^- respectively)

Formation of SO_2 : Sulfuric acid forms SO_2 gas when it reacts with several compounds. For example, I_2 and SO_2 are formed when I^- reacts with concentrated H_2SO_4; Br_2 and SO_2 are formed when Br^- reacts with concentrated H_2SO_4.Cu^{2+} and SO_2 are formed in hot solutions of Cu(s) in H_2SO_4. This last reaction is unusual, because most metal reacts with solutions of H_2SO_4 to form hydrogen gas and a metal sulfate.

45. When sulfuric acid reacts with copper. How does the oxidation number of the sulfur change?

(A) From +4 to +6 **(B)** From +6 to +4 **(C)** From +6 to +8 **(D)** From +8 to +6

46. The apparatus shown below can be used to prepare HNO_3 (boiling point = 86°C). The yield of HNO_3 collected in the tube can be maximized by maintaining the temperatures of the flask and tube, respectively, at .....&.....



(A) 0°C and 100°C

(B) 100°C and 0°C

(C) 350° and 150°C

(D) 350° and 100°

47. Which of the following is the balanced equation describing the combustion of elemental sulfur?

(A) $2H_2S + 3O_2 \longrightarrow 2SO_2 + 2H_2O$ **(B)** $H_2S + 2O_2 \longrightarrow SO_3 + H_2O$

(C) $2SO_3 \longrightarrow 2S + 3O_2$ **(D)** $S + O_2 \longrightarrow SO_2$

48. In the second step of preparing H_2SO_4 from elemental sulfur (the catalytic oxidation of SO_2), which strategy is most likely to increase the yield of SO_3 formed?

(A) Reducing the reaction temperature **(B)** Reducing the reaction pressure

(C) Removing SO_3 from the reaction mixture **(D)** Removing O_2 from the reaction mixture

49. Which of the following expression can be used to determine the number of moles of water in 1 ml. of concentrated H_2SO_4?

(A) $\frac{1.84\times0.98}{98}+\frac{1.84\times0.02}{18}$ **(B)** $\frac{1.84\times0.02}{18}$

(C) $\frac{1.84\times0.98}{18}$ **(D)** $\frac{1.84\times0.98\times18}{98}$

Paragraph for Questions 50 - 52

The noble gases have closed-shell electronic configuration and are monoatomic gases under normal conditions. The low boiling points of the lighter noble gases are due to weak dispersion force between the atoms and the absence of other interatomic interactions.

The direct reaction of xenon with fluorine leads to a series of compounds with oxidation number +2, +4 and +6. XeF_4 reacts violently with water to give XeO_3. The compounds of xenon exhibit rich stereochemistry and their geometries can be deduced considering the total number of electron pairs in the valence shell.

50. Argon is used in arc welding because of its:

(A) Low reactivity with metal **(B)** Ability to lower the melting point of metal

(C) Flammability **(D)** High calorific value

51. The structure of XeO_3 is:

(A) Linear **(B)** Planar **(C)** Pyramidal **(D)** T-shaped

52. XeF_4 and XeF_6 are expected to be:

(A) Oxidizing **(B)** Reducing **(C)** Both (A) & (B) **(D)** Strongly basic

Paragraph for Questions 53 - 55

A, B, C and D all are different triatomic compounds that exist as gases under normal conditions. A and B have a linear geometry whereas C and D are bent molecules. Elemental analysis establishes the presence of common constituents in gases B and C. Gas B does not react with water while A and D both forms weak diprotic acids on hydrolysis, gas C readily disproportionate in water to give a strong acid and a diatomic species E. Each of the species A to D can be prepared by one of the following preparative routes.

$NH_4NO_{3(s)} \xrightarrow{250^\circ}$

$CaCO_{3(s)} \xrightarrow{\Delta}$

$S_{8(s)} + O_{2(g)} \xrightarrow{\Delta}$

$E_{(g)} + O_{2(g)} \longrightarrow$

When equimolar quantities of C and E are passed through a solution of aqueous caustic soda a salt F is formed. Treatment of F with sulphuric acid produces a weak acid G and sodium sulphate. G readily decomposes to give a strong acid, water and substance E.

53. Which gas is used as a mild anesthetic and a propellant for whipped cream?

(A) E **(B)** B **(C)** C **(D)** D

54. The correct statements are:

1. A, C and D all turns moist blue litmus to red.

2. C, D, G and E all turns orange colouration of acidified potassium dichromate solution to green.

3. The decomposition reaction of G is a disproportionation reaction.

4. Both D and E are paramagnetic.

5. Both A and D turns lime water milky.

(A) 1, 2, 3, 5 **(B)** 1, 2, 4, 5 **(C)** 1, 3, 4, 5 **(D)** 1, 2, 3, 4

55. Which two gases on reacting in equimolar amounts at –30°C form ***BLUE LIQUID***?

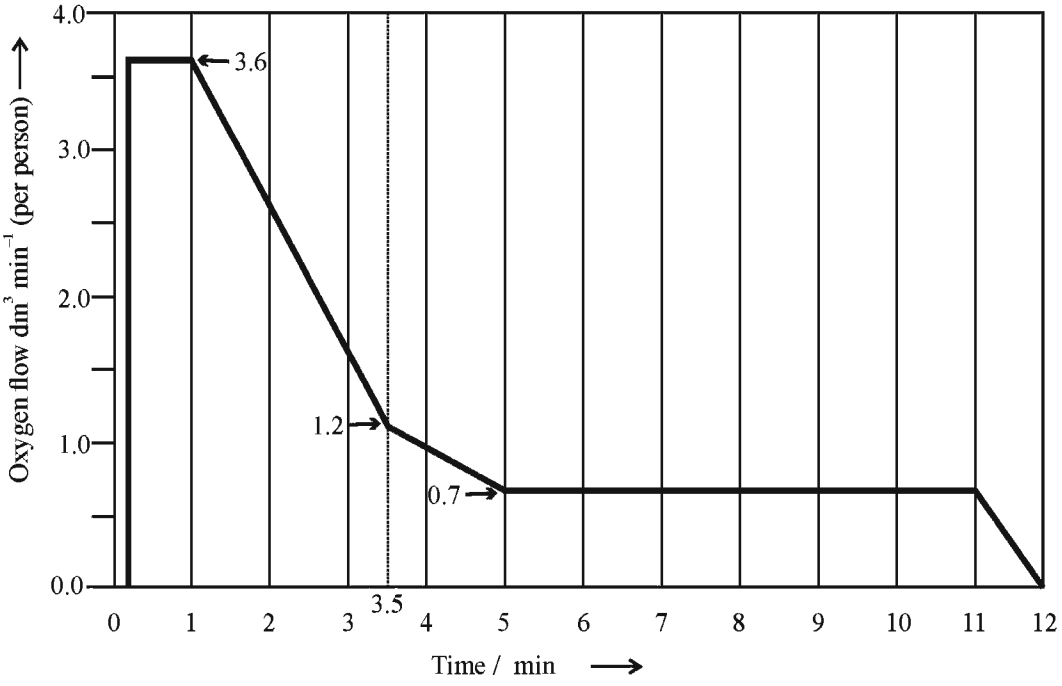
(A) A and B **(B)** B and C **(C)** C and E **(D)** B and E

Paragraph for Questions 56 - 58

Rather than carrying highly pressurized heavy oxygen cylinders, most aeroplanes rely on chemically generated oxygen in the event of an emergency.

These generators are typically composed of a mixture of sodium chlorate (V), $NaClO_3$, iron fillings and barium peroxide, BaO_2. Once initiated, the sodium chlorate (V) undergoes thermal decomposition producing oxygen gas. The iron combines with some of the oxygen to produce enough heat to sustain the reaction. The barium peroxide removes toxic side products which include chlorine and chloric (I) acid, HClO. Barium chloride and oxygen are common products in these two reactions.

When a mask is deployed for inhaling purpose, the flow rate of oxygen gas is designed to change over time as the aeroplane arrives to a safe altitude. Shown below in graph is the typical specification for the flow rate from one such oxygen generator.



Ten seconds after being activated, the flow rate is at its maximum of 3.6 $dm^3\ min^{-1}$. This lasts for approximately 50 seconds before falling as shown in the graph.

A portable, self-contained closed circuit breathing apparatus contains a chemical supply of oxygen similar to that in an aeroplane. It also contains a means to remove exhaled carbon dioxide. Very often potassium superoxide (KO_2) is used for this. KO_2 reacts with water, liberating further oxygen, and the by-product of this reaction absorbs the CO_2.

56. The mass of sodium chlorate needed to produce nearly 60 dm^3 of oxygen under the condition at which molar volume of a gas is 24 dm^3, is:

(A) 365 g **(B)** 178 g **(C)** 399 g **(D)** 266 g

57. The approximate volume of oxygen produced by the generator by using the graph to estimate will be:

(A) 15 dm^3 **(B)** 18 dm^3 **(C)** 16 dm^3 **(D)** 12 dm^3

58. The correct balanced equation for the reaction between barium peroxide and chloric(I) acid is:

(A) $BaO_2 + 2HClO \rightarrow Ba(ClO)_2 + H_2O_2$ **(B)** $BaO_2 + 2HClO \rightarrow BaCl_2 + \frac{1}{2}O_2 + H_2O$

(C) $BaO_2 + 2HClO \rightarrow Ba(ClO)_2 + \frac{1}{2}O_2 + H_2O$ **(D)** $BaO_2 + 2HClO \rightarrow BaCl_2 + 1\frac{1}{2}O_2 + H_2O$

Paragraph for Questions 59 - 61

Sodium sulphite (Na_2SO_3) is added to meat as a preservative. The presence of Na_2SO_3 can be detected by adding dil. H_2SO_4 when the pungent smelling gas evolved turns the lime water milky. The gas evolved was detected as sulphur dioxide. The SO_2 evolved was dissolved in water and it requires I_2 solution in order to oxidize SO_2 to SO_4^{2-} in titration

$$SO_2 + 2H_2O + I_2 \longrightarrow 4H^+ + SO_4^{2-} + +2I^-$$

In order to check the results of titration, excess barium chloride is added to the final solution. The resulting precipitate is collected and weighed.

59. SO_2 and CO_2 both turns lime water milky. Which of the following reagent can be used to distinguish these two gases?

(I) $K_2Cr_2O_7/H_2SO_4$ **(II)** $KMnO_4/H+$ **(III)** I_2 solution

(A) I, II, III correct **(B)** I, III only correct

(C) II, III only correct **(D)** III only correct

60. SO_2 gas is used as a bleaching agent. Its bleaching action is:

(A) Temporary and due to its oxidizing nature **(B)** Temporary and due to its reducing action

(C) Permanent and due to its oxidizing action **(D)** Permanent and due to its reducing action

61. Which of the following compounds is formed, when Na_2SO_3 is boiled with sulphur.

(A) Na_2SO_4 **(B)** $Na_2S_2O_5$ **(C)** $Na_2S_2O_6$ **(D)** $Na_2S_2O_3$

Paragraph for Questions 62 - 64

A and B are elements in the same group of the periodic table. In nature they are not found as free elements but found as ions in various minerals and sea water. Ionic salts containing either A or B reacts with phosphoric acid (H_3PO_4) to give, H_xA or H_xB a gaseous product, respectively, on heating. Aqueous solution of H_xA is weakly acidic while of H_xB is strongly acidic. H_xA can also be formed when the above reaction was carried out using sulfuric acid instead of H_3PO_4, however, ionic salts containing B gave B_2 under these conditions. Compound A_2 can be produced via electrolysis of the molten salt KHA_y whereas B_2 is stable in an aqueous medium.

Diatomic molecules A_2 and B_2 exist as a gas and a volatile solid, respectively, under normal conditions.

Reaction of A_2 with B_2 produces one of four compounds of the type BA_n depending on the stoichiometry of the reaction. All four are reactive species.

62. The elements 'A' and 'B' are:

(A) O and S **(B)** N and P **(C)** F and I **(D)** Cl and Br

63. Incorrect statement for A and B is:

(A) Electron gain enthalpy of B is less than that of A.

(B) Element B shows positive oxidation state in its compound.

(C) A_2 disproportionates in water or alkali.

(D) The hydracid of A is able to form glasses through itching.

64. Shape of BA_3 molecules is:

(A) Triangular planar **(B)** Trigonal pyramidal

(C) T–shape **(D)** Tetrahedral

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

65. Which of the following is/are **correct** balanced equation(s) for the formation of $P_2O_7^{4-}$?

(A) $2H_3PO_4 \xrightarrow[250\text{-}260^\circ C]{\Delta} H_4P_2O_7 + H_2O$ **(B)** $5H_3PO_4 + POCl_3 \longrightarrow 3H_4P_2O_7 + 3HCl$

(C) $P_4O_{10} + 4H_2O \longrightarrow 2H_4P_2O_7$ **(D)** $H_3PO_4 + H_3PO_3 \longrightarrow H_4P_2O_7 + H_2$

66. Which of the following ions have single S–S linkage?

(A) $S_2O_8^{2-}$ **(B)** $S_2O_6^{2-}$ **(C)** $S_2O_5^{2-}$ **(D)** $S_2O_3^{2-}$

67. The element which exist(s) in the liquid state at or near normal room temperature is(are):

(A) Bromine **(B)** Mercury **(C)** Gallium **(D)** Lithium

68. Which among the following is/are paramagnetic?

(A) O_2 **(B)** ClO_2 **(C)** S_2 **(D)** KO_2

69. Which of the following is(are) not the characteristic of inter-halogen compounds?

(A) They are more reactive than halogens

(B) They are quite unstable, but none of them is explosive

(C) They are covalent in nature

(D) They have low boiling point

70. Which of the following is **correct** about the reaction?

$$3NaClO \xrightarrow{\Delta} NaClO_3 + 2NaCl$$

(A) It is a disproportionation reaction

(B) Oxidation number of Cl decreases as well as increases in this reaction

(C) This reaction is used for the manufacture of halates

(D) It is a comproportionation reaction

71. Chlorine is manufactured from:

(A) Electrolysis of brine solution

(B) Electrolysis of Fused KCl

(C) Electrolysis of bleaching powder

(D) Oxidation of HCl by O_2 using $CuCl_2$ as catalyst.

72. Select the correct statement about $Na_2S_2O_3.5H_2O$

(A) It is known as hypo **(B)** It is used in photography to form complex with AgBr

(C) It is used to remove stain of I_2 **(D)** It can be used as an antichlor

73. Which of the following exist in different allotropic forms?

(A) Carbon **(B)** Phosphorous **(C)** Sulphur **(D)** Tin

74. Which of the following is/are covalent solids?

(A) Diamond **(B)** Black phosphorous **(C)** Boron **(D)** Iodine

75. Which of the following is/are network solids?

(A) Quartz (SiO_2) **(B)** Diamond **(C)** Sulphur **(D)** Iodine

76. Thionyl chloride ($SOCl_2$) is an important chemical reagent, for which of the following change it can be used?

(A) Hydrated ferric chloride $\rightarrow$ anhydrous ferric chloride

(B) Ethyl alcohol $\rightarrow$ Ethyl chloride

(C) Acetic acid $\rightarrow$ Acetyl chloride

(D) White phosphorous $\rightarrow$ Phosphorous trichloride

77. The following substances are covalent or molecular solids and also exist in diatomic form in vapour phase. Which of the following have paramagnetic diatomic form?

(A) Carbon **(B)** Boron **(C)** Sulphur **(D)** None of these

78. Which of the following allotropic transformation takes place on decreasing temperature?

(A) Diamond $\rightarrow$ Graphite **(B)** Rhombic sulphur $\rightarrow$ monoclinic sulphur

(C) White phosphorous $\rightarrow$ Black phosphorous **(D)** White tin $\rightarrow$ Grey tin

79. Which of the following is(are) correct order of increasing number of pi-bonds?

(A) $B_2 < C_2 < SO_3$ **(B)** $NO < CO < XeO_3$

(C) $SO_2 < SO_3 < XeO_4$ **(D)** $ClO_2^- < ClO_3^- < ClO_4^-$

80. Which of the following is/are used for preparation of pseudohalogen, cyanogen $(CN)_2$?

(A) Reaction of excess KCN with $CuSO_4$ solution **(B)** Heating ammonium oxalate with P_2O_5

(C) Heating thalium (III) cyanide **(D)** Heating ammonium formate with P_2O_5

81. Which of the following dissociation results in an increase in paramagnetism?

(A) $2O_3 \xrightarrow{\Delta} 3O_2$ **(B)** $N_2O_4 \xrightarrow{\Delta} 2NO_2$

(C) $N_2O_3 \xrightarrow{\Delta} NO + NO_2$ **(D)** $S_8 \xrightarrow{\Delta} 4S_2$

82. Which of the following can be used for dehydrating readily hydrolysable inorganic halides?

(A) conc. H_2SO_4 **(B)** P_4O_{10} **(C)** CaO **(D)** $OSCl_2$

83. Identify correct statement(s) related to two stable allotropes of oxygen i.e. dioxygen (O_2) and ozone (O_3) :

(A) In ozone central oxygen atoms is sp^2 hybridized.

(B) Ozone has a nonzero dipole moment.

(C) Dioxygen is weakly attracted to strong magnetic field.

(D) Ozone is weakly repelled by magnetic field.

84. Identify correct statement(s):

(A) Polyatomic S_8 allotropic form of sulphur is more stable than diatomic S_2.

(B) Polyatomic O_3 allotropic form of oxygen is less stable than diatomic O_2.

(C) S_2 and O_2 both are paramagnetic. **(D)** S_8 and O_3 both are diamagnetic.

85. Which substance has a zero standard free energy of formation.

(A) Pb(s) **(B)** Hg(l) **(C)** $Cl_2(g)$ **(D)** $Br_2(l)$

86. Which of the following pair(s) have identical structure?

(A) XeF_2 and I_3^- **(B)** $XeOF_2$ and ClF_3 **(C)** XeO_3F_2 and PF_5 **(D)** $XeOF_4$ and IF_5

87. Which of the following uses of noble gases is correctly matched?

(A) He : Helium is mixed with O_2 in 4 : 1 ratio to provide an artificial atmosphere for divers.

(B) Ne : Neon is used in discharge tubes for advertisement display purposes.

(C) Ar : Argon is used to provide an inert atmosphere in high temperature metallurgical process.

(D) He : Helium is used in filling balloons for meteorological observations.

88. Which of the following reaction(s) represent strong oxidizing power of xenon fluorides?

(A) $XeF_6(s) + 3H_2O(l) \longrightarrow XeO_3(aq) + 6HF(g)$

(B) $XeF_2(s) + 2H_2O(l) \longrightarrow 2Xe(g) + 4HF(g) + O_2(g)$

(C) $XeF_4(s) + Pt(s) \longrightarrow PtF_4(s) + Xe(g)$

(D) $2XeF_6(s) + 3SiO_2(s) \longrightarrow 2XeO_3(s) + 3SiF_4(g)$

89. Which of the following is correct regarding structure of xenon fluorides?

(A) XeF_2 is linear **(B)** XeF_4 is square planar

(C) XeF_6 is distorted octahedral **(D)** XeF_8^{2-} is square antiprism

90. XeF_4 is expected to be:

(A) oxidizing **(B)** reducing **(C)** unreactive **(D)** fluorinating agent

91. Formation of ozone from oxygen is endothermic hence O_3 is prepared by

(A) Heating oxygen at 298 K.

(B) Passing dry stream of oxygen through a silent electrical discharge.

(C) Passing fluorine in water.

(D) Treating H_2O_2 with fluorine.

92. Which of the following compound(s) is/are thermodynamically unstable at 298 K?

(A) O_3 **(B)** H_2O_2 **(C)** XeO_3 **(D)** O_2F_2

93. Which of the following compounds can't be prepared by direct combination of the constituent elements at 298 K?

(A) N_2O **(B)** XeO_3 **(C)** XeF_2 **(D)** P_4O_{10}

94. Which of the following reaction is/are used for preparation of xenon oxide, XeO_3?

(A) $2Xe + 3O_2 \longrightarrow 2XeO_3$ **(B)** $XeF_2 + \frac{3}{2}O_2 \longrightarrow XeO_3 + F_2$

(C) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$ **(D)** $Xe + Al_2O_3 \longrightarrow XeO_3 + 2Al$

95. Select the correct statement(s).

(A) Boiling point of HF is lower than the boiling point of H_2O

(B) HF has stronger hydrogen bonds than water

(C) HF is stronger acid than water

(D) Liquid HF is more viscous than water

96. Which of the following is correct regarding oxides of halogens?

(A) OF_2 is oxygen fluoride

(B) ClO_2 is used as a bleaching agent for paper pulp

(C) I_2O_5 is used in the estimation of carbon monoxide

(D) BrO_3 is least stable halogen oxide

97. Which of the following reaction(s) of halogen with water is correctly represented?

(A) $2F_2(g) + 2H_2O(l) \longrightarrow 4HF(aq) + O_2(g)$

(B) $Cl_2(g) + H_2O(l) \longrightarrow HCl(aq) + HOCl(aq)$

(C) $Br_2(l) + H_2O(l) \longrightarrow HBr(aq) + HOBr(aq)$

(D) $2I_2(s) + 2H_2O(l) \longrightarrow 4HI(aq) + O_2(g)$

98. Which of the following can be used as bleaching agent?

(A) ClO_2 **(B)** H_2O_2 **(C)** Cl_2 **(D)** SO_2

99. Which of the following is/are correct?

(A) All the chlorine oxides are endothermic and unstable

(B) XeO_3 is endothermic and unstable.

(C) Ozone is endothermic and decomposes on heating.

(D) H_2O_2 disproportionate on heating.

100. Which of the following is/are correct statement(s)?

(A) Formation of ozone from oxygen is an endothermic process.

(B) Ozone is violet black in solid form.

(C) Ozone molecule is angular.

(D) Ozone is polar molecule.

101. Which of the following is/are correctly matched?

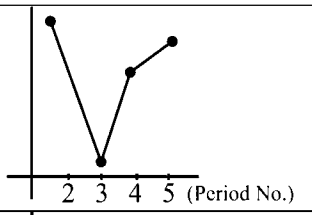
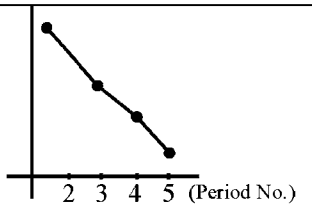
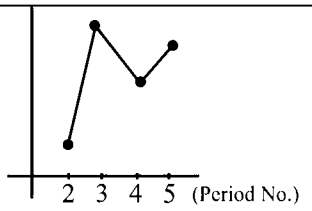
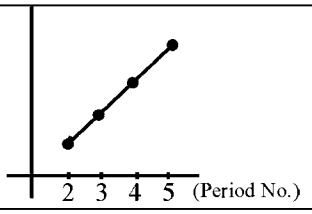
(A) Al_2Cl_6;sp^3 hybridized central atom **(B)** B_2H_6;sp^3 hybridized central atom

(C) S_2F_{10};sp^3d^2 hybridized central atom **(D)** Be_2Cl_4;sp^2 hybridized central atom

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

102. MATCH THE COLUMN:

Column 1		Column 2	
(A)	Bond energies of the hydra acids of the halogens fluorine, chlorine, bromine, iodine	**(p)**	
(B)	Boiling points of the hydrides of the 16 group elements oxygen, sulphur, selenium, tellurium	**(q)**	
(C)	The stability of monochlorides of group 13 elements boron, aluminium, gallium, indium	**(r)**	
(D)	Melting points of the dioxides of the group 14 elements carbon, silicon, germanium, tin	**(s)**	

103. MATCH THE COLUMN:

Column 1		Column 2	
(A)	Maximum solubility in water	**(p)**	F_2
(B)	Corrosive liquid	**(q)**	Cl_2
(C)	Maximum intermolecular distance	**(r)**	Br_2
(D)	Enthalpy of dissociation (maximum)	**(s)**	I_2

104. MATCH THE COLUMN:

Column 1 (Gaseous Substance)		Column 2 (Absorbent)	
(A)	Cl_2	**(p)**	Potash solution
(B)	O_2	**(q)**	Ammonical cuprous chloride
(C)	CO	**(r)**	$FeSO_4$ solution
(D)	NO	**(s)**	Alkaline pyrogallol solution

105. MATCH THE COLUMN:

Column 1		Column 2	
(A)	XeF_4	**(p)**	Pyramidal
(B)	XeF_6	**(q)**	Trigonal bipyramidal
(C)	XeO_3	**(r)**	Distorted octahedral
(D)	XeO_2F_2	**(s)**	Square planar

106. MATCH THE COLUMN:

Column 1		Column 2	
(A)	F_2	**(p)**	Shows only one non zero oxidation state
(B)	Cl_2	**(q)**	Coloured
(C)	Br_2	**(r)**	Readily dipsroportiotes in alkali
(D)	I_2	**(s)**	Stronger oxidizing agent
		(t)	More negative electron gain enthalpy

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

107. Among the following, the number of elements showing only one non-zero oxidation state is_____.

O, Cl, F, N, P, S*n*, T*l*, Na, Mg

108. Find out total number of lone pairs in KI_3.

109. To an aqueous solution containing anion a few drops of acidified $KMnO_4$ are added. How many of the following anions if present will not decolourize the $KMnO_4$ solution.

$I^-, CO_3^{2-}, NO_2^-, Cl^-, S^{2-}, SO_3^{2-}, SO_4^{2-}, Br^-, C_2O_4^{2-}$.

110. An acid is formed by heating orthophosphoric acid at 250 – 260°C. The number of series of salts formed by this acid are _____.

111. The ratio of lone pairs and the number of S–S bonds in S_8 molecules is _____.

112. How many of the following are pseudo halides?

$I_3^-, CN^-, SCN^-, OCN^-, CNO^-, NNN^-, HCOO^-, S_2^{2-}, ICl_2^-$

113. How many of the following oxoacids are mono basic acids?

$H_3BO_3, H_2CO_3, H_2SO_3, H_2SO_4, H_3PO_4, H_3PO_3, H_3PO_2, HPO_3$

114. The number of non-ionizable hydrogen atoms attached to phosphorus atom in hypophosphorus acid are _____.

115. How many of the following chlorides can be hydrolysed?

$BCl_3, CCl_4, SiCl_4, NCl_3, PCl_3, AsCl_3, SbCl_3, SCl_4, ICl_3$

116. How many of the following oxides are mixed anhydrides?

$N_2O_3, NO_2, P_4O_6, P_4O_8, P_4O_{10}, Cl_2O_7, SO_3, I_2O_5, N_2O_5, Cl_2O_6$.

117. How many of the following on heating liberate O_2 ?

$HgO, Pb_3O_4, Ag_2O, Ag_2CO_3, AgNO_3, NaNO_3, LiNO_3, KClO_3, Mg(NO_3)_2$,

118. How many of the following oxides are only acidic in nature?

$MgO, Al_2O_3, SO_2, Cl_2O_7, CO_2, N_2O_5, Mn_2O_7, CrO_3, V_2O_5$

119. How many of the following oxides are neutral?

$Na_2O, CaO, Al_2O_3, CO, NO, CO_2, N_2O, Cl_2O, B_2O_3$.

120. Total number of lone pair of electrons in XeF_2 are_____.

121. Xe reacts with fluorine in 1 : x ratio at high temperature and pressure to form XeF_4. What is the value of x?

122. Treating Ba_2XeO_6 with concentrated sulphuric acid produces an explosive unstable gaseous substance XeO_4. The number of $d\pi - p\pi$ bonds in XeO_4 are_____.

123. Solution containing $(SO_3^{2-}) \xrightarrow{\text{dil.HCl}} \underset{\text{(pungent smell)}}{\text{Gas 'A'}} \xrightarrow[\text{(Orange solution)}]{K_2Cr_2O_7, H^+}$ solution turns Green. What is change in oxidation state of Sulphur on reaction with orange solution?

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Colourless solutions of the following four salts are placed separately in four different test tubes and a strip of copper is dipped in each one of these which solution will turn blue?

(A) KNO_3 **(B)** $AgNO_3$ **(C)** $Zn(NO_3)_2$ **(D)** $ZnSO_4$

2. $Cr_2O_7^{2-} \underset{Y}{\overset{X}{\rightleftharpoons}} 2CrO_4^{2-}$, X and Y are respectively:

(A) $X = OH^-, Y = H^+$ **(B)** $X = H^+, Y = OH^-$

(C) $X = OH^-, Y = H_2O_2$ **(D)** $X = H_2O_2, Y = OH^-$

3. Solution of MnO_4^- is purple - coloured due to:

(A) d-d-transition **(B)** Charge transfer from O to Mn

(C) Due to both d-d-transition and charge transfer **(D)** None of these

4. The transition elements are more metallic than representative elements (s and p-block elements) due to:

(A) Availability of d-orbitals for bonding

(B) Variable oxidation states are not shown by transition elements

(C) All electrons are paired in d-orbitals **(D)** *f*-orbitals are available for bonding

5. During estimation of oxalic acid using $KMnO_4$, the self indicator is:

(A) $KMnO_4$ **(B)** oxalic acid **(C)** K_2SO_4 **(D)** $MnSO_4$

6. The most common oxidation state of lanthanides is:

(A) +3 **(B)** +2 **(C)** +4 **(D)** +5

7. $Y \xleftarrow{KI} CuSO_4 \xrightarrow{\text{dil } H_2SO_4} X$ (Blue colour), X and Y are:

(A) $X = I_2, Y = [Cu(H_2O)_4]^{2+}$ **(B)** $X = [Cu(H_2O)_4]^{2+}, Y = I_2$

(C) $X = [Cu(H_2O)_4], Y = I_2$ **(D)** $X = [Cu(H_2O)_6]^{2+}, Y = I_2$

8. Transition elements are usually characterized by variable oxidation states but Zn does not show this property because of:

(A) Completion of np-orbitals **(B)** Completion of (n-1)d orbitals

(C) Completion of ns-orbitals **(D)** Inert pair effect

9. $CuSO_4$ solution reacts with KCN to give:

(A) $Cu(CN)_2$ **(B)** CuCN **(C)** $K_2[Cu(CN)_2]$ **(D)** $K_3[Cu(CN)_4]$

10. The higher oxidation states of transition elements are found to be in the combination with A and B, which are:

(A) F, O **(B)** O, N **(C)** O, Cl **(D)** F, Cl

11. In the equation: $4M + 8CN^- + 2H_2O + O_2 \longrightarrow 4[M(CN)_2]^- + 4OH^-$, metal M is:

(A) Pt **(B)** Au **(C)** Cu **(D)** Hg

12. Among following, the compound which shows the lowest degree of paramagnetism per mole at 298 K is:

(A) $CuSO_4.5H_2O$ **(B)** $NiSO_4.6H_2O$ **(C)** $FeSO_4.6H_2O$ **(D)** $MnSO_4.4H_2O$

13. Solid $CuSO_4.5H_2O$ having covalent, ionic as well as co-ordinate bonds. Copper atom/ion forms ___ co-ordinate bonds with water.

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

14. The main product obtained when a solution of sodium carbonate reacts with mercuric chloride is:

(A) $Hg(OH)_2$ **(B)** HgO **(C)** $HgCO_3$ **(D)** $HgCO_3 \cdot Hg(OH)_2$

15. The aqueous solution of $CuCr_2O_7$ is green because it contains:

(A) Green Cu^{2+} ions **(B)** Green $Cr_2O_7^{2-}$ ions

(C) Blue Cu^{2+} ions and green $Cr_2O_7^{2-}$ ions **(D)** Blue Cu^{2+} ions and yellow $Cr_2O_7^{2-}$ ions

16. Manganese steel is used for making railways because:

(A) it is hard with high percentage of Mn **(B)** it is soft with high percentage of Mn

(C) it is hard with small concentration of manganese with impurities

(D) it is soft with small concentration of manganese with impurities

17. In nitroprusside ion, the iron exists as Fe^{2+} and NO as NO^+ rather than Fe^{3+} and NO respectively. These forms of ions are established with the help of:

(A) Magnetic moment in solid state **(B)** Thermal decomposition method

(B) By reaction with KCN **(D)** By action with K_2SO_4

18. Transition elements in lower oxidation states act as Lewis acid because:

(A) They form complexes **(B)** They are oxidizing agents

(B) They donate electrons **(D)** They do not show catalytic properties

19. The shape of gaseous $SnCl_2$ is:

(A) tetrahedral **(B)** bent **(C)** linear **(D)** distorted tetrahedral

20. The solubility of silver bromide in hypo solution is due to the formation of:

(A) Ag_2SO_3 **(B)** $Ag_2S_2O_3$ **(C)** $[Ag(S_2O_3)]^-$ **(D)** $[Ag(S_2O_3)_2]^{3-}$

21. An extremely hot copper wire reacts with steam to give:

(A) CuO **(B)** Cu_2O **(C)** Cu_2O_2 **(D)** CuO_2

22. Which of the following is obtained when SO_2 gas is bubbled through a solution of $CuCl_2$.

(A) Cu **(B)** Cu_2Cl_2 **(C)** $CuSO_4$ **(D)** CuS

23. On strongly heating $AgNO_3$, the gases evolved are:

(A) N_2O and NO **(B)** NO_2 and O_2 **(C)** NO and O_2 **(D)** NO_2 and NO

24. A white solid halide of mercury forms a black mixture with ammonium hydroxides. The halide is:

(A) $HgCl_2$ **(B)** HgI_2 **(C)** Hg_2I_2 **(D)** Hg_2Cl_2

25. Which of the following pair cannot exist together?

(A) $Cu(NO_3)_2$ and $AgNO_3$ **(B)** $HgCl_2$ and $SnCl_2$

(C) $FeCl_3$ and $FeCl_2$ **(D)** None of these

26. Which of the following is not the characteristics of zinc?

(A) It is a volatile metal **(B)** It dissolves in alkali forming sodium metazincate

(C) It is brittle at very high temperature **(D)** Zinc dust is used as a reducing agent

27. Mercury is transported in metal containers made of:

(A) Silver **(B)** Lead **(C)** Iron **(D)** Aluminium

28. Splitting of silver is:

(A) Reduction of ammonical silver nitrate solution by tartrate

(B) Making of silver amalgam during filling of teeth

(C) A extraction of silver from its ore Ag_2S by hydrometallurgy

(D) Cooling of molten silver with the evolution of oxygen causing violent spurting

29. $CuCl_2$ and $CuBr_2$ exist as:

(A) Monomer **(B)** Dimer **(C)** Trimer **(D)** Polymer

30. Acidified potassium permanganate solution is decolourised by:

(A) Bleaching powder **(B)** White vitriol

(C) Mohr's salt **(D)** None of these

31. A metal which is not affected by conc. H_2SO_4, HNO_3 alkalis forms a compound X. This compound X can be used to give a complex which finds its application for toning in photography? The metal is:

(A) Au **(B)** Ag **(C)** Hg **(D)** Cu

32. Philosopher's wool when heated with BaO at 1100°C gives a compound. Identify the compound:

(A) $BaZnO_2$ **(B)** $Ba + ZnO_2$ **(C)** $BaCdO_2$ **(D)** $BaO_2 + Zn$

33. The formula for corrosive sublimate is:

(A) $HgCl_2$ **(B)** Hg_2Cl_2 **(C)** Hg_2O **(D)** Hg

34. Which of the following does not give a precipitate with excess of NaOH?

(A) $HgCl_2$ **(B)** $HgNO_3$ **(C)** $FeSO_4$ **(D)** $ZnSO_4$

35. KI and $CuSO_4$ solution when mixed give:

(A) $CuI_2 + K_2SO_4$ **(B)** $Cu_2I_2 + K_2SO_4$

(C) $Cu_2I_2 + I_2 + K_2SO_4$ **(D)** $K_2SO_4 + CuI_2 + I_2$

36. Au is insoluble in nitric acid but dissolves in aqua regia. The enhanced solubility of Au arises from:

(A) oxidizing strength of HNO_3 **(B)** oxidizing strength of NO_3

(C) oxidizing strength of H^+ **(D)** ability of Cl to form complexes

37. A solution of sodium thiosulphate on addition of few drops of ferric chloride gives violet colour due to the formation of:

(A) $Na_2S_4O_6$ **(B)** $Fe_2(SO_4)_3$ **(C)** $Fe_2(S_2O_3)_3$ **(D)** $Fe_2(S_2O_3)_2$

38. The colour of light absorbed by Prussian blue is:

(A) Orange - red **(B)** Blue-green **(C)** Yellow **(D)** Violet

39. When HCl reacts with finely powdered iron it forms:

(A) $FeCl_2$ and H_2 **(B)** $FeCl_3$ and H_2 **(C)** $FeCl_2.6H_2O$ & H_2 **(D)** $FeCl_3.6H_2O$ & H_2

Paragraph for Questions 40 - 43

Light green (Compound 'A') $\xrightarrow{\Delta}$ White Residue **(B)** $\xrightarrow[\text{Temp.}]{\text{High}}$ C + D + E.

Light green (Compound 'A') $\xrightarrow{BaCl_2}$ white ppt. insoluble in HCl and HNO_3

(i) 'D' and 'E' are two acidic gas.

(ii) 'D' is passed through $HgCl_2$ solution to give yellow ppt.

(iii) 'E' is passed through water first and then H_2S is passed, white turbidity is obtained.

(iv) A is water soluble and addition of $HgCl_2$ in it, white ppt is obtained but white ppt does not turn into grey on addition of excess solution of 'A'.

40. 'D' and 'E' are respectively.

(A) SO_2 and SO_3 **(B)** SO_3 and SO_2 **(C)** SO_2 and CO_2 **(D)** CO_2 and CO

41. Yellow ppt in the above observation is:

(A) Mercuric oxide **(B)** Basic mercury (I) sulphite

(C) Basic mercury (II) sulphate **(D)** Mercuric iodide

42. 'C' is soluble in:

(A) dil. HCl **(B)** dil. H_2SO_4 **(C)** conc. CH_3COOH **(D)** Boiled conc. HCl

43. What happens when H_2S gas is passed in solution of 'C' in conc HCl?

(A) Light green colour turns to yellowish green and yellow turbidity

(B) Yellowish green solution turns to greenish yellow and white turbidity

(C) Yellowish green ppt

(D) Black ppt

Paragraph for Questions 44 - 47

Transition metal and their compounds are used as catalysts in industry and in biological system. For example, in the Contact Process, vanadium compounds in the +5 state $(V_2O_5 \text{ or } VO_3^-)$ are used to oxidise SO_2 to SO_3.

$$SO_2 + \frac{1}{2}O_2 \xrightarrow{V_2O_2} SO_3$$

It is thought that the actual oxidation process takes place in two stages. In the first step, V^{5+} in the presence of oxide ions converts SO_2 to SO_3. At the same time, V^{5+} is reduced to V^{4+}.

$$2V^{5+} + O^{2-} + SO_2 \longrightarrow 2V^{4+} + SO_3$$

In the second step, V^{5+} is regenerated from V^{4+} by oxygen: $2V^{4+} + \frac{1}{2}O_2 \longrightarrow 2V^{5+} + O^{2-}$

The overall process is, of course, the sum of these two steps: $SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$

44. Transition metals and their compound catalyse reactions because:

(A) They have completely filled s-subshell

(B) They have a comparable size due to poor shielding of d-subshell

(C) They introduce an entirely new reaction mechanism with a lower activation energy

(D) They have variable oxidation states differ by two units

45. During the course of the reaction:

(A) Catalyst undergoes changes in oxidation state

(B) Catalyst increases the rate constant

(C) Catalyst is regenerated in its original form when the reactants converted to the products

(D) All are correct

46. Catalytic activity of transition metals depends on:

(A) Their ability to exist in different oxidation states **(B)** The size of the metal atoms

(C) The number of empty atomic orbitals available **(D)** None of these

47. Which of the following ion involved in the above process will show paramagnetism?

(A) V^{5+} **(B)** V^{4+} **(C)** O^{2-} **(D)** VO_3^-

Paragraph for Questions 48 - 51

MnO_2 is the most important oxide of manganese. MnO_2 occurs naturally as the black coloured mineral pyrolusite. It is an oxidizing agent, and decomposes to Mn_3O_4 on heating to 530°C. It is used in the preparation of potassium permanganate and in the production of Cl_2 gas. Over half a million tons per year of MnO_2 is used in dry batteries.

48. In the laboratory, MnO_2 is made by:

(A) Heating Mn in O_2 **(B)** Oxidizing Mn^{2+} in air

(C) Electrolytic oxidation of $MnSO_4$

(D) Precipitating MnO_2 from solution when performing titration of $KMnO_4$ in alkaline medium.

49. When MnO_2 is fused with KOH in the presence of air, the product formed is:

(A) purple colour $KMnO_4$ **(B)** green colour K_2MnO_4

(C) colourless MnO_4^- **(D)** purple colour K_2MnO_4

50. MnO_2 dissolved in concentrated HCl to form:

(A) Mn^{4+} ion and Cl_2 **(B)** Mn^{2+} ion and Cl_2

(C) $[MnCl_4]^{2-}$ and Cl_2 **(D)** only $[MnCl_4]^{2-}$

51. In which of the following species, the colour is due to charge transfer.

(I) $[Mn(OH)_4]^{2-}$ **(II)** MnO_4^{2-} **(III)** MnO_2 **(IV)** $KMnO_4$

(A) I, II, III correct **(B)** II, IV correct **(C)** I, III correct **(D)** only IV correct

Paragraph for Questions 52 - 54

Iron (+II) is one of the most important oxidation states, and salts are called ferrous salts. Most of the Fe(+II) salts are pale green and contain $[Fe(H_2O)_6]^{2+}$ ion. Fe(+II) compounds are easily oxidized by air and so are difficult to obtain in pure from Fe^{2+} form many complexes like $K_4[Fe(CN)_6]$.

52. Anhydrous $FeCl_2$ is made by:

(A) Heating Fe with dilute HCl **(B)** Heating Fe with gaseous HCl

(C) Reacting Fe with conc. HCl **(D)** Heating Fe with Cl_2 gas

53. $K_3[Fe(CN)_6]$ is used in the detection of Fe^{2+} ion with which it gives a deep colour. This colour is due to the formation of:

(A) $K_2Fe[Fe(CN)_6]$ **(B)** $Fe_4[Fe(CN)_6]_3$ **(C)** $Fe[Fe(CN)_6]$ **(D)** $Fe_3[Fe(CN)_6]_2$

54. $FeSO_4$ is used in brown ring test for nitrates and nitrites. In this test, a freshly prepared $FeSO_4$ solution is mixed with solution containing NO_2^- or NO_3^- and the conc. H_2SO_4 is run down the side of the test tube. If the mixture gets hot or is shaken,

I. The brown colour disappears **II.** NO is evolved

III. A yellow solution of $Fe_2(SO_4)_3$ is formed

(A) I, II, III are correct **(B)** I, III are correct

(C) II, III are correct **(D)** Only I is correct

Paragraph for Questions 55 - 58

The following observations were made on Na_2CrO_4 and $Na_2Cr_2O_7$.

(A) When CO_2 was passed over Na_2CrO_4, then $Na_2Cr_2O_7$ was formed.

(B) When Zn is added to acidic solution of $Na_2Cr_2O_7$, the colour changes from orange to green.

(C) Na_2CrO_4 when added to a nitrate salt solution gave a yellow coloured precipitate which after separation and drying followed by flame test gave a green coloured flame.

55. What is the function of CO_2 in the first observation?

(A) Acts as an oxidizing agent **(B)** Acts as a reducing agent

(B) Produces chromium and oxygen **(D)** Makes the solution acidic

56. The reason for the colour of $Na_2Cr_2O_7$ solution to first change from orange to green on adding Zn is because

(A) Zn is a reducing agent and changes Cr^{4+} to Cr^{3+}

(B) Zn is a reducing agent and changes Cr^{6+} to Cr^{3+}

(C) Zn is a reducing agent and it reduces Cr^{6+} to Cr^{2+} **(D)** None of these

57. The extent of splitting in d-orbitals is more when the chromium in the solution is in

(A) +1 oxidation state **(B)** +2 oxidation state

(C) +3 oxidation state **(D)** +6 oxidation state

58. The nitrate salt which gives a yellow precipitate with Na_2CrO_4 and the yellow precipitate gives green flame with Bunsen burner is of:

(A) Pb^{2+} **(B)** Ca^{2+} **(C)** Mg^2 **(D)** Ba^{2+}

Paragraph for Questions 59 - 63

A colourless solid (A) on strong heating gives a brown gas (B) and a grey residue (C). On dissolution of solid (A) in NH_3 a solution of compound (D) is formed which oxidizes glucose. $FeSO_4$ reduces solution of (A) in water. Aqueous solution of (A) also gives a brick red precipitate (E) with K_2CrO_4 solution. On the basis of above information answer the following questions.

59. Compound (A) is:

(A) $AgNO_3$ **(B)** $Hg_2(NO_3)_2$ **(C)** $Cu(NO_3)_2$ **(D)** AgBr

60. Compound (B) is:

(A) Br_2 **(B)** NO_2 **(C)** NO **(D)** none of the above

61. Compound (C) is:

(A) Hg **(B)** Bi **(C)** Ag **(D)** Cu

62. Compound (D) is:

(A) $[Cr(NH_3)_6]^{3+}$ **(B)** $[HgI_4]^{2-}$ **(C)** $[Cu(NH_3)_4]^{2+}$ **(D)** $[Ag(NH_3)_2]^{+}$

63. Compound (E) is:

(A) HgI_2 **(B)** $K_2Cr_2O_7$ **(C)** $HgCrO_4$ **(D)** Ag_2CrO_4

Paragraph for Questions 64 - 68

A brown powdery substance (A) when heated with concentrated HCl gives compound (B) along with the liberation of a greenish yellow gas (C), which liberates a compound (D) when passed through KI solution. Compound (D) dissolves in excess of KI, forming a yellow solution. (A) when fused with KOH in presence of atmospheric oxygen gives a green mass, which on extraction with water and on treatment with a gas (E), changes to purple. Moreover the gas (E) when passed through dry KOH at low temperature gives a deep red coloured compound. On the basis of above information answer the following questions.

64. Compound (A) is:

(A) Fe_2O_3 **(B)** MnO_2 **(C)** CuS **(D)** PbS

65. Compound (B) is :

(A) $FeCl_3$ **(B)** $MnCl_2$ **(C)** $CuCl_2$ **(D)** $PbCl_2$

66. Compound (C) is:

(A) CrO_2Cl_2 **(B)** NO **(C)** Cl_2 **(D)** H_2S

67. Compound (D) is:

(A) NO_2 **(B)** I_2 **(C)** O_2 **(D)** SO_2

68. Compound (E) is:

(A) O_3 **(B)** Cl_2 **(C)** O_2 **(D)** NO_2

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

69. Which of the following is/are correctly matched?

(A) $HgCl_2$; Corrosive sublimate **(B)** HgS; Vermilion

(C) Hg_2Cl_2 ; Calomel **(D)** HgI; Amalgam

70. The ionization energies of transition elements are:

(A) less than p-block elements **(B)** more than s-block elements

(C) less than s-block elements **(D)** more than p-block elements

71. The metal(s) which does/do not form amalgam is (are):
(A) Fe **(B)** Pt **(C)** Zn **(D)** Ag

72. The highest oxidation state shown by transition elements is:
(A) +7 by Mn **(B)** +8 by Os **(C)** +8 by Ru **(D)** +7 by Fe

73. The catalytic activity of transition elements is related to their:
(A) Variable oxidation states **(B)** Surface area
(C) Complex formation ability **(D)** Magnetic moment

74. Acidified $KMnO_4$ can be decolourised by:
(A) SO_2 **(B)** H_2O_2 **(C)** $FeSO_4$ **(D)** $FeCl_3$

75. The lanthanide contraction is responsible for the fact that:
(A) Zr and Hf have same atomic sizes
(B) Zr and Hf have same properties
(C) Zr and Hf have different atomic sizes
(D) Zr and Hf have different properties

76. Which of the following is(are) not regarded as transition element(s)?
(A) Zn **(B)** Cd **(C)** Hg **(D)** Uub

77. Which of the following is(are) transition element(s)?
(A) Sc **(B)** Cu **(C)** Ag **(D)** Hg

78. Which of the following d-block elements exhibit variable oxidation states?
(A) Zn **(B)** Sc **(C)** Cu **(D)** Fe

79. Identify correct statement related with oxidation states of d-block elements?
(A) The maximum oxidation states of reasonable stability correspond in value to the sum of the s and d electrons upto manganese
(B) Variable oxidation states of transition elements differ from each other by unity
(C) In a group of d-block elements in general higher oxidation states are favoured by the heavier members
(D) In metal carbonyls transition elements are found in lower oxidation state

80. Cr^{2+} is reducing while Mn^{3+} is oxidizing because:
(A) Both have d^4 configuration
(B) In Cr^{2+} its electronic configuration changes from d^4 to d^3
(C) In Mn^{3+} its electronic configuration changes from d^4 to d^5
(D) Of the increasing stability of the species to which they are converted

81. Which of the following d-block elements do not form trihalides?
(A) Fe **(B)** Ni **(C)** Cu **(D)** Zn

82. Which of the following is(are) mixed oxides?
(A) Mn_3O_4 **(B)** Fe_3O_4
(C) Co_3O_4 **(D)** $Fe_{0.93}O$

83. Which of the following halides of copper is(are) not known?

(A) CuF **(B)** CuI **(C)** CuI_2 **(D)** $CuCl_2$

84. Identify correct statement(s) related with Cu?

(A) The standard reduction potential for the reduction of Cu^{2+} to Cu is positive

(B) $Cu^{2+}_{(aq)}$ is more stable than $Cu^{+}_{(aq)}$

(C) Copper (I) compounds undergo disproportionation in aqueous solution

(D) CuI_2 is stable

85. Identify correct statement(s) related with halides of transition elements.

(A) VF_5, CrF_6 and MnF_7 all are known

(B) $VCl_5 + H_2O \rightarrow VOCl_3 + HCl$

(C) $2CuI_2 \rightarrow 2CuI + I_2$

(D) $2FeCl_{3(aq)} + H_2S_{(aq)} \rightarrow 2FeCl_{2(aq)} + 2HCl_{(aq)} + S_{(s)}$

86. Which of the following is/are alloy of transition metals with non transition metals?

(A) Brass **(B)** Bronze

(C) Zinc-amalgam **(D)** German silver

87. The reaction $Fe(CNS)^{3-}_6 \rightarrow FeF^{3-}_6$ takes place with:

(A) Increase in spin only magnetic moment **(B)** Change in hybridization state

(C) Change in geometry **(D)** Decrease in number of isomers

88. $[Sc(H_2O)_6]^{3+}$ ion is:

(A) colourless **(B)** diamagnetic

(C) yellow coloured **(D)** paramagnetic

89. Which of the following pair(s) of elements is(are) called "chemical twins" because of their very similar chemical properties?

(A) Li and Mg **(B)** Be and Al

(C) Hf and Zr **(D)** Al and Zn

90. A certain metal will liberate hydrogen from dilute acids. It will react with water to form hydrogen only when the metal is heated and water is in the form of steam. The metal is probably:

(A) Iron **(B)** Copper

(C) Zinc **(D)** Sodium

91. $CuSO_{4(aq)} + X \longrightarrow Y +$ other products. 'X' and 'Y' respectively are:

(A) $PH_3; Cu_3P_2$ **(B)** $NH_{3(aq)}, [Cu(NH_3)_4]SO_4$

(C) KI; $Cu_2I_2 + I_2$ **(D)** $KCN; K_3[Cu(CN)_4] + (CN)_2$

92. Many of the metals and/or their compounds are essential catalysts in the chemical industry. Identify correctly matched catalyst and process.

(A) V_2O_5 Catalyses the oxidation of SO_2 in the manufacture of H_2SO_4

(B) $TiCl_4$ and $Al(CH_3)_3$; manufacture of polyethylene

(C) Fe; Manufacture of NH_3

(D) Ni; Hydrogenation of fats

93. The correct statement(s) about lanthanides is/are:

(A) Ce^{4+} is a strong oxidizing agent

(B) All trivalent lanthanoid ions are coloured

(C) La^{3+} and Ce^{4+} are diamagnetic

(D) Yb^{2+} is paramagnetic

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

94. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Kipp's apparatus waste	**(p)**	$(NH_4)_2SO_4.FeSO_4.6H_2O$
(B)	Green coloured compound	**(q)**	$Cu(OH)_2.CuCO_3$
(C)	Leave(s) brown residue on heating	**(r)**	$FeSO_4$
(D)	Leaves(s) black residue on heating	**(s)**	$CuCl_2.2H_2O$

95. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Fe	**(p)**	Variable oxidation state
(B)	Cu	**(q)**	Coloured aqua complex
(C)	Zn	**(r)**	Extracted from sulphide ores
(D)	Mn	**(s)**	Extracted from oxide ores
		(t)	Becomes passive with conc. HNO_3

96. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	$FeCl_3 \cdot 6H_2O$	**(p)**	Cannot be dehydrated by heating
(B)	$FeSO_4 \cdot 7H_2O$	**(q)**	Can be dehydrated by heating
(C)	$CuSO_4 \cdot 5H_2O$	**(r)**	Paramagnetic
(D)	$ZnSO_4 \cdot 7H_2O$	**(s)**	Coloured salt
		(t)	Forms two oxides of sulphur on heating strongly.

97. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Fe	**(p)**	Catalyst in Haber's process
(B)	Ni	**(q)**	Catalyst in Hydrogenation of vegetable oil
(C)	Pt	**(r)**	Catalyst in contact process
(D)	Pd	**(s)**	Does not form amalgams
		(t)	Absorb large amount of H_2.

98. MATCH THE FOLLOWING:

Column 1		Column 2	
(A)	Acidic $KMnO_4$	**(p)**	$H_2S \rightarrow S$
(B)	Acidic $K_2Cr_2O_7$	**(q)**	$NO_2^- \rightarrow NO_3^-$
(C)	$FeCl_3$ solution	**(r)**	$I^- \rightarrow I_2$
(D)	$CuSO_4$ solution	**(s)**	Coloured solution

Numerical Value Type

The Answer to the following questions are positive integers of 1/2/3 digits and zero

99. How many hydrogen bonded water molecule(s) are associated with $CuSO_4 \cdot 5H_2O$?

100. The number of equivalent Cr–O bond(s) in dichromate $(Cr_2O_7^{2-})$ ion are _____.

101. How many ions are formed on dissolving one molecules of Mohr's salts in water?

102. How many of the following hydrated metal halides on heating directly can form anhydrous halides.

$MgCl_2 \cdot 6H_2O$, $AlCl_3 \cdot 6H_2O$, $FeCl_3 \cdot 6H_2O$, $CrCl_3 \cdot 6H_2O$, $LiCl \cdot 2H_2O$, $BaCl_2 \cdot 6H_2O$, $CaCl_2 \cdot 6H_2O$, $SnCl_2 \cdot 2H_2O$, $ZnCl_2 \cdot 2H_2O$

103. Iron is x^{th} most abundant element in the earth's crust. The numerical value of x is _____.

104. The number of peroxide bonds in $Cr_2O_{12}^{2-}$ are_____.

105. Copper sulphate reacts with sodium cyanide and forms a cyanide complex. Write the balanced equation and find out the number of NaCN molecules involved in the equation for one mole of $CuSO_4$?

106. What is the stoichiometric coefficient in balanced reaction of Cu with HNO_3 to produce NO and NO_2 in the ratio 2 : 1?

107. The number of electrons in 5d orbital of Pt (atomic number = 78) are_____.

108. The number of electrons in 5s orbital of Pd (atomic number = 46) are_____.

109. The total number of electrons in s-orbitals of Cu (atomic number = 29) are_____.

110. Predict how many of the following will be coloured in aqueous solution?

$Ti^{3+}, V^{3+}, Cu^{+}, Sc^{3+}, Mn^{2+}, Fe^{3+}, Co^{2+}, Cu^{2+}, Zn^{2+}$

111. Decide how many of the following atomic number are the atomic numbers of the inner transition elements;

29, 59, 74, 95, 102, 104.

112. How many of the following elements of 1st series of d-block elements do not exhibit variable oxidation state?

Sc, Ti, V, Cr, Mn, Fe, CO, Ni, Cu, Zn

113. A well known alloy of lanthanoids is ***misch metal*** which consist of a lanthanoid metal (~ x%) and iron (~ y%) and traces of S, C, Ca and Al. What is the value of y?

114. With how many of following reagents Cu^{2+} gives blue colour solution/precipitation.

(i) $NH_2CH_2CH_2NH_2$ (ii) aq. KCN

(iii) aq. $K_4[Fe(CN)_6]$ (iv) aq. KI

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. In the precipitation of the iron group in qualitative analysis, ammonium chloride is added before adding ammonium hydroxide to:

(A) decrease concentration of OH^- ions.

(B) prevent interference by phosphate ions.

(C) increase concentration of Cl^- ions.

(D) increase concentration of NH_4^+ ions.

2. A salt gives violet vapours when treated with conc. H_2SO_4, it contains:

(A) Cl^- **(B)** I^- **(C)** Br^- **(D)** NO_3^-

3. The acidic solution of a salt produced a deep blue colour with starch iodide solution. The salt may be:

(A) chloride **(B)** nitrite **(C)** acetate **(D)** bromide

4. When a mixture of solid NaCl, solid $K_2Cr_2O_7$ is heated with conc. H_2SO_4, orange red vapours are obtained. These are of the compound:

(A) chromous chloride **(B)** chromyl chloride

(C) chromic chloride **(D)** chromic sulphate

5. Which of the following pairs of ions would be expected to form precipitate when dilute solution are mixed?

(A) Na^+, SO_4^{2-} **(B)** NH_4^+, CO_3^{2-}

(C) Na^+, S_2^{2-} **(D)** Fe^{3+}, PO_4^{3-}

6. When bismuth chloride is poured into a large volume of water the white precipitate produced is:

(A) $Bi(OH)_3$ **(B)** Bi_2O_3 **(C)** BiOCl **(D)** Bi_2OCl_3

7. A mixture, on heating with conc. H_2SO_4 and MnO_2, liberates brown vapour of:

(A) Br_2 **(B)** NO_2 **(C)** HBr **(D)** I_2

8. Nitrate is confirmed by ring test. The brown colour of the ring is due to formation of:

(A) ferrous nitrite **(B)** nitroso ferrous sulphate

(C) ferrous nitrate **(D)** $FeSO_4 \cdot NO_2$

9. $Fe(OH)_3$ can be separated from $Al(OH)_3$ by addition of:

(A) dil.HCl **(B)** NaCl solution

(C) NaOH solution **(D)** NH_4Cl and NH_4OH

10. If NaOH is added to an aqueous solution of zinc ions a white precipitate appears and on adding excess NaOH, the precipitate dissolves. In this solution zinc exist in the:

(A) cationic part
(B) anionic part
(C) both in cationic and anionic parts
(D) there is no zinc ion in the solution

11. Sometimes yellow turbidity appears while passing H_2S gas even in the absence of II group radicals. This is because of:

(A) sulphur is present in the mixture as impurity.
(B) IV group radicals are precipitated as sulphides.
(C) the oxidation of H_2S gas by some acid radicals.
(D) III group radicals are precipitated as hydroxides.

12. The ion that cannot be precipitated by H_2S and HCl is:

(A) Pb^{2+} **(B)** Cu^{2+} **(C)** Ag^{+} **(D)** Ni^{2+}

13. In V group, $(NH_4)_2CO_3$ is added to precipitate out the carbonates. We do not add Na_2CO_3 along with NH_4Cl because:

(A) $CaCO_3$ is soluble in Na_2CO_3.
(B) Na_2CO_3 increases the solubility of V group carbonate.
(C) $MgCO_3$ will be precipitated out in V group.
(D) None of these

14. Which of the following cations is detected by the flame test?

(A) NH_4^+ **(B)** K^+ **(C)** Mg^{2+} **(D)** Al^{3+}

15. Which one among the following pairs of ions cannot be separated by H_2S in dilute HCl?

(A) Bi^{3+}, Sn^{4+} **(B)** Al^{3+}, Hg^{2+}
(C) Zn^{2+}, Cu^{2+} **(D)** Ni^{2+}, Cu^{2+}

16. A metal salt solution gives a yellow precipitate with silver nitrate. The precipitate dissolves in dil. nitric acid as well as in ammonium hydroxide. The solution contains:

(A) bromide **(B)** iodide
(C) phosphate **(D)** chromate

17. A metal salt solution forms a yellow precipitate with potassium chromate in acetic acid, a white precipitate with dilute sulphuric acid, but gives no precipitate with sodium chloride or iodide, it is:

(A) lead carbonate **(B)** basic lead carbonate
(C) barium nitrate **(D)** strontium nitrate

18. Which is soluble in NH_4OH?

(A) $PbCl_2$ **(B)** $AgCl$ **(C)** $PbSO_4$ **(D)** $CaCO_3$

19. Prussian blue is formed when:

(A) ferrous sulphate reacts with $FeCl_3$

(B) ferric sulphate reacts with $K_4[Fe(CN)_6]$

(C) Ammonium sulphate reacts with $FeCl_3$

(D) ferrous ammonium sulphate reacts with $FeCl_3$

20. Which of the following will not give positive chromyl chloride test?

(A) Copper chloride, $CuCl_2$

(B) Mercuric chloride, $HgCl_2$

(C) Zinc chloride, $ZnCl_2$

(D) Anillinium chloride, $C_6H_5NH_3Cl$

21. A while crystalline substance dissolves in water. On passing H_2S gas in this solution, a black precipitate is obtained. The black precipitate dissolves completely in hot HNO_3. On adding a few drops of conc. H_2SO_4, a white precipitate is obtained. This precipitate is that of:

(A) $BaSO_4$ **(B)** $SrSO_4$

(C) $PbSO_4$ **(D)** $CdSO_4$

22. When excess of $SnCl_2$ is added to a solution of $HgCl_2$, a white precipitate turning grey is obtained. The grey colour is due to the formation of:

(A) Hg_2Cl_2 **(B)** $SnCl_4$ **(C)** Sn **(D)** Hg

23. Of the following sulphides which one is insoluble in dil. acids but soluble in alkalies.

(A) PbS **(B)** CdS **(C)** FeS **(D)** As_2S_3

24. When chlorine water is added to an aqueous solution of potassium halide in presence of chloroform, a violet colour is obtained. On adding more of chlorine water the violet colour disappears, and a colourless solution is obtained. The test confirms the presence of the following in aqueous solution.

(A) Iodide **(B)** Bromide

(C) Chloride **(D)** Iodide and bromide

25. An aqueous solution of colourless metal sulphate M, gives a white precipitate, with NH_4OH. This was soluble in excess of NH_4OH. On passing H_2S through this solution a white precipitate is formed. The metal M in the salt is:

(A) Ca **(B)** Ba **(C)** Al **(D)** Zn

26. A substance on treatment with dil. H_2SO_4 liberates a colourless gas which produces (i) turbidity with baryta water and (ii) turns acidified dichromate solution green. The reaction indicates the presence of:

(A) CO_3^{2-} **(B)** S^{2-} **(C)** SO_3^{2-} **(D)** NO_2^-

27. A white solid is first heated with dil H_2SO_4 and then with conc. H_2SO_4. No action was observed in either case. The solid salt contains:

(A) sulphide **(B)** Sulphite

(C) thiosulphate **(D)** sulphate

28. On the adding of a solution containing CrO_4^{2-} ions to the solution of Ba^{2+}, Sr^{2+} and Ca^{2+} ions, the precipitate obtained first will be of:

(A) $CaCrO_4$ **(B)** $SrCrO_4$

(C) $BaCrO_4$ **(D)** a mixture of all the three

29. A mixture of chlorides of copper, cadmium, chromium, iron and aluminium was dissolved in water acidified with HCl and hydrogen sulphide gas was passed for sufficient time. It was filtered, boiled and a few drops of nitric acid were added while boiling. To this solution ammonium chloride and sodium hydroxide wre added in excess and filtered. The filtrate shall give test for

(A) sodium and iron ion

(B) sodium, chromium and aluminium ion

(C) aluminum and iron ion

(D) sodium, iron, cadmium and aluminium ion

30. A white precipitate obtained durring analysis of a mixture becomes black on treatment with NH_4OH. It may be:

(A) $PbCl_2$ **(B)** AgCl **(C)** $HgCl_2$ **(D)** Hg_2Cl_2

31. A salt on treatment with dil. HCl gives a pungent smelling gas and a yellow precipitate. The salt gives green flame when tested. The solution gives a yellow precipitate with potassium chromate. The salt is:

(A) $NiSO_4$ **(B)** BaS_2O_3

(C) PbS_2O_3 **(D)** $CuSO_4$

32. Which compound does not dissolve in hot dilute HNO_3?

(A) HgS **(B)** PbS **(C)** CuS **(D)** CdS

33. Which of the following compound on reaction with NaOH and Na_2O_2 gives yellow colour?

(A) $Cr(OH)_3$ **(B)** $Zn(OH)_2$

(C) $Al(OH)_3$ **(D)** None of these

34. An aqueous solution of a substance gives a white precipitate. on treatment with dil. HCl, which dissolves on heating. When hydrogen sulphide is passed through the hot acidic solution, a black precipitate is obtained. The substance is a:

(A) Hg^{2+} salt **(B)** Cu^{2+} salt

(C) Ag^{+} salt **(D)** Pb^{2+} salt

35. Which of the following gives a precipitate with $Pb(NO_3)_2$ but not with $Ba(NO_3)_2$?

(A) Sodium chloride **(B)** Sodium acetate

(C) Sodium nitrate **(D)** Sodium hydrogen phosphate

36. Which of the following is soluble in yellow ammonium sulphide?

(A) CuS **(B)** CdS **(C)** SnS **(D)** PbS

37. Which of the following gives blood red colour with KCNS?

(A) Cu^{2+} **(B)** Fe^{3+} **(C)** Al^{3+} **(D)** Zn^{2+}

38. Which of the following is insoluble in excess of NaOH?

(A) $Al(OH)_3$ **(B)** $Cr(OH)_3$ **(C)** $Fe(OH)_3$ **(D)** $Zn(OH)_2$

39. Potassium chromate solution is added to an aqueous solution of a metal chloride. The precipitate thus obtained are insoluble in acetic acid. These are subjected to flame test, the colour of the flame is:

(A) Lilac **(B)** Apple green

(C) Crimson red **(D)** Golden yellow

40. $MgSO_4$ on reaction with NH_4OH and Na_2HPO_4 forms a white crystalline precipitate. What is its formula?

(A) $Mg(NH_4)PO_4$ **(B)** $Mg_3(PO_4)_2$

(C) $MgCl_2 \cdot MgSO_4$ **(D)** $MgSO_4$

Paragraph for Q. 41 - 43

A white solid (A) reacts with dilute H_2SO_4 to produce a colourless gas (B) and a colourless solution (C). The reaction between (B) and acidified dichromate yields a green solution and a slightly coloured precipitate (D). The substance (D), when burnt in air, gives a gas (E) which reacts with (B) to yield (D) and a colourless liquids. Anhydrous copper sulphate turns blue with this colourless liquid. The addition of aqueous NH_3 or NaOH to (C) produces a precipitate that dissolves in an excess of the reagent to form a clear solution.

41. Which of the following gases are (B) and (E) respectively?

(A) CO_2 and SO_2 **(B)** SO_2 and H_2S **(C)** H_2S and SO_2 **(D)** CO_2 and H_2S

42. What would appear if the gas (B) is passed through an aqueous solution of $Pb(NO_3)_2$?

(A) white precipitate soluble in hot dilute HNO_3

(B) A black precipitate soluble in hot dilute HNO_3

(C) A black precipitate insoluble in hot dilute HNO_3

(D) A yellow precipitate soluble in hot concentrated HNO_3

43. Suppose the solution obtained by the treatment of the solution (C) with an excess of NaOH is acidified with acetic acid and the gas (B) is passed through it. Which of the following will obtained?

(A) Colourless solution **(B)** Yellow precipitate

(C) Black precipitate **(D)** White precipitate

Paragraph for Q. 44 - 47

A chemist opened a cupboard to find four bottles containing water solutions, each of which had lost its label. Bottle 1, 2 and 3 contained colourless solutions, while bottle 4 contained a blue solution. The labels from the bottles were lying scattered on the floor of the cupboard. They were:

Copper (II) sulphate; Hydrochloric acid, Lead nitrate; Sodium carbonate

By mixing samples of the contents of the bottles, in pairs, the chemist made the following observation:

Bottle 1 + Bottle 2	White precipitate
Bottle 1 + Bottle 3	White precipitate
Bottle 1 + Bottle 4	White precipitate
Bottle 2 + Bottle 3	Colourless gas evolved
Bottle 2 + Bottle 4	No visible reaction
Bottle 3 + Bottle 4	Blue precipitate

44. Bottle 3 contains:

(A) copper (II) sulphate **(B)** hydrochloric acid

(C) lead nitrate **(D)** sodium carbonate

45. When bottle 1 is mixed with bottle 4, white precipitate is observed, which is:

(A) $PbSO_4$ **(B)** $PbCO_3$

(C) $PbCl_2$ **(D)** $Pb(NO_3)_2$

46. Which of the following bottle will give distinctive colour with NH_3 ?

(A) Bottle 1 **(B)** Bottle 2

(C) Bottle 3 **(D)** Bottle 4

47. On mixing bottle 2 and bottle 3 sample, a colourless gas evolves. The gas is:

(A) N_2 **(B)** CO_2 **(C)** SO_2 **(D)** NO_2

Paragraph for Q. 48 - 50

One unknown mixture contains one or two of the following: $CaCO_3, BaCl_2, AgNO_3, Na_2SO_4, ZnSO_4$ and NaOH. The mixture is completely soluble in water and solution gives pink colour with phenolphthalein. When dilute acid is gradually added to the solution, a precipitate is formed which dissolves with further addition of the acid.

48. The mixture is soluble in water to give strong alkali, it confirms:

(A) Na_2SO_4 **(B)** $CaCO_3$ **(C)** $ZnSO_4$ **(D)** NaOH

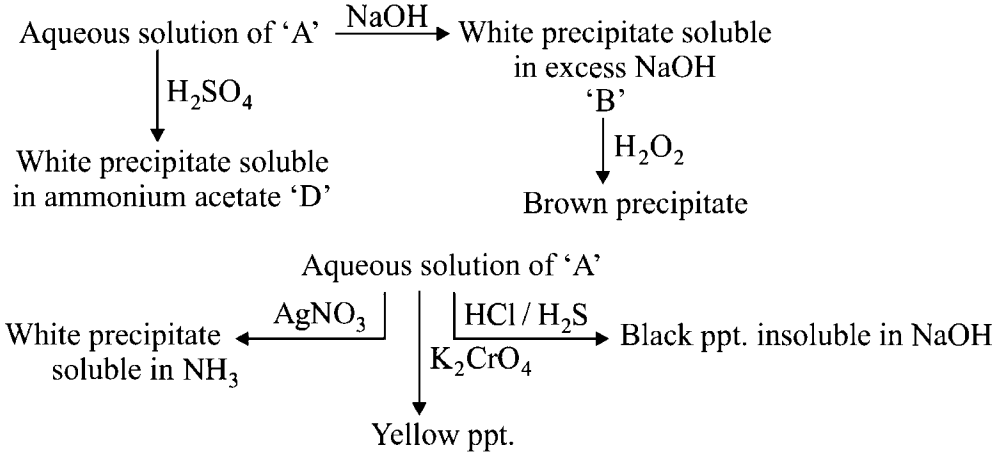
49. The aqueous solution of mixture give white precipitate with dil. HCl which dissolves in excess of dil HCl. It confirms:

(A) $BaCl_2$ **(B)** Na_2SO_4 **(C)** $ZnSO_4$ **(D)** $AgNO_3$

50. The white precipitate is:

(A) $ZnSO_3$ **(B)** Na_2ZnO_2 **(C)** $Zn(OH)_2$ **(D)** $ZnCl_2$

Paragraph for Q. 51 - 53



51. The complex 'B' soluble in excess NaOH is:

(A) $Na[Cu(OH)_4]$ **(B)** $Na_2[Pb(OH)_4]$

(C) $Bi(OH)_3$ **(D)** Na_2SnO_2

52. Aqueous solution of 'A' on treatment with HCl and H_2S gives a black precipitate. Thus which of the following cationic species must be in the compound 'A'?

(A) Hg^{2+} **(B)** Pb^{2+} **(C)** Bi^{3+} **(D)** Cd^{2+}

53. If aqueous solution of 'A' is treated with KI solution, a yellow precipitate comes out. That is:

(A) PbI_2 **(B)** AgI **(C)** Hg_2I_2 **(D)** BiI_3

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

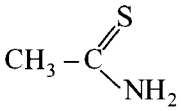
54. $[X] + H_2SO_4 \longrightarrow [Y]$ (gas)

$[Y] + K_2Cr_2O_7 + H_2SO_4 \longrightarrow$ Green solution. [X] and [Y] respectively are:

(A) SO_3^{2-}, SO_2 **(B)** Cl^-, HCl **(C)** S^{2-}, H_2S **(D)** CO_3^{2-}, CO_2

55. $FeCl_3$ (acidified) $+(P) \longrightarrow FeCl_2 +$ other products

Reagent (P) can be:

(A) H_2S **(B)** Na_2S **(C)**  **(D)** None of these

56. The salt used for performing "bead" test in qualitative inorganic analysis is/are:

(A) $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ **(B)** $Na(NH_4)HPO_4 \cdot 4H_2O$

(C) $Na_2B_4O_7 \cdot 10H_2O$ **(D)** $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

57. The correct statement(s) in respect to chromyl chloride test is/are:

(A) formation of lead chromate **(B)** formation of chromyl chloride

(C) liberation of chlorine **(D)** formation of red vapours

58. $K_4[Fe(CN)_6] + X \longrightarrow Y$

'X' and Y respectively are:

(A) $Fe^{3+}; Fe_4[Fe(CN)_6]_3$ **(B)** $Cu^{2+}; Cu_2[Fe(CN)_6]$

(C) $Zn^{2+}; Zn_2[Fe(CN)_6]$ **(D)** $H_2O_2; K_3[Fe(CN)_6]$

59. Which of the following metal ion form a black precipitate on reaction with H_2S?

(A) Pb^{2+} **(B)** Cu^{2+} **(C)** Hg^{2+} **(D)** Ni^{2+}

60. Fe^{2+} ion and Fe^{3+} ion can be distinguished by:

(A) NH_4SCN **(B)** $K_4[Fe(CN)_6]$

(C) CH_3COONa **(D)** $K_3[Fe(CN)_6]$

61. In which of the following salt basic radical can be identified by borax bead test?

(A) $CuSO_4$ **(B)** $FeSO_4$

(C) $NiCl_2$ **(D)** $Co(NO_3)_2$

62. In which of the following salts basic radical can be identified by flame test?

(A) NaCl **(B)** $CaCl_2$ **(C)** $BaCl_2$ **(D)** KNO_3

63. $\text{Salt} + H_2SO_4 \xrightarrow{\Delta} \text{Gas}.$

Identify correctly matched, salt and gas, pair(s).

(A) Acetic slat; gas with smell of vinegar.

(B) Nitrite salt; gas with brown colour

(C) Sulphide salt; gas with smell of rotten eggs.

(D) Sulphite salt; gas with pungent smell.

64. Mark the correct statement(s).

(A) I group basic radicals precipitates as chlorides

(B) IV group basic radicals precipitates as sulphides.

(C) V group basic radicals precipitates as carbonates.

(D) III group basic radicals precipitates as hydroxides.

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. More than one choice from Column 2 can be matched with Column 1.

65. **MATCH THE COLUMN:**

Column –1		Column –2	
(A)	S^{2-}	**(p)**	White precipitate. with $AgNO_3$
(B)	NO_2^-	**(q)**	Evolution of pungent smell gas with (Al + conc. NaOH)
(C)	SO_3^{2-}	**(r)**	Brown fumes with conc. H_2SO_4 (hot)
(D)	CH_3COO^-	**(s)**	Decolourises acidified $KMnO_4$

66. **MATCH THE COLUMN:**

Column –1 (Radicals)		Column –2 (Reagents)	
(A)	Pb^{2+}	**(p)**	Dil. HCl
(B)	Co^{2+}	**(q)**	$H_2S + HCl$ (very dil.)
(C)	Zn^{2+}	**(r)**	H_2S (alkaline)
(D)	Hg^{2+}	**(s)**	NH_4OH / OH^-

67. MATCH THE COLUMN:

Column –1 (Radicals)		Column –2 (Reagents)	
(A)	Cl^-	**(p)**	$K_2Cr_2O_7, H^+$
(B)	SO_3^{2-}	**(q)**	H_2SO_4 (conc.)
(C)	S^{2-}	**(r)**	H_2SO_4 (dil.)
(D)	NO_3^-	**(s)**	$AgNO_3$ solution

68. MATCH THE COLUMN:

Column –1 (Radicals)		Column –2 (Precipitating form)	
(A)	Pb^{2+}	**(p)**	Hydroxide
(B)	Ni^{2+}	**(q)**	Sulphide
(C)	Cr^{3+}	**(r)**	Carbonate
(D)	Ag^+	**(s)**	Chloride

69. MATCH THE COLUMN:

Column–1 (Mixture of radicals)		Column–2 (Reagents which are not useful to separate mixture components)	
(A)	Pb^{2+}, Ag^+	**(p)**	HCl, hot water
(B)	Pb^{2+}, Cu^{2+}	**(q)**	KI
(C)	Fe^{3+}, Mn^{2+}	**(r)**	H_2S
(D)	Cd^{2+}, Zn^{2+}	**(s)**	$K_4[Fe(CN)_6]$

70. MATCH THE COLUMN:

Column–1 (Radicals)		Column–2 Colour of precipitate formed with group reagent in systematic qualitative analysis	
(A)	Fe^{3+}	**(p)**	White
(B)	Pb^{2+}	**(q)**	Black
(C)	Ag^+	**(r)**	Yellow
(D)	Bi^{3+}	**(s)**	Red brown

Numerical Value Type Questions
Inorganic Chemistry

71. Consider the reaction $BCl_3 + 2LiAlH_4 \longrightarrow X$

Compound X contains electron deficient-bonds. Find the maximum number of atoms of compound X that are lying in the same plane.

72. Number of sp^2 hybrid boron atoms in the anion of borax, $Na_2B_4O_7 \cdot 10H_2O$ is_____.

73. How many among the following species contain P-P linkage(s)?

(i)	Red phosphorous	(ii)	$H_4P_2O_5$
(iii)	$H_4P_2O_7$	(iv)	$(PO_3^-)_3$
(v)	P_4O_{10}	(vi)	P_4S_3
(vii)	P_4O_6	(viii)	P_4

74. How many of the following reagents will produce at least one oxide of nitrogen in significant quantity?

(i)	Ag + conc. NHO_3	(ii)	Sn + cold, dil.HNO_3
(iii)	heated Cu + HNO_3 vapors	(iv)	Mg + hot dil. HNO_3
(v)	Cr + conc. HNO_3	(vi)	Mn + 2% HNO_3 (very dilute)
(vii)	P_4 + conc. HNO_3	(viii)	S_8 + conc.HNO_3
(ix)	Cu + dil.HNO_3		

75. How many of the following on reaction with aqueous HCl as well as with NaOH solution liberate H_2 ?

B, Al, B_2H_6, B_2O_3, $NaAlH_4$, Al_2O_3

76. How many of the following metallurgical extractions involve leaching for concentration of ore?

$Al_2O_3 \longrightarrow Al$,; $Ag_2S \longrightarrow Ag$; $Au \longrightarrow Au$; $CuFeS_2 \longrightarrow Cu$; $PbS \longrightarrow Pb$

$MgCl_2 \longrightarrow Mg$; $FeCO_3 \longrightarrow Fe$; $HgS \longrightarrow Hg$

77. How many of the following compounds do not impart characteristic colour to the Bunsen flame?

NaCl, $BeCl_2$, KOH, $BaSO_4$, $MgCl_2$, CsCl, Na_2SO_4, $Mg(OH)_2$, K_2CO_3

78. How many geometrical isomers are possible for octahedral complex $[Pt(gly)_2Cl_2]$?

79. Find the number of reducing agents involved in the extraction of pig iron from haematite ore using blast furnace.

80. How many of the following will liberate reddish brown gas on complete reaction with conc. HNO_3 ?

$H_2C_2O_4$, Fe, Cu, $AgNO_3$, Ag, $FeSO_4$, S_8, $Na_2S_2O_3$

81. How many oxides are soluble in moderately concentrated aqueous solution of NaOH?

SO_3 , Cl_2O_7 , N_2O_5 , CO

K_2O , Cr_2O_3 , BaO , GeO_2

82. How many of the following metals are extracted using self-reduction method? Hg, Cu, Al, Mg, Pb, Fe, Sn .

83. How many of the following species are not known?

PH_3, PH_5, SF_6, PbI_4, NCl_5, OF_2, OF_4, HFO_4, FeI_3, KHF_2, HOF

84. How many of the following relations is/are correct?

(a) Mg > Al (electropositive character) (b) Al > Ga (electronegativity)

(c) $N^+ > N$ (Ionization energy) (d) Se > S (magnitude of $\Delta_{eg}H$)

(e) $He^+ > H$ (Atomic size) (f) $O_2^{2-} < O_2$ (paramagnetic nature)

(g) $C_2 > N_2$ (Number of π bonds) (h) $F_2 > B_2$ (bond order)

85. How many oxygen atoms in emerald $[Be_3Al_2Si_6O_{18}]$ are part of a ring?

86. Find the number of compounds where $d_{x^2-y^2}$ orbitals will not take part in hybridisation.

(1) $[Pt(NH_3)Cl(H_2O)Br]$ (2) SF_4

(3) $[Cu(NH_3)_4]^{2+}$ (4) XeO_3F_2

(5) XeO_2F_2 (6) $[Co(en)_3]^{3+}$

(7) $[Fe(CO)_5]$ (8) $POCl_3$

(9) XeF_4 (10) XeO_6^{4-}

(11) $[Ni(dmg)_2]$ (12) $[Ni(PPh_3)_2Cl_2]$

(13) $[PdCl_4]^{2-}$ (14) $[Cu(CN)_4]^{3-}$

(15) $[Fe(NO)(H_2O)_5]^{2+}$ (16) SNF_3

(17) ICl_4^-

87. How many of the following oxides are anhydrides of dibasic oxy-acid?

(i) SO_2 (ii) P_4O_{10} (iii) NO_2

(iv) CO_2 (v) N_2O (vi) CO

(vii) ClO_2 (viii) Cl_2O (ix) I_2O_5 (x) SeO_2

88. Number of pairs of ions which are coloured in aqueous solutions?

(i) Ti^{3+}, V^{3+} (ii) Cu^+, Sc^{3+} (iii) Fe^{2+}, Fe^{3+}

(iv) Co^{2+}, Ni^{2+} (v) Zn^{2+}, Ag^+ (vi) Mn^{2+}, Cr^{3+}

(vii) Al^{3+}, Bi^{3+}

89. How many of the following pairs of ions can be separated by using H_2S in dilute HCl?

Bi^{3+} and Sn^{4+}, Al^{3+} and Hg^{2+}, Cd^{2+} and Zn^{2+}, Fe^{3+} and Cu^{2+}, As^{3+} and Sb^{3+}

90. The number of completely filled orbitals in $_{29}Cu$ which have atleast two radial nodes is/are:

91. How many of the following are used for extraction of metal by electrometallurgy?

NaCl, Cr_2O_3, $MgCl_2$, Al_2O_3, $CaCl_2$, Fe_2O_3

92. Depending upon the nature of oxides, they are classified as acidic, basic, amphoteric and neutral oxides. Among the following, the total number of acidic oxides are:

NO_2, CuO, CO_2, P_4O_6, CO, PbO_2, Cr_2O_3, SnO_2, CrO_3, Mn_2O_7, OsO_4, I_2O_5, BeO, Al_2O_3.

93. In how many of the following reactions, one of the products is obtained as a yellow precipitate?

$Ba^{2+}(aq) + CrO_4^{2-}(aq) \longrightarrow$ products

$Ag^{+}(aq) + Br^{-}(aq) \longrightarrow$ products

$Pb^{2+}(aq) + I^{-}(aq) \longrightarrow$ products

$NH_4^{+}(aq) + [PtCl_6]^{2-}(aq) \longrightarrow$ products

$Cd^{2+} + Na_2S \rightarrow$ Products

$Na_3PO_4 + (NH_4)_2M_0O_4 \rightarrow$ Products

94. How many of the following on heating with NaOH produce a gaseous substance?

Cl_2, S_8, P_4, Al, B, Fe, Be, Zn, F_2, XeO_3

95. How many of the following do not have lone pair of electrons on central atom?

(i)	XeF_4	**(ii)**	NH_3	**(iii)**	SO_2	**(iv)**	NO_3^-
(v)	O_3	**(vi)**	$XeOF_4$	**(vii)**	ICl_3	**(viii)**	IF_7
(ix)	SO_4^{2-}	**(x)**	XeO_3				

96. In how many of the following complex ions, the central metal ions use (n – 1)d, ns and np orbitals for hybridisation?

$[Mn(CN)_6]^{4-}, [Ni(NH_3)_6]^{2+}, [Co(NO_2)_6]^{4-}, [AgF_4]^{-}, [Ni(CN)_4]^{2-}, [PdCl_4]^{2-}, [Pd(CN)_4]^{2-}, [Co(SCN)_4]^{2-}$

97. A complex, Prussian blue, has formula $Fe_4[Fe(CN)_6]_3$. What is the sum of oxidation numbers of iron in ionisation sphere and coordination sphere?

98. Find the value of spin only magnetic moment in BM for species X in the reaction given below? $Mn^{2+} + S_2O_8^{2-} \longrightarrow [X] + SO_4^{2-} + H^{+}$.

99. How many of the following orders are correct:

(i)	$Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Ba(OH)_2$	Basic character
(ii)	$BaCO_3 > SrCO_3 > CaCO_3 > MgCO_3$	Decomposition temperature
(iii)	$Na^{+} > Mg^{2+} > Li^{+} > Be^{2+}$	Size in gas phase
(iv)	$Li_2CO_3 > Na_2CO_3 > K_2CO_3 > Rb_2CO_3 > Cs_2CO_3$	Water solubility
(v)	$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$	Thermal Stability
(vi)	$NaF < NaCl < NaBr < NaI$	Melting point
(vii)	$He < O_2 = CO_2 < O_3 = CH_4$	Value of poison's ratio (γ)
(viii)	$Na_2O_2 < KO_2 < O_2[AsF_4]$	O – O bond length

100. How many of the following oxides show amphoteric nature?

V_2O_3, V_2O_5, CrO, CrO_3, Cr_2O_3, Mn_2O_7, FeO, Cu_2O, ZnO.

101. Reaction of hydrated ferric chloride ($FeCl_3 \cdot 6H_2O$) with thionyl chloride gives anhydrous ferric chloride with evolution of hydrochloric acid (HCl) and sulphur dioxide (SO_2) gases. The number of sulphur dioxide (SO_2) molecules involved in the balanced chemical equation is:

102. An unknown metal, M, with excess chlorine to give the metal chloride, MCl_x. When 0.396 g of the chloride is dissolved in water and passed through an anion exchange column charged with hydroxide ions, the solution required 23.55 mL of 0.195 M HCl for neutralization.

(a) Calculate the number of moles of HCl used in the titration

(b) Determine the mass of chlorine and the mass of metal in this sample of MCl_x

(c) Assuming that x in MCl_x is 1, 2 and 3, calculate possible atomic masses for M

(d) Use for knowledge of the Periodic Table to write formulas for the possible compounds between chlorine and metals and identify those expected to be stable

103. The behaviour of elements can often be predicted based on their positions in the Periodic Table. Use your knowledge about trends in the behaviour of elements to answer the following questions about the recently isolated elements 114, 116 and 118.

(a) Give the names and symbols of the elements in the row above 114, 116 and 118 in the Periodic Table

(b) Predict the relative ionization energies of elements 114, 116 and 118 and describe how the ionization energy of one of them is expected to compare with the ionization energy of the element above it, giving reasons for your answers

(c) Predict the oxidation states expected for element 114 and indicate which oxidation state is expected to be most stable, giving reasons for your answer

(d) Suggest a reason that elements 114, 116 and 118 have been made, but elements 113, 115 and 117 have not

104. When a mixture of a metal carbonate, MCO_3, and its oxide, MO, is heated to release carbon dioxide gas and is converted completely to the metallic oxide, MO.

(a) If a 0.6500 g sample of MCO_3 and MO forms 0.1575 L of carbon dioxide gas at 25.0 °C and a barometric pressure of 700.0 mm Hg, determine the number of moles of CO_2 formed.

(b) When the 0.3891 g of MO resulting from the process in a is titrated with 0.500 M HCl, 38.60 mL are required. Determine the number of moles of MO in 0.3891 g.

(c) Determine the atomic mass of the metal M and give its symbol.

(d) Determine the mole percentages of MCO_3 and MO in the original sample.

105. This question concerns the chemistry of the Group 13 elements (B - Tl). Base your answers on principles of atomic structure and bonding.

(a) The first ionization energies (IE) of most main group elements decrease steadily upon descending the family whereas the first IE of B-Tl are [B 801, Al 578, Ga 579, In 558, Tl 589] kJ mol^{-1}.

(i) Explain briefly why the IEs for most families decreases steadily upon descending a family.

(ii) Suggest a reason that the IE for Ga is essentially the same as that for Al and the IE for Tl is greater than that for In.

(b) The members of this family exhibit oxidation states of +1 and/or +3.

(i) Account for the fact that the stable oxidation states are +1 and −3 and a + 2 oxidation state is not observed.

(ii) Account for the fact that B and Al show the +3 oxidation state exclusively while the +3 state for Tl is a strong oxidizing agent.

(c) BCl_3 and $AlCl_3$ are strong Lewis acids.

(i) Write an equation to illustrate BCl_3 acting as a Lewis acid with an appropriate Lewis base. Explains what occurs in a Lewis acid-base reaction.

(ii) Account for the fact that the Lewis acidity of the other tri-chlorides decreases down the family.

106. Explain each of the following observations using acid-base principles.

(a) The acids HCl and HBr appear equally strong in H_2O but HBr is a stronger acid in 100% (glacial) acetic acid.

(b) The acidity of anhydrous H_2SO_4 is much less than the acidity of fuming H_2SO_4 (a saturated solution of SO_3 in H_2SO_4).

(c) The first and second ionization constants for sulfurous acid, H_2SO_3 (aq), differ by a factor of $\sim 2\times10^5$ while the first and second ionization constants of hydrosulfuric acid, H_2S (aq), differ by a much greater factor $(\sim 1\times10^{12})$.

107. A salt containing chromium, chlorine, and water has the formula $CrCl_n(H_2O)_m$.

(a) A sample of the salt is electrolyzed for 1310 s using n current of 1.24 A and deposits 0.292 g metallic Cr,. What is the value of n in the salt?

(b) A 3.000 g sample of the chromium salt is heated carefully at $600\,°C$ to drive off any water in the salt, until the sample achieves a constant mass of 1.783 g. What is the value of m in the salt?

(c) A 0.300 g sample of the chromium salt is dissolved in 10 mL water to which a few drops of Na_2CrO_4 solution have been added. A 0.400 M solution of silver nitrate is titrated quickly into the solution until the appearance of a dark red colour ; this requires 2.81 mL of the $AgNO_3$ solution.

(i) Write balanced chemical equations for the reaction taking place during the titration and the reaction that takes place at the endpoint.

(ii) How many moles of chloride are detected in this titration per mole of chromium present?

(d) Propose an explanation for the result in part (c) (ii).

108. Chlorine is an industrially and biologically important element.

(a) Give the ground state electron configuration for gas-phase atomic Cl.

(b) Draw a Lewis structure for molecular chlorine, including all lone pairs and any formal charges.

(c) Which would have a greater first ionization energy, atomic Cl or molecular chlorine? Justify your answer.

(d) Which would have a larger radius, atomic Cl or the chloride ion (Cl^-) ? Justify your answer.

(e) Explain why the oxoanions ClO^-, ClO_2^-, ClO_3^- and ClO_4^- all form stable salts, but the oxoanion ClO_5^- is unknown.

109. A compound used as a fertilizer contains only the elements C, H, N and O.

(a) Combustion of 1.000 g of the fertilizer in an oxygen atmosphere produces 0.5637 g CO_2, 0.6924 g H_2O, and 0.3589 g N_2. What are the mass percentages of C, H and N in the fertilizer?

(b) Give the empirical formula of the fertilizer.

(c) A solution of 1.000 g of the fertilizer dissolved in 20.00 g water has a freezing point of $-2.38\,°C$. What is the apparent molar mass of the fertilizer? Combined with the result in (b), what is the implication of this molar mass? (For water, the freezing point depression constant $K_f = 1.86\ °C/m$).

(d) Propose a structure for the fertilizer compound.

110. Oxygen and sulfur form a number of binary fluorides.

(a) Draw the Lewis structure of dioxygen difluoride, O_2F_2, and sketch or describe the three-dimensional shape of this polar molecule.

(b) Explain why the $O-F$ bonds in dioxygen difluoride, O_2F_2 (157.5 pm) are much longer than those in oxygen difluoride, OF_2 (140.5 pm).

(c) Disulfur difluoride, S_2F_2, exists as two structural isomers. One isomer is analogous in structure to dioxygen difluoride, O_2F_2, but the second, more thermodynamically stable isomer, has a structure in which the two sulfur atoms are in different chemical environments. Draw a Lewis structure of the more stable isomer of disulfur difluoride, S_2F_2, and sketch or describe its three dimensional shape.

(d) Sulfur difluoride, SF_2, is very unstable, converting to disulfur tetraflouride, S_2F_4, in which all four fluorines are in different environments. Clearly show a chemical reasonable three-dimensional structure of disulfur tetrafluoride, S_2F_4, and explain how the structure accounts for the inequivalence of all four fluorine atoms.

(e) Sulfur tetrafluoride, SF_4 (bp $-38\,°C$), has a higher boiling point than sulfur hexafluoride, SF_6 (bp $-64\,°C$). Explain why sulfur tetrafluoride, SF_4 is less volatile than sulfur hexafluoride, SF_6.

111. Studtite is a mineral that contains only hydrogen, oxygen, and a metal M. Its empirical formula is $MO_x(H_2O)_y$, where x and y are integers.

A 1.0000 g sample of studtite is heated at $520\,°C$, which cause it to decompose to molecular oxygen, water vapour, and the solid metal trioxide MO_3. The gases from this reaction are collected in a rigid container with a volume of 1.000 L. When this container is maintained at $200.0\,°C$, the pressure is 355.0 mm Hg. When the container is cooled to $25\,°C$, some of the water vapor condenses to the liquid, and the pressure in the container falls to 48.65 mm Hg. The vapour pressure of water at $25.0\,°C$ is 23.80 mm Hg.

(a) Calculate the number of moles of O_2 produced in this reaction.

(b) Calculate the number of moles of H_2O produced in this reaction.

(c) Calculate the mass of solid MO_3 produced in this reaction.

(d) What is the identity of the metal M? Support your answer.

(e) What is the oxidation state of the metal M in the mineral studtite? Explain your answer.

112. The chemistry of beryllium (Be) has a number of interesting features.

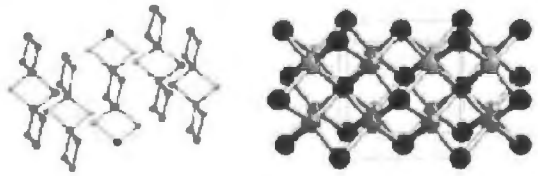
(a) Explain the difference between Be and its heavier congener, barium (Ba), with regard to the following properties.

(i) Be has a higher ionization energy ($900\,kJ\,mol^{-1}$) than Ba ($563\ kJ\ mol^{-1}$).

(ii) Adding an electron to gas-phase Be atom requires energy, while adding an electron to a gas-phase Ba atom releases a small amount of energy ($14\ kJ\,mol^{-1}$).

(iii) $BeCl_2$ (s) has a more positive $\Delta H_f^\circ(-496.2\ kJ\,mol^{-1})$ than $BaCl_2$(s) $(-858.6\,kJ\,mol^{-1})$

(iv) Solid $BeCl_2$ adopts the structure shown on the left, while solid $BaCl_2$ adopts the structure shown on the right (metal = black spheres, chlorine = gray spheres).



$BeCl_2$ $BaCl_2$

(b) In the vapor phase, $BeCl_2$ exists as a mixture of $BeCl_2$ monomers and Be_2Cl_4 dimers. Draw or clearly describe the geometries of these two gas-phase species.

(c) At 800 K, K_p for dimerzation of $BeCl_2$(g) is 2.9.

$$2BeCl_2(g) \rightleftharpoons Be_2Cl_4(g) \qquad K_p = 2.9$$

Calculate the mole fraction of dimeric Be_2Cl_4 in $BeCl_2$ vapor at a total pressure of 1.100 bar at 800 K.

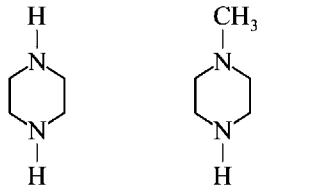
113. Borazine, $B_3N_3H_6$, has a structure consisting of a six-membered ring with alternating BH and NH groups.

(a) Draw a Lewis structure for borazine, including non-zero formal charges if needed. Show all major resonance structures of borazine.

(b) Two other compounds containing boron, nitrogen, and hydrogen are BH_3NH_3 and BH_2NH_2. Draw Lewis structures for these two compounds, again including any formal charges and major resonance structures.

(c) The $B-N$ distances in $B_3N_3H_6$, BH_3NH_3 and BH_2NH_2 are 139.1, 142.9 and 156.4 pm (not necessarily in that order). Assign each $B-N$ distances to the proper compound and explain your reasoning.

(d) Typically, when one replaces a hydrogen attached to N with a CH_3 group, the boiling point of the compound decreases. For example, piperazine has a normal boiling point of $146\,°C$ while N-methylpiperazine has a normal boiling point of $138\,°C$. Explain this observation.



Piperazine
bp = 146 °C

N-methylpiperazine
bp = 138 °C

(e) In contrast to the situation in (d), when one $N-H$ group in borazine (bp = $55\,°C$) is changed to an $N-CH_3$ group, the normal boiling point of N-methylborazine increases significantly, to $84\,°C$. Explain why the usual trend in boiling points is not observed for borazine and N-methylborazine.

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Photochemical smog occurs in warm, dry and sunny climate. One of the following is not amongst the components of photochemical smog, identify it.

(A) NO_2 **(B)** O_3 **(C)** SO_2 **(D)** Unsaturated hydrocarbon

2. Which of the following statements is not true about classical smog?

(A) Its main components are produced by the action of sunlight on emissions of automobiles and factories

(B) Produced in cold and humid climate

(C) It contains compounds of reducing nature

(D) It contains smoke, fog and sulphur dioxide

3. Biochemical Oxygen Demand, (BOD) is a measure of organic material present in water. BOD value less than 5 ppm indicates a water sample to be _____.

(A) rich in dissolved oxygen **(B)** poor in dissolved oxygen

(C) highly polluted **(D)** not suitable for aquatic life

4. Which of the following statements is wrong?

(A) Ozone is not responsible for greenhouse effect

(B) Ozone can oxidise sulphur dioxide present in the atmosphere to sulphur trioxide

(C) Ozone hole is thinning of ozone layer present in stratosphere

(D) Ozone is produced in upper stratosphere by the action of UV rays on oxygen

5. Which of the following statements about photochemical smog is wrong?

(A) It has high concentration of oxidising agents

(B) It has low concentration of oxidising agent

(C) It can be controlled by controlling the release of NO_2, hydrocarbons, ozone etc

(D) Plantation of some plants like Pinus helps in controlling photochemical smog

6. The pollutants which come directly in the air from sources are called primary pollutants. Primary pollutants are sometimes converted into secondary pollutants. Which of the following belongs to secondary air pollutants?

(A) CO **(B)** Hydrocarbon **(C)** Peroxyacetyl nitrate **(D)** NO

7. 'X' is a gas that is poisonous to both plants and animals. The following have been reported regarding 'X'.

I. In low concentration, it causes respiratory diseases e.g. Asthma, bronchitis, emphysema in human beings

II. It causes irritation to the eyes, resulting in tears and beings.

III. High concentration of X leads to stiffness of flower buds which eventually fall off 'X' is

(A) CO_2 **(B)** O_2 **(C)** N_2 **(D)** SO_2

8. Which of the following statements is NOT true?

(A) Uncatalysed oxidation of SO_2 is very fast

(B) The presence of particulate matter in polluted air catalyses the oxidation of SO_2 to SO_3

(C) The conversion of SO_2 to SO_3 is also promoted by ozone

(D) Uncatalysed oxidation of SO_2 is slow

9. In automobile engines (at high temperature) when fossil is burnt, dinitrogen and dioxygen combine to yield significant quantities of the gases 'P' & 'Q'.

$$N_2(g) + O_2(g) \xrightarrow{1488K} 2P(g)$$

$$2P(g) + O_2(g) \rightarrow 2Q(g)$$

Rate of production of Q is faster when P reacts with ozone in the stratosphere.

$$P(g) + O_3(g) \rightarrow Q(g) + O_2(g)$$

P & Q are respectively:

(A) N_2 & NO **(B)** NO_2 & NO **(C)** NO & NO_2 **(D)** NO & N_2

10. Which of the following statements regarding the effects of NO_2, false?

(A) Higher concentrations of NO_2 damage the leaves of plants and retard the rate of photosynthesis

(B) NO_2 is a lung irritant and can lead to acute respiratory disease in children

(C) NO_2 is harmful to various textile fibers and metals

(D) None of the above

11. Nitrous oxide:

I. occurs naturally in the environment

II. is produced when fossil fuels are burnt

III. quantity has increased due to the use of chemical fertilizers

(A) I and III **(B)** I and II **(C)** II and III **(D)** I, II and III

12. Catalytic converters are used in cars to reduce the effect of exhaust fumes on the atmosphere. Which of the following statements regarding them are true?

I. The main component of the converter is a ceramic honeycomb coated with precious metals - Pd, Pt and Rh.

II. The exhaust gases containing unburnt fuel, CO and NO_x, when pass through the convertor at 573 K, are converted into CO_2 and N_2.

(A) Only I **(B)** Only II **(C)** I and II **(D)** None of the above

13. Which of the following statements is NOT true?

(A) Air-borne particles such as dust, fumes, mist etc are dangerous for human health

(B) Particulate pollutants bigger than 5 microns are likely to lodge in the nasal passage

(C) Particulate of size of about 1 micron enter into lungs easily

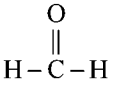
(D) None of the above

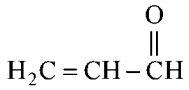
14. Classical and photochemical smog are:

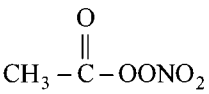
(A) both oxidising in nature **(B)** both reducing in nature

(C) oxidising and reducing respectively **(D)** reducing and oxidising respectively

15. The common components of photochemical smog besides ozone and nitric oxide are:

(A) 
Formaldehyde

(B) 
Acrolein

(C) 
Peroxyacetyl nitrate (PAN)

(D) All the above

16. The upper stratosphere consists of considerable amount of X. X protects us from the harmful ultraviolet (UV) radiations coming from the sun. These radiations cause skin cancer (melanoma) in humans. X is:

(A) CO **(B)** CO_2 **(C)** O_3 **(D)** O_2

17. The most serious water pollutants are the disease-causing agents called pathogens. Which of the following statements is/are true?

I. Pathogens include bacteria and other organisms that enter water from domestic sewage and animal excreta.

II. Human excreta contain bacteria such as Escherichia coli and Streptococcus faecalis which cause gastrointestinal diseases.

(A) Only I **(B)** Only II **(C)** I and II **(D)** None of the above

18. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : The pH of acid rain is less than 5.6.

Reason (R) : Carbon dioxide present in the atmosphere dissolves in rain water and forms carbonic acid.

In the light of the above statements, choose the correct answer from the options given below:

(A) Both A and R are correct and R is the correct explanation of A

(B) Both A and R are correct but R is not the correct explanation of A

(C) Both A and R are not correct

(D) A is not correct but R is correct

19. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Photochemical smog is oxidising in nature.

Reason (R) : Photochemical smog contains NO_2 and O_3, which are formed during the sequence of reactions.

In the light of the above statements, choose the correct answer from the options given below:

(A) Both A and R are correct and R is the correct explanation of A

(B) Both A and R are correct but R is not the correct explanation of A

(C) Both A and R are not correct

(D) A is not correct but R is correct

20. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Ozone is destroyed by solar radiation in upper stratosphere.

Reason (R) : Thinning of the ozone layer allows excessive UV radiations to reach the surface of earth.

In the light of the above statements, choose the correct answer from the options given below:

(A) Both A and R are correct and R is the correct explanation of A

(B) Both A and R are correct but R is not the correct explanation of A

(C) Both A and R are not correct

(D) A is not correct but R is correct

21. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Excessive use of chlorinated synthetic pesticides causes soil and water pollution.

Reason (R) : Such pesticides are non-biodegradable.

In the light of the above statements, choose the correct answer from the options given below:

(A) Both A and R are correct and R is the correct explanation of A

(B) Both A and R are correct but R is not the correct explanation of A

(C) Both A and R are not correct

(D) A is not correct but R is correct

22. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : If BOD level of water in a reservoir is less than 5 ppm it is highly polluted.

Reason (R) : High biological oxygen demand means low activity of bacteria in water.

In the light of the above statements, choose the correct answer from the options given below:

(A) Both A and R are correct and R is the correct explanation of A

(B) Both A and R are correct but R is not the correct explanation of A

(C) Both A and R are not correct

(D) A is not correct but R is correct

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

23. Which of the following conditions shows the polluted environment?

(A) pH of rain water is 5.6

(B) amount of carbondioxide in the atmosphere is 0.03%

(C) biochemical oxygen demand 10 ppm

(D) eutrophication

24. The consequences of global warming may be _____.

(A) increase in average temperature of the earth **(B)** melting of Himalayan Glaciers

(C) increased biochemical oxygen demand **(D)** eutrophication

25. Which of the following statements regarding the TROPOSPHERE is true?

(A) It is the lowest region of the atmosphere in which the human beings along with other organisms live

(B) It extends between 10 & 50 km above sea level

(C) It is a turbulent, dusty zone containing air, much water vapour and clouds

(D) It extends upto a height of ~ 10 km from sea level

26. Particulate pollutants:

(A) are minute solid particles or liquid droplets in air

(B) are present in vehicle emissions, smoke particles, dust particles and ash from industries

(C) may be viable or non-viable

(D) include oxides of sulphur and nitrogen

27. Viable particulates:

(A) are minute living organisms that are dispersed in the atmosphere

(B) are - bacteria, fungi, moulds, algae etc

(C) can cause allergy to human beings

(D) can cause plants diseases

28. The CFCs are used in refrigerators, air conditioners, in the production of plastic foam etc. Which of the following statements are correct?

(A) The CFCs are responsible for the depletion of the ozone layer

(B) The CFCs get broken down by powerful UV radiations in the stratosphere, releasing chlorine free radical $CF_2Cl_2(g) \xrightarrow{UV} \dot{Cl}(g) + \dot{C}F_2Cl(g)$

(C) The chlorine radical then reacts with stratosphere ozone to form chlorine monoxide radicals and molecular oxygen $\dot{Cl}(g) + O_3(g) \rightarrow Cl\dot{O}(g) + O_2(g)$

(D) Reaction of chlorine monoxide radical with atomic oxygen produces more chlorine radicals $Cl\dot{O}(g) + O(g) \rightarrow \dot{Cl}(g) + O_2(g)$

29. Pollution of water originates from human activities. Through different paths, pollution reaches surface or ground water. Which of the following are true?

(A) Easily identified source or place of pollution is called the point source

(B) Non-point sources of pollution are those where a source of pollution cannot be easily identified

(C) Municipal and industrial discharge pipes are non-point sources of pollution

(D) Agricultural runoff, acid rain, storm-water drainage (from streets etc) are point sources of pollution

30. The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called BIOCHEMICAL OXYGEN DEMAND (BOD). Which of the following statements are correct?

(A) The amount of BOD in the water is a measure of the amount of organic material in the water, in the terms of how much oxygen will be required to break it down biologically

(B) Clean water would have BOD value of more than 17 ppm whereas highly polluted water could have a BOD value of less than 5 ppm

(C) Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of more than 17 ppm

(D) Clean water and polluted water both have BOD value of 5 ppm

31. Which of the following statements is false?

(A) About 25% of the solar energy reaching the earth is absorbed by the earth's surface

(B) The greenhouse gases trap some of the heat that is radiated back to the atmosphere

(C) Natural greenhouse effect is essential for life because it maintains the temperature and makes earth perfect for life

(D) If the amount of CO_2 present in the atmosphere crosses the delicate proportion of 0.03 percent, the natural greenhouse balance may get disturbed

MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column I are labelled as (A), (B), (C) & (D) whereas statements in Column II are labeled as p, q, r, s & t. More than one choice from Column II can be matched with Column I.

32. Match the terms given in Column I with the compounds given in Column II.

Column I		Column II	
(A)	Acid rain	**(p)**	$CHCl_2 - CHF_2$
(B)	Photochemical smog	**(q)**	CO
(C)	Combination with haemoglobin	**(r)**	CO_2
(D)	Depletion of ozone layer	**(s)**	SO_2
		(t)	Unsaturated hydrocarbons

33. Match the pollutant(s) in Column I with the effect(s) in Column II.

Column I		Column II	
(A)	Oxides of sulphur	**(p)**	Global warming
(B)	Nitrogen dioxide	**(q)**	Damage to kidney
(C)	Carbon dioxide	**(r)**	'Blue baby' syndrome
(D)	Nitrate in drinking water	**(s)**	Respiratory diseases
(E)	Lead	**(t)**	Red haze in traffic and congested areas

34. Match the activity given in Column I with the type of pollution created by it given in Column II.

Column I		Column II	
(A)	Releasing gases to the atmosphere after burning waste material containing sulphur	**(p)**	Water pollution
(B)	Using carbamates as pesticides	**(q)**	Photochemical smog, damage to plant life, corrosion to building material, induce breathing problems, water pollution
(C)	Using synthetic detergents for washing clothes	**(r)**	Damaging ozone layer
(D)	Releasing gases produced by automobiles and factories in the atmosphere	**(s)**	May cause nerve diseases in human
(E)	Using chlorofluorocarbon compounds for cleaning computer parts	**(t)**	Classical smog, acid rain, water pollution, induce breathing problems, damage to buildings, corrosion of metals

35. Match the pollutants given in Column I with their effects given in Column II.

Column I		Column II	
(A)	Phosphate fertilisers in water	**(p)**	BOD level of water increases
(B)	Methane in air	**(q)**	Acid rain
(C)	Synthetic detergents in water	**(r)**	Global warming
(D)	Nitrogen oxides in air	**(s)**	Eutrophication

SINGLE CORRECT ANSWER TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct.

1. Which statement about aspirin is not true?

(A) Aspirin belongs to narcotic analgesics **(B)** It is effective in relieving pain

(C) It has anti-blood clotting action **(D)** It is a neurologically active drug

2. Which of the following is a narrow spectrum antibiotic?

(A) Penicillin G **(B)** Chloramphenicol

(C) Ampicillin **(D)** Amoxycillin

3. Equanil is _____.

(A) artificial sweetener **(B)** tranquilizer

(C) antihistamine **(D)** antifertility drug

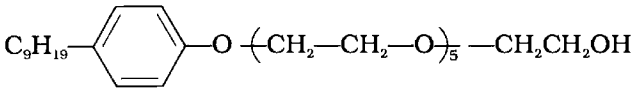
4. Glycerol is added to soap. It functions _____.

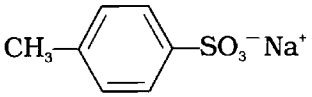
(A) as a filler **(B)** to increase leathering

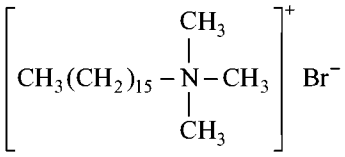
(C) to prevent rapid drying **(D)** to make soap granules

5. Which of the following is an example of liquid dishwashing detergent?

(A) $CH_3(CH_2)_{10}-CH_2OSO_3^- Na^+$

(B) 

(C) 

(D) 

6. Polyethylene glycols are used in the preparation of which type of detergents?

(A) Cationic detergents **(B)** Anionic detergents

(C) Non-ionic detergents **(D)** Soaps

7. Which of the following is not a target molecule for drug function in body?

(A) Carbohydrates **(B)** Lipids

(C) Vitamins **(D)** Proteins

8. 2-Acetoxy benzoic acid is used as an:

(A) antimalarial **(B)** antidepressant **(C)** antiseptic **(D)** antipyretic

9. A drug that is antipyretic as well as analgesic is:

(A) chloroquin **(B)** penicillin

(C) paracetamol **(D)** chloropromazine hydrochloride

10. Bithional is an example of:

(A) disinfectant **(B)** antiseptic **(C)** antibiotic **(D)** analgesic

11. Novalgin is a common:

(A) Analgesic **(B)** Antibiotic **(C)** Antipyretic **(D)** Both (A) and (C)

12. Which of the following is/are antidepressant drug/s?

(A) Cocaine **(B)** Benzedrine **(C)** Tofranil **(D)** All the three

13. Salol can be used as:

(A) Antiseptic **(B)** Antipyretic **(C)** Analgesic **(D)** Disinfectant

14. Mixture of chloroxylenol and terpineol acts as:

(A) Analgesic **(B)** Antiseptic **(C)** Antipyretic **(D)** Antibiotic

15. Which of the following in an analgesic?

(A) Chloromycetin **(B)** Novalgin **(C)** Penicillin **(D)** Streptomycin

16. Artificial sweetener which is stable under cold conditions only is:

(A) Saccharine **(B)** Sucralose **(C)** Aspartame **(D)** Alitame

17. Which of the following hormones is produced under the condition of stress which stimulates glycogenolysis in the liver of human being?

(A) Thyroxin **(B)** Insulin **(C)** Adrenaline **(D)** Estradiol

18. Drug which helps to reduce anxiety and brings about calmness is called as:

(A) analgesic **(B)** diuretioc **(C)** tranquilizer **(D)** antihistamine

19. Which of the following is not an antiseptic drug?

(A) Iodoform **(B)** Dettol **(C)** Gammexane **(D)** Boric acid

20. Competitive inhibitors are drugs which?

(A) Do not bind to the enzyme's active site

(B) Occupy the allosteric site, thereby changing the shape of the active site and thus inhibiting the enzymes

(C) Compete with the natural substrate for their attachment on the active sites of enzymes

(D) Do not act on enzymes

21. Which of the following statements regarding RECEPTOR PROTEINS is true?

I. They are crucial to the body's communication process.

II. They are embedded in the cell membranes but a small part possessing the active site projects out.

III. They are completely embedded in the cell membrane.

IV. They are found inside the cell nucleus.

(A) I **(B)** I and IV **(C)** I and II **(D)** I and III

22. Which of the following statements are true?

I. There are several types of receptors present in the body.

II. Receptors are only of one type

III. Different receptors interact with different chemical messengers and hence show selectivity.

IV. Receptors can never show selectivity with regard to chemical messengers.

(A) I and IV **(B)** II and IV **(C)** only IV **(D)** I and III

23. Drugs such as cimetidine and ranitidine treat hyperacidity by:

(A) Reacting with the excess hydrochloric acid thereby neutralising it

(B) Preventing the interaction of histamine with the receptors present in the stomach wall by reacting with histamine to form a complex

(C) Preventing the interaction of histamine with the receptors present in the stomach wall by blocking the active sites present on the receptor

(D) By decreasing the pH of the stomach

24. Noradrenaline plays a role in:

(A) inducing sleep **(B)** curbing pain

(C) mood changes **(D)** inducing acid secretion

25. Which of the following statements about ANALGESICS are true?

I. They reduce or abolish pain.

II. They do not cause impairment of consciousness, mental confusion, incoordination or paralysis.

III. All analgesics are addictive.

IV. Barbiturates are analgesics.

(A) I, II and III **(B)** I and II **(C)** I and IV **(D)** I, II, III and IV

26. Which of the following compounds have anti blood clotting ability?

(A) Morphine **(B)** Aspirin **(C)** Heroin **(D)** Codeine

27. Inside the body, the drug-prontosil is converted into a compound 'X'. 'X' is the real active compound responsible for the antibacterial action of prontosil 'X' is:

(A) sulphonic acid **(B)** sulphanilic acid **(C)** sulphanilamide **(D)** None of the above

28. Which of the following statements is NOT correct?

(A) Chlorine in the concentration of 0.2 to 0.4 ppm in aqueous solution is used as a disinfectant

(B) 0.2% solution of phenol is an antiseptic

(C) Sulphur dioxide in v. low concentration is a disinfectant

(D) Norethindrone is an antiseptic

29. Which of the following statements in NOT true for the artificial sweetener-saccharin?

(A) It remains unchanged when it is excreted from the body in urine

(B) It appear to be entirely inert and harmless when consumed

(C) It is about 2000 times as sweet as cane sugar

(D) It is of great use to diabetic persons and people who need to control intake of calories

30. Match the following:

Artificial sweetener		**Sweetness value in comparision to cane sugar**	
(i)	Aspartame	**(a)**	2000
(ii)	Saccharin	**(b)**	600
(iii)	Sucralose	**(c)**	550
(iv)	Alitame	**(d)**	100

(A) (i)-(a); (ii)-(b); (iii)-(c); (iv)-(d) **(B)** (i)-(a); (ii)-(c); (iii)-(b); (iv)-(d)

(C) (i)-(d); (ii)-(b); (iii)-(c); (iv)-(a) **(D)** (i)-(d); (ii)-(c); (iii)-(b); (iv)-(a)

31. Match the following:

Column I		Column II	
(i)	A dipeptide artificial sweetener	**(a)**	Aspartame
(ii)	A trichloro derivative of sucrose	**(b)**	Sodium benzoate
(iii)	Food preservative	**(c)**	Alitame
(iv)	Most potent artificial sweetener	**(d)**	Sucralose

(A) (i)-(d); (ii)-(c); (iii)-(b); (iv)-(a) **(B)** (i)-(a); (ii)-(b); (iii)-(c); (iv)-(d)

(C) (i)-(a); (ii)-(d); (iii)-(b); (iv)-(c) **(D)** (i)-(b); (ii)-(a); (iii)-(d); (iv)-(c)

32. Match the following:

Column I		Column II	
(i)	Component of Dettol	**(a)**	Ethynylestradiol
(ii)	Progesterone derivatives	**(b)**	Boric acid
(iii)	Estrogen derivative	**(c)**	Norethindrone
(iv)	Weak antiseptic for eyes	**(d)**	Chloroxylenol

(A) (i)-(d); (ii)-(a); (iii)-(c); (iv)-(b) **(B)** (i)-(b); (ii)-(a); (iii)-(c); (iv)-(d)

(C) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(b) **(D)** (i)-(b); (ii)-(c); (iii)-(a); (iv)-(d)

33. Match the following:

Column I		Column II	
(i)	Veronal	**(a)**	Narcotic analgesic
(ii)	Morphine	**(b)**	Non-narcotic analgesic
(iii)	Aspirin	**(c)**	Mild tranquilizer
(iv)	Chlordiazepoxide	**(d)**	Barbiturate tranquilizer

(A) (i)-(c); (ii)-(b); (iii)-(a); (iv)-(d) **(B)** (i)-(c); (ii)-(a); (iii)-(b); (iv)-(d)

(C) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c) **(D)** (i)-(d); (ii)-(b); (iii)-(a); (iv)-(c)

34. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Penicillin (G) is an antihistamine.

Reason (R) : Penicillin (G) is effective against gram positive as well as gram negative bacteria.

In the light of the above statements, choose the correct answer from the options given below:

(A) Assertion and reason both are correct statement but reason does not explain assertion

(B) Assertion and reason both are correct and reason explains the assertion

(C) Both assertion and reason are wrong statement

(D) Assertion is correct statement reason is wrong statement

35. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A) : Sulpha drug contain sulphonamide group.
Reason (R) : Salvarsan is a sulpha drug.
In the light of the above statements, choose the correct answer from the options given below:
(A) Assertion and reason both are correct statement but reason does not explain assertion
(B) Assertion and reason both are correct and reason explains the assertion
(C) Both assertion and reason are wrong statement
(D) Assertion is correct statement reason is wrong statement

36. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A) : Enzymes have active sites that hold substrate molecule for a chemical reaction.
Reason (R) : Drugs compete with natural substrate by attaching covalently to the active site of enzyme.
In the light of the above statements, choose the correct answer from the options given below:
(A) Assertion and reason both are correct statement but reason does not explain assertion
(B) Assertion and reason both are correct and reason explains the assertion
(C) Both assertion and reason are wrong statement
(D) Assertion is correct statement reason is wrong statement

37. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A) : Sodium chloride is added to precipitate soap after saponification.
Reason (R) : Hydrolysis of esters of long chain fatty acids by alkali produces soap in colloidal form.
In the light of the above statements, choose the correct answer from the options given below:
(A) Assertion and reason both are correct statement but reason does not explain assertion
(B) Assertion and reason both are correct and reason explains the assertion
(C) Both assertion and reason are wrong statement
(D) Assertion is correct statement reason is wrong statement

38. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A) : Competitive inhibitors compete with natural substrate for their attachment on the active sites of enzymes.
Reason (R) : In competitive inhibition, inhibitor binds to the allosteric site of the enzyme.
In the light of the above statements, choose the correct answer from the options given below:
(A) Assertion and reason both are correct statement but reason does not explain assertion
(B) Assertion and reason both are correct and reason explains the assertion
(C) Both assertion and reason are wrong statement
(D) Assertion is correct statement reason is wrong statement

39. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A) : Receptor proteins show selectivity for one chemical messenger over the other.
Reason (R) : Chemical messenger binds to the receptor site and inhibits its natural function.
In the light of the above statements, choose the correct answer from the options given below:
(A) Assertion and reason both are correct statement but reason does not explain assertion
(B) Assertion and reason both are correct and reason explains the assertion
(C) Both assertion and reason are wrong statement
(D) Assertion is correct statement reason is wrong statement

40. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Preservative are added to food items.

Reason (R) : Preservatives inhibit the growth of microorganisms.

In the light of the above statements, choose the correct answer from the options given below:

(A) Assertion and reason both are correct statement but reason does not explain assertion

(B) Assertion and reason both are correct and reason explains the assertion

(C) Both assertion and reason are wrong statement

(D) Assertion is correct statement reason is wrong statement

41. Given below are two statements, one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Artificial sweeteners are added to the food to control the intake of calories.

Reason (R) : Most of the artificial sweeteners are inert and do not metabolise in the body.

In the light of the above statements, choose the correct answer from the options given below:

(A) Assertion and reason both are correct statement but reason does not explain assertion

(B) Assertion and reason both are correct and reason explains the assertion

(C) Both assertion and reason are wrong statement

(D) Assertion is correct statement reason is wrong statement

42. Which of the following are not used as food preservatives?

(A) Table salt **(B)** Sodium Benzoate

(C) Cane sugar **(D)** Salt of sorbic acid

MULTIPLE CORRECT ANSWERS TYPE

Each of the following Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

43. Which of the following statements are incorrect about receptor proteins?

(A) Majority of receptor proteins are embedded in the cell membranes

(B) The active site of receptor proteins opens on the inside region of the cell

(C) Chemical messengers are received at the binding sites of receptor proteins

(D) Shape of receptor doesn't change during attachment of messenger

44. Which of the following are not used as food preservatives?

(A) Table salt **(B)** Sodium hydrogencarbonate

(C) Cane sugar **(D)** Benzoic acid

45. Which of the following statements are correct about barbiturates?

(A) Hypnotics or sleep producing agents

(B) These are tranquilizers

(C) Non-narcotic analgesics

(D) Pain reducing without disturbing the nervous system

46. Which of the following are sulpha drugs?

(A) Sulphapyridine **(B)** Prontosil **(C)** Salvarsan **(D)** Nardil

47. Which of the following statements are incorrect about penicillin?

(A) An antibacterial fungus **(B)** Ampicillin is its synthetic modification

(C) It has bacteriostatic effect **(D)** It is a broad spectrum antibiotic

48. Veronal and luminal are derivatives of barbituric acid which are _____.

(A) Tranquilizers **(B)** Non-narcotic analgesic

(C) Antiallergic drugs **(D)** Neurologically active drugs

49. Which of the following are anionic detergents?

(A) Sodium salts of sulphonated long chain alcohol

(B) Ester of stearic acid and polyethylene glycol

(C) Quaternary ammonium salt of amine with acetate ion

(D) Sodium salts of sulphonated long chain hydrocarbons

50. Which of the following statements are correct?

(A) Cationic detergents have germicidal properties

(B) Bacteria can degrade the detergents containing highly branched chains

(C) Some synthetic detergents can give foam even in ice cold water

(D) Synthetic detergents are not soaps

51. Narcotic analgesics such as morphine and its homologues are chiefly used for:

(A) relief of post operative pain **(B)** relief of cardiac pain

(C) relief of pain of terminal cancer **(D)** relief of skeletal pain such as due to arthritis

52. Which of the following statements are not true for antibiotics?

(A) They are produced wholly or partly by chemical synthesis

(B) In low concentrations, they inhibit the growth or destroy microorganisms by intervening in their metabolic processes

(C) Even in low doses, they are highly toxic for humans

(D) They are products of microorganisms as purely synthetic compounds can never have antibacterial activity

53. Which of the following are bacteriostatic antibiotics?

(A) Erythromycin **(B)** Ofloxacin

(C) Tetracycline **(D)** Chloramphenicol

54. Which of the following statements are true for chloramphenicol?

(A) It is a broad-spectrum antibiotic **(B)** It is a narrow spectrum antibiotic

(C) It is has a bactericidal effect **(D)** It has a bacteriostatic effect

55. Which of the following are broad spectrum antibiotics?

(A) Vancomycin **(B)** Ofloxacin **(C)** Penicillin G **(D)** Chloramphenicol

56. Which of the following statements are NOT true about chloramphenicol?

(A) It is a narrow spectrum antibiotic

(B) It is given orally in case of typhoid, dysentery, acute fever, certain form of urinary infections, meningitis, pneumonia

(C) It is not absorbed by the gastrointestinal tract and hence cannot be consumed orally

(D) It has a bactericidal effect

57. Which of the following compounds are antiseptics?

(A) Furacine **(B)** Soframicine **(C)** Terpineol **(D)** Bithionol

58. Which of the following statements is correct?

(A) same substances can act as antiseptic as well as antibiotic by varying the concentration

(B) same substances can act as antiseptic as well as disinfectant by varying the concentration

(C) 0.2 percent solution of phenol is an antiseptic while its one percent solution is a disinfectant

(D) 0.2 percent solution of phenol is a disinfectant antiseptic while its one percent solution is an antiseptic

59. Which of the following statements is NOT true for natural sweeteners such as sucrose?

(A) They add to the calorie intake

(B) They are approximately 500 times as sweet as artificial sweetener such as saccharin

(C) They are of great value to diabetic persons

(D) Sucralose is an example of a natural sweetener

60. Compounds with antiseptic properties are _____.

(A) $CHCl_3$ **(B)** CHI_3

(C) Boric acid **(D)** 0.3 ppm aqueous solution of Cl_2

61. Which of the following statements are correct about barbiturates?

(A) Hypnotics or sleep producing agents

(B) These are tranquilizers

(C) Non-narcotic analgesics

(D) Pain reducing without disturbing the nervous system

62. Amongst the following antihistamines, which are antacids?

(A) Ranitidine **(B)** Brompheniramine

(C) Terfenadine **(D)** Cimetidine

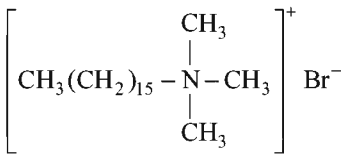
MATRIX MATCH TYPE

Each of the following question contains statements given in two columns, which have to be matched. Statements in Column I are labelled as (A), (B), (C) & (D) whereas statements in Column II are labeled as p, q, r, s & t. More than one choice from Column II can be matched with Column I.

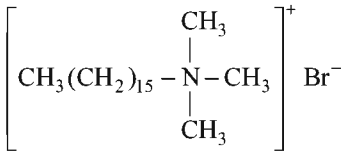
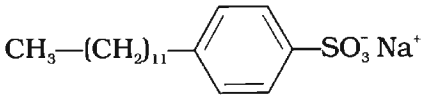
63. Match the medicines given in Column I with their use given in Column II.

Column I		Column II	
(A)	Ranitidine	**(p)**	Tranquilizer
(B)	Furacine	**(q)**	Antibiotic
(C)	Phenelzine	**(r)**	Antihistamine
(D)	Chloramphenicol	**(s)**	Antiseptic
		(t)	Antifertility drug

64. Match structures given in Column I with the type of detergents given in Column II.

Column I		Column II	
(A)	$CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$	**(p)**	Cationic detergent
(B)	$C_{17}H_{35}COO^-Na^+$	**(q)**	Anionic detergent
(C)	$CH_3-(CH_2)_{10}CH_2SO_3^-Na^+$	**(r)**	Nonionic detergent
(D)		**(s)**	Soap

65. Match the detergents given in Column I with their uses given in Column II.

Column I		Column II	
(A)		**(p)**	Dishwashing powder
(B)		**(q)**	Laundry soap
(C)	$C_{17}H_{35}COO^-Na^+ + Na_2CO_3 + \text{Rosin}$	**(r)**	Hair conditioners
(D)	$CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$	**(s)**	Toothpaste

66. Match the class of compounds given in Column I with their functions given in Column II.

Column I		Column II	
(A)	Antagonists	**(p)**	Communicate message between two neurons and that between neurons to muscles
(B)	Agonists	**(q)**	Bind to the receptor site and inhibit its natural function
(C)	Chemical messenger	**(r)**	Crucial to body's communication process
(D)	Inhibitors	**(s)**	Mimic the natural messenger
(E)	Receptors	**(t)**	Inhibit activities of enzymes

67. Match the classes of drugs given in Column I with their action given in Column II.

Column I		Column II	
(A)	Analgesics	**(p)**	Inhibit the growth of microorganisms can be given orally
(B)	Antiseptics	**(q)**	Treatment of stress
(C)	Antihistamines	**(r)**	Applied to inanimate objects
(D)	Antacids	**(s)**	Prevents the interaction of histamine with its receptor
(E)	Tranquilisers	**(t)**	Pain killing effect
(F)	Antibiotics	**(u)**	Applied to diseased skin surfaces
(G)	Disinfectants	**(v)**	Treatment of acidity

Numerical Value Type Questions

The Answer to the following questions can be positive or negative integers of 1/2/3 digits, 0 and decimal numerical value.

68. How many of the following are antifical sweeteners?

(i)	Aspartame	**(ii)**	Saccharin	**(iii)**	Sucralose
(iv)	Bithionol	**(v)**	Terpineol	**(vi)**	Chloroxylenol
(vii)	Alitame	**(viii)**	Sodium Benzoate	**(ix)**	Sorbic acid

69. In how many of the following drugs, S is present?

(i)	Histamine	**(ii)**	Cimetidine	**(iii)**	Ranitidine
(iv)	Terfenadine	**(v)**	Phenelzine	**(vi)**	Veronal
(vii)	Valium	**(viii)**	Sulphonamide	**(ix)**	Sulphapyridine

70. From the given set of drugs, how many of them can be used as antibiotics?

(i)	Penicillin	**(ii)**	Erythromycin	**(iii)**	Ofloxacin
(iv)	Tetracycline	**(v)**	Chloramphenicol	**(vi)**	Salvarsan
(vii)	Prontosil	**(viii)**	Bithional	**(ix)**	Chloroxylenol

VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

Answer Key to JEE Advanced Revision Booklet | Chemistry

STOICHIOMETRY-I & II

1	2	3	4	5	6	7	8	9	10	11	12	13
D	B	C	C	B	D	A	A	D	C	A	B	C
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
AC	ABCD	ABC	BCD	AB	ABD	BD	AB	AB	AD	AB	ABC	AC
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
AC	C	B	C	D	5	4	9	1	0.82	1.75	200	3.12
40	**41**											
44.25	1.104											

ATOMIC STRUCTURE

1	2	3	4	5	6	7	8	9	10	11	12	13
B	C	B	A	A	D	A	C	B	B	D	C	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
C	D	B	D	B	A	AB	ABD	ABD	ABC	AB	ABCD	AB
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**				
6	4	4	4	199.26	–1.22	5	20.4	173.9				

GASEOUS STATE

1	2	3	4	5	6	7	8	9	10	11	12	13
C	B	C	D	B	C	B	D	C	C	C	D	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
B	C	B	ABC	ABD	BD	ABC	BCD	BC	AC	BC	CD	AD

27	28	29	30	31	32	33	34			35	
ABD	B	AC	CD	AD	ABC	AC	[A-s] [B-p] [C-r] [D-q]			[A-p, q, r] [B-s] [C-s] [D-s]	
36	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**
6	3	2	4	7	4	7	4	5.26	8.25	1.64	0.29

CHEMICAL BONDING

1	2	3	4	5	6	7	8	9	10	11	12	13
B	A	C	B	ABC	AB	BD	BD	AC	AC	AC	ABCD	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
ABC	CD	C	A	C	A	C	CD	A	BC	C	C	ABD
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
ABC	AB	ABCD	D	C	C	C	B	B	C	B	C	D
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
B	A	B	A	C	C	A	D	A	C	C	A	D

53	54	55	56	57	58	59
D	B	D	B	D	D	[A-p, q, r] [B-p, s] [C-s, t] [D-q, t]

60	61	62
[A-p, q, r][B-r, s, t] [C-s, t] [D-s, t]	[A-s] [B-p, q, t] [C-r] [D-p, q, t]	[A-p] [B-p, r, s][C-p, q, r, s][D-p, q, r]

63	64	65	66	67	68	69	70	71	72	73	74	75
5	5	6	6	6	3	5	4	3	4	84.4	75	4

76
7

CHEMICAL EQUILIBRIUM

1	2	3	4	5	6	7	8	9	10	11	12	13
B	B	A	A	D	A	A	A	A	C	A	C	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	A	C	A	C	D	B	B	B	C	D	C	ABC

27	28	29	30	31	32	33	34	35	36	37		
ABC	ABC	AB	AC	BD	CD	ABCD	AB	ABC	A	[A-r] [B-r] [C-q s] [D-p]		
38	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
4	3	9	2	2	12	1	4	4	6	0.05	22.62	0.66
51	**52**	**53**										
0.0036	1.5	9										

IONIC EQUILIBRIUM

1	2	3	4	5	6	7	8	9	10	11	12	13
C	C	B	C	B	D	D	D	D	D	A	C	B
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	A	B	D	D	C	D	D	C	B	A	C	B
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
A	C	A	B	A	A	C	B	A	ACD	ABC	BC	BC
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
AB	ABC	A	ACD	ABCD	CD	ABCD	AB	BC	ABCD	ACD	ABCD	CD
53	**54**	**55**				**56**				**57**	**58**	
AB	ABC	[A-p, s] [B-q, r] [C-p, r] [D-p]				[A-p, s] [B-q] [C-p, r] [D-p, q]				3	6	
59		**60**	**61**	**62**	**63**	**64**	**65**					
x = 6.9, y = 0.26		x = 7.5	0.0489	9	5.97	3.88	3.31					

THERMOCHEMISTRY & THERMODYNAMICS

1	2	3	4	5	6	7	8	9	10	11	12	13
A	D	C	B	A	A	A	B	C	B	A	D	A
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
D	D	A	C	B	A	B	C	A	A	D	D	D
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
C	ABC	AB	AB	ABC	AD	ACD	ACD	AD	ABC	BC	B	AB

40	41	42	43	44	45	46	47	48	49	50		
B	ABD	BCD	ACD	BC	ABD	ABC	BC	BC	ABCD	[A-q] [B-p, s] [C-r]		
51			52				53			54	55	56
[A-p] [B-r] [C-q] [D-t]			[A-q][B-Q, r, s] [C-q, r] [D-p]				[A-s] [B-p] [C-r] [D-q]			8	5	6
57	58	59	60	61	61							
8	8	27.20	15	–557	10.9							

CHEMICAL KINETICS

1	2	3	4	5	6	7	8	9	10	11	12	13
B	D	A	A	A	B	A	D	D	B	A	C	C
14	15	16	17	18	19	20	21	22	23	24	25	26
B	C	B	B	B	A	B	C	C	B	C	A	D
27	28	29	30	31	32	33	34	35	36	37	38	39
B	B	C	B	D	B	B	C	D	B	AD	BC	ABD
40	41	42	43	44	45	46	47	48			49	50
ACD	AB	ABD	CD	AD	AB	AC	BD	[A-p, q] [B-s] [C-r] [D-r]			2	9
51	52	53	54	55	56	57	58	59	60	61	62	63
3	4	4	9	2	60	490	3.44	5.2	12500	1.93	75	4.5
64	65	66	67	68	69	70	71	72	73	74	75	76
60	0.693	5	1.188	70.8	6	2.30	48	0.75	1	7.33	3.2	4

COLLIGATIVE PROPERTIES OF SOLUTIONS

1	2	3	4	5	6	7	8	9	10	11	12	13
C	A	B	C	B	A	A	A	B	A	C	B	C
14	15	16	17	18	19	20	21	22	23	24	25	26
B	B	C	C	A	A	C	A	B	C	A	B	A
27	28	29	30	31	32	33	34	35	36	37	38	39
B	B	B	A	B	B	C	B	C	C	A	C	B

40	41	42	43	44	45	46	47	48	49
B	ABC	ABD	ABC	AB	[A-q, r] [B-q, r] [C-p, r] [D-s]	69.6	46.9	3.35	100.25

50	51	52	53	54	55
4.48	0.478	84.86°C	2736	83.5%	2.24

ELECTROCHEMISTRY

1	2	3	4	5	6	7	8	9	10	11	12	13
D	A	C	A	C	D	B	C	D	D	B	D	C
14	15	16	17	18	19	20	21	22	23	24	25	26
C	A	B	D	B	BD	CD	ABC	ABD	ACD	AC	ACD	CD
27	28	29	30	31	32	33	34		35		36	
BD	BC	ABD	CD	AC	AC	ACD	ABD		ABC		AC	

37	38	39	40	41	42
[A-p, s] [B-s] [C-p, q, s] [D-q, r, s]	[A-q, s] [B-p, r, s, t] [C-r, s, t] [D-p, s]	C	2	2	4

43	44	45	46	47	48	49	50
8	8	4	9	–1.66	18.99	193	0.521

SOLID STATE

1	2	3	4	5	6	7	8	9	10	11	12	13
B	C	C	B	D	A	A	B	A	B	C	B	A
14	15	16	17	18	19	20	21	22	23	24	25	26
C	D	B	C	A	C	A	D	C	B	D	C	C
27	28	29	30	31	32	33	34	35	36	37	38	39
C	B	ACD	ABC	ACD	BD	ABC	ABCD	ABC	AD	ABCD	ABCD	ACD
40	41	42	43	44	45	46	47	48	49	50	51	52
C	A	A	4	2	4	2	4	3	7	4	0	3

53	54
5	8

IOC & HYDROCARBONS

1	2	3	4	5	6	7	8	9	10	11	12	13
B	D	C	A	A	B	B	C	A	C	D	C	B
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
C	B	A	AB	AC	BD	ABCD	BD	BD	AD	ACD	ABC	BC
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
BC	C	BD	ABCD	ABD	BCD	BC	ABC	ACD	ABC	AB	ABCD	BC
40	**41**	**42**	**43**					**44**				
ABC	ABC	ABCD	[A-p, q, s] [B-p, r, s] [C-p, q, s] [D-p, r, s]					[A-r] [B-p, q, s] [C-p, q, s] [D-p, s]				
45				**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**
[A-p, s] [B-p, s, r] [C-q, r, s] [D-r, s]				4	4	194	5	10	6	5	7	6
55	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**			
6	6	5	3	05	08	06	5	3	8			

HALOGEN CONTAINING ORGANIC COMPOUNDS & ORGANIC CONCEPTS

1	2	3	4	5	6	7	8	9	10	11	12	13
D	B	A	B	C	B	B	C	B	D	B	B	A
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
C	C	A	D	C	D	B	D	B	A	B	D	ACD
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
ABC	BC	A	ABCD	CD	ABD	ABD	ACD	ABC	ABD	AC	ABCD	ABC
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
ABCD	ABD	ABC	ABD	AB	BC	BCD	BC	CD	AB	ABCD	AD	ABCD
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**
C	ABC	BCD	BD	ABCD	BD	BCD	BC	ABC	ABC	ABCD	ABCD	ABC
66	**67**	**68**	**69**	**70**				**71**				
ABD	B	A	C	[P-A, E] [Q-B] [R-C, E] [S-D, E]				[P-A, B, C, D] [Q-C, D] [R-A, B, C, E] [S-A]				
72	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**
4	4	9	6	6	9	6	5	6	2	8	1	7

85	86	87	88	89	90	91	92	93	94	95	96
3	3	9	32	3	43	31	8	31.37%	8	4	8
97	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	
8	2	3	1	4	6	6	3	5	4	5	

OXYGEN CONTAINING ORGANIC COMPOUNDS-I

1	2	3	4	5	6	7	8	9	10	11	12	13
A	A	D	C	C	C	B	A	D	ABD	AC	ABC	AD
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
ABCD	CD	ABC	AB	CD	AB	AB	BC	AB	ABD	ABCD	AD	BC
27	**28**	**29**			**30**			**31**	**32**	**33**	**34**	**35**
ACD	ABCD	[A-p] [B-r] [C-s] [D-q]			[A-r] [B-r, q] [C-p] [D-s]			3	6	9	9	9
36	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**		**46**	
1	8	9	3	2	7	3	9	16	06		05	

OXYGEN CONTAINING ORGANIC COMPOUNDS-II

1	2	3	4	5	6	7	8	9	10	11	12	13
C	A	D	B	A	A	C	A	B	B	ABCD	ABC	ABCD
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
ABC	BCD	ABC	AC	BD	ABCD	CD	ABC	BCD	ABD	AB	BC	ABD
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
ABC	ACD	BCD	ABC	ABCD	ABD	AB	ABD	CD	ACD	ABCD	AC	B
40	**41**				**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
AB	[A-q, s] [B-q, r, s] [C-q, s] [D-q, r, s]				D	C	C	2	8	3	6	6
50	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**
3	8	5	9	2	3	10	9	6	8	5	0	9
63	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**				
2	12	4	3	12	04	6	7	3				

OXYGEN CONTAINING ORGANIC COMPOUNDS-III

1	2	3	4	5	6	7	8	9	10	11	12	13
B	B	C	C	A	B	D	B	A	D	B	A	C
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	ABCD	CD	AB	ABC	BCD	AC	BC	ABCD	AC	ABC	ACD	ACD
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	
BC	BD	AC	ABC	BC	AB	ABCD	ACD	ABC	D	ABD	ABCD	
39				**40**			**41**	**42**	**43**	**44**	**45**	**46**
[A-p, r] [B-p, q, r] [C-p, r, s] [D-p, r]				[A-r] [B-s] [C-q] [D-p]			6	4	3	4	22	21
47	**48**	**49**	**50**	**51**	**52**	**53**	**54**					
4	5	10	42	9	6	6	6					

NITROGEN CONTAINING ORGANIC COMPOUNDS

1	2	3	4	5	6	7	8	9	10	11	12	13
B	B	C	B	C	B	D	C	A	A	B	A	BCD
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
BCD	A	BCD	CD	AD	BC	CD	ACD	ABCD	BD	BCD	ABCD	ABCD
27	**28**	**29**	**30**	**31**				**32**			**33**	**34**
ABCD	BCD	CD	AB	[A-r, s, t] [B-p, r, s] [C-s] [D-q, t]				[A-s] [B-r] [C-q] [D-p]			3	3
35	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**				
4	6	2	4	4	03	04	7	3				

SURFACE CHEMISTRY, BIOMOLECULES, PRACTICAL ORG. CHEM. & POLYMERS

1	2	3	4	5	6	7	8	9	10	11	12	13
B	B	A	D	D	C	D	A	C	A	C	D	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	B	C	B	B	C	D	C	C	C	B	A	B
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
A	C	A	C	D	B	C	A	A	A	D	A	B

40	41	42	43	44	45	46	47	48	49	50	51	52
B	AC	AC	AB	AC	BC	AB	AC	AC	ACD	AC	BC	AB
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	
BD	ABD	ABCD	ABC	CD	BCD	CD	ACD	ABC	ABCD	AC	ABCD	
65			**66**					**67**				
[A-r] [B-s] [C-p, q] [D-r]			[A-p, q, s] [B-p, q, r] [C-r] [D-s]					[A-p, r, t] [B-p, s, t] [C-p, s, t] [D-q, r]				
68					**69**				**70**			
[A-q, r, s] [B-r, s] [C-p, r, s] [D-p, r, s]					[A-q, r] [B-p, r] [C-s] [D-r]				[A-p, r] [B-p, s] [C-q, s] [D-q, s]			
71			**72**			**73**	**74**	**75**	**76**	**77**	**78**	**79**
[A-p, s] [B-r] [C-q] [D-p, s]			[A-s] [B-r] [C-q] [D-p]			5	8	8	6	5	8	9
80	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**				
9	4	4	4	6	5	3	1	2.5				

COORDINATION COMPOUNDS

1	2	3	4	5	6	7	8	9	10	11	12	13
B	B	A	B	B	A	A	A	C	A	B	B	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	A	A	C	C	B	C	D	B	B	A	B	D
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
B	C	C	C	B	A	B	C	B	D	A	C	C
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
D	A	D	D	C	D	ABD	BCD	ABD	ABD	ABC	ABC	ABCD
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**
BC	ABCD	CD	ABD	D	ACD	ABCD	ABCD	BC	AB	B	BD	ABC
66	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**
ACD	AD	BCD	ABCD	ABC	ABCD	ABD	AC	AB	ABCD	AD	ABD	BC
79	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**
C	B	D	B	D	6	4	5	3	2	6	9	4
92												
3												

METALLURGY

1	2	3	4	5	6	7	8	9	10	11	12	13
B	C	C	A	B	C	C	A	B	B	C	B	B
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
B	B	A	C	D	C	D	D	C	B	D	A	D
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
C	A	A	ABCD	ABC	AC	ABC	ABCD	ACD	ABC	AB	AD	C
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**			**48**		
ABCD	BC	ABCD	ABC	ABCD	ABCD	ABC	[A-r] [B-p] [C-s] [D-q]			[A-r] [B-r, s] [C-p, q] [D-q]		
49			**50**			**51**			**52**	**53**	**54**	**55**
[A-r] [B-s, t] [C-p] [D-q]			[A-p] [B-q] [C-r] [D-s]			[A-p] [B-q] [C-r, s] [D-t]			6	6	8	3
56	**57**	**58**	**59**	**60**	**61**							
1	5	4	9	9	4							

HYDROGEN & s-BLOCK ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13
D	B	C	D	C	B	D	C	A	A	A	A	C
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	C	A	A	C	D	C	D	B	D	C	C	A
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
D	C	A	A	B	D	B	C	B	D	C	C	A
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
B	D	D	D	D	B	D	C	C	A	A	B	A
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**
C	B	A	C	A	C	C	D	B	D	B	D	A
66	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**
A	D	B	D	C	D	D	A	D	B	ABD	ABC	BD
79	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**
BD	ABD	ABD	BCD	ACD	ACD	ABC	BCD	ABCD	ACD	ABD	ABC	ABD

92	93	94	95	96	97	98	99	100	101	102	103	104
ABC	ABCD	ABC	AC	ABC	BC	BD	BC	ABCD	ABCD	ABD	CD	BCD
105	**106**						**107**					
BC	[A-r] [B-p, r, s] [C-p, q, s] [D-p, q, s]						[A-p, q, s] [B-p, s] [C-p, q, r, s] [D-p, q, s]					
108				**109**				**110**				**111**
[A-q, r] [B-p, s] [C-p, q, r] [D-p, s]				[A-p, q, r, s] [B-p] [C-p, q] [D-r, s]				[A-r, s] [B-r] [C-q, r] [D-p, t]				8
112	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**		**122**	
5	1	2	4	9	6	6	6	5	5		0	

p-BLOCK ELEMENTS-I

1	2	3	4	5	6	7	8	9	10	11	12	13
C	D	B	A	C	B	C	D	A	B	D	C	C
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
C	C	A	D	B	C	A	C	A	A	A	A	D
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
A	D	C	B	B	C	B	A	B	C	A	D	C
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
D	A	D	A	C	B	C	C	D	B	D	B	C
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**
C	A	C	C	B	B	A	D	A	D	B	A	B
66	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**
C	B	ABCD	BCD	ABD	BCD	ABCD	C	ABC	ABCD	B	B	B
79	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**		
ABC	C	ABCD	BCD	ABCD	ABCD	ACD	ABCD	ABD	ABCD	[A-r] [B-s] [C-p, q] [D-p]		
90			**91**					**92**				
[A-q] [B-r] [C-s] [D-p]			[A-p, s, t] [B-p, s] [C-q, r] [D-r, s, t]					[A-p, q] [B-q, t] [C-p, r, s] [D-q, t]				
93				**94**				**95**				
[A-p, s, t] [B-p, t] [C-q, r, s] [D-p, r]				[A-p] [B-q, r] [C-q, r] [D-r, s]				[A-p, r] [B-p, q, s] [C-p, q, t] [D-p, q, t]				

96					97	98	99	100	101	102	103	104
[A-p, q, r] [B-p, q, r] [C-p, q, r] [D-s, t]					7	6	5	3	5	2	1	2
105	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**		**115**	
1	6	6	1	3	3	4	2	1	1		4	

p-BLOCK ELEMENTS-II

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
A	C	A	A	C	D	C	B	C	B	C	C	A
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
A	D	C	D	B	C	A	A	A	B	D	B	C
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
B	A	D	C	B	D	C	D	D	D	C	D	B
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
A	D	D	C	A	B	B	D	C	B	A	C	C
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**
B	A	C	B	A	B	A	B	D	C	C	C	AB
66	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**
B	ABC	ABCD	BD	ABC	ABCD	ABCD	ABCD	ABC	AB	ABCD	BC	D
79	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**
ABCD	ABC	ABCD	D	ABCD	ABCD	ABCD	ABCD	ABCD	BC	ABCD	ABD	B
92	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**		
ABCD	ABC	C	ABCD	ABCD	ABC	ABCD	ABCD	ABCD	ABCD	[A-q] [B-p] [C-s] [D-r]		
103			**104**			**105**			**106**			
[A-p] [B-r] [C-p] [D-q]			[A-p] [B-s] [C-q] [D-r]			[A-s] [B-r] [C-p] [D-q]			[A-p, q, s] [B-q, r, t] [C-q, r] [D-p]			
107	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**
3	9	2	4	2	5	3	2	8	3	9	7	3
120	**121**	**122**	**123**									
9	5	4	2									

d-BLOCK ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13
B	A	B	A	A	A	B	B	D	A	B	A	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
B	D	A	A	A	B	D	A	B	B	D	B	C
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
C	D	D	C	A	A	A	D	C	D	C	A	A
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
B	C	D	B	C	D	A	B	D	B	B	D	B
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**
D	A	D	B	D	D	A	B	C	D	D	B	B
66	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**
C	B	A	ABC	AB	AB	BC	ABC	ABC	AB	ABCD	ABC	CD
79	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**
ABCD	BCD	BCD	ABCD	AC	ABC	BCD	ABD	ABD	AB	ABC	AC	ABCD

92	93	94	95
ABCD	AC	[A-r] [B-p, q, r, s] [C-p, r] [D-q]	[A-p, q, s, t] [B-p, q, r] [C-r] [D-p, q, s]

96	97	98
[A-p, r, s] [B-q, r, s, t] [C-q, r, s] [D-q]	[A-p, s] [B-q] [C-q, r, s] [D-q, t]	[A-p, q, r, s] [B-p, q, r, s] [C-p, q, r, s] [D-r, s]

99	100	101	102	103	104	105	106	107	108	109	110	111
1	6	5	1	4	5	5	7	9	0	7	6	3

112	113	114
2	5	1

QUALITATIVE ANALYSIS

1	2	3	4	5	6	7	8	9	10	11	12	13
A	B	B	B	D	C	A	B	C	B	C	D	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
B	A	C	C	B	B	B	C	D	D	A	D	C
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
D	C	B	D	B	A	A	D	A	C	B	C	B
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
A	C	B	D	D	A	D	B	D	C	C	B	B
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	
A	ABC	ABC	BC	ABD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	ABCD	
65				**66**				**67**				
[A-s] [B-p, q, r, s] [C-p, s] [D-p]				[A-p, q, r] [B-r, s] [C-r, s] [D-r]				[A-p, q, s] [B-p, r] [C-r, s] [D-q]				
68				**69**				**70**			**71**	**72**
[A-q, s] [B-p, q] [C-r] [D-q, s]				[A-p] [B-p, q, s] [C-q, r] [D-r, s]				[A-s] [B-p] [C-p] [D-q]			6	2
73	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
3	5	2	3	3	5	2	6	5	3	6	4	6
86	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**
7	3	4	3	1	4	7	6	5	3	6	5	0
99	**100**	**101**										
4	3	6										

ENVIRONMENTAL CHEMISTRY

1	2	3	4	5	6	7	8	9	10	11	12	13
C	A	A	A	B	C	D	A	C	D	D	C	D
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
D	D	C	C	B	A	D	A	C	CD	AB	ACD	ABC
27	**28**	**29**	**30**	**31**	**32**				**33**			
ABCD	ABCD	ABD	AC	BCD	[A-r, s] [B-s, t] [C-q] [D-p]				[A-s] [B-t] [C-p] [D-r] [E-q]			
34				**35**								
[A-t] [B-s] [C-p] [D-q] [E-r]				[A-p, s] [B-r] [C-p] [D-q]								

CHEMISTRY IN EVERYDAY LIFE

1	2	3	4	5	6	7	8	9	10	11	12	13
A	A	B	C	B	C	C	D	C	A	D	D	A
14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
B	B	C	C	C	C	C	C	D	C	C	B	B
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
C	D	C	D	C	C	C	C	D	D	A	D	D
40	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
B	B	C	BD	BD	AB	AB	CD	AD	AD	ACD	ABC	CD
53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**		
ACD	AD	ABD	ACD	ABCD	BC	BCD	BC	AB	AD	[A-r] [B-s] [C-p] [D-q]		
64			**65**			**66**						
[A-r] [B-s] [C-q] [D-p]			[A-r] [B-s] [C-q] [D-p]			[A-q] [B-s] [C-p] [D-t] [E-r]						
67						**68**	**69**	**70**				
[A-t] [B-u] [C-s] [D-v] [E-q] [F-p] [G-r]						4	4	7				