VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

Mock JEE Advanced-2 (CBT) | Paper – 1 | JEE 2024

Maximum Marks: 180

Timing: 9:00 AM to 12:00 PM **Duration : 3.0 Hours**

General Instructions

1. The question paper consists of 3 Subject (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Part has **three** sections (Section 1, Section 2 & Section 3).

2. **Section 1** contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

Section 2 contains **FOUR (04)** Matching List sets. Each set has **TWO** lists: **List I** and **List II**.
Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

Section 3 contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

3. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ Invigilator's Signature _____

MARKING SCHEME

SECTION – 1 | (Maximum Marks: 24)

- This section consists of **Six (06)** Questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +4 If only (all) the correct option(s) is(are) chosen

Partial Marks: +3 If all the four options are correct but ONLY three options are chosen

Partial Marks: +2 If three or more options are correct but ONLY two options are chosen and both of which are correct

Partial Marks: +1 If two or more options are correct but ONLY one option is chosen, and it is a correct option

Zero Mark: 0 if none of the options is chosen (i.e. the question is unanswered)

Negative Marks: –2 In all other cases.

SECTION – 2 | (Maximum Marks: 12)

- This section contains **Four (04**) Matching List sets. Each set has **TWO** lists: **List I** and **List II**.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme.

Full Marks : +3 If ONLY the correct option is chosen.

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).

Negative Marks : −1 In all other cases.

SECTION – 3 | (Maximum Marks: 24)

- This section contains **Eight (08) Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +3 **ONLY** if the correct numerical value is entered.

Zero Mark: 0 In all other cases.

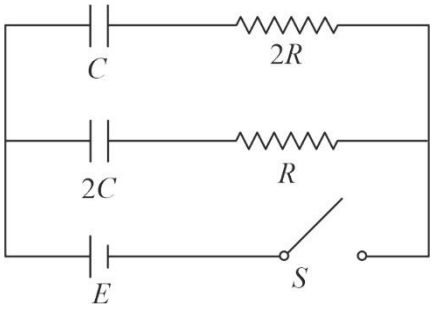
SUBJECT I : PHYSICS 60 MARKS

SECTION 1

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

1. In the circuit shown in the figure, switch *S* is closed at time $t = 0$. Select the correct statements. Choose the correct options.



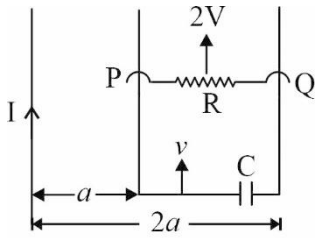
(A) Rate of increase of charge is same in both the capacitors at all times

(B) Ratio of charge stored in capacitors *C* and 2*C* at any time t would be 1 : 2

(C) Time constants of both the capacitors are equal

(D) Steady state charges on capacitors *C* and 2*C* are in the ratio of 1 : 2

2. A U shaped conducting wire frame having capacitor C is coplanar with an infinite wire having current I. On frame, a wire PQ having resistance R makes sliding contact as shown. Frame and wire are moving with speed *v* and 2*v* respectively as shown. There is no friction anywhere. Choose the correct options.



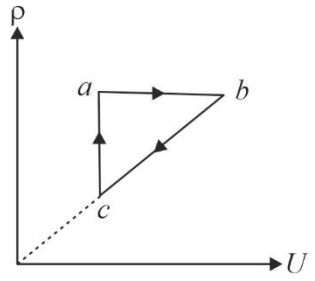
(A) Charge on capacitor at time *t* is $q = \dfrac{C\mu_0 Iv(\ln 2)}{2\pi}\left(1 - e^{-t/RC}\right)$

(B) Charge on capacitor at time *t* is $q = \dfrac{C\mu_0 Iv(\ln 2)}{\pi}\left(1 - e^{-t/RC}\right)$

(C) Current through resistor at time *t* is $i = \dfrac{\mu_0 Iv(\ln 2)}{2\pi R}\left(e^{-t/RC}\right)$

(D) Current through capacitor at time *t* is $i = \dfrac{\mu_0 Iv(\ln 2)}{\pi R}\left(e^{-t/RC}\right)$

3. Density (ρ) versus internal energy (U) graph of a gas is as shown in figure. Choose the correct options.



(A) $Q_{bc} = 0$ **(B)** $W_{bc} = 0$ **(C)** $W_{ca} < 0$ **(D)** $Q_{ab} > 0$

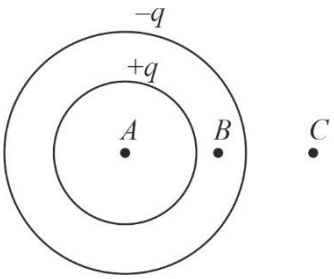
Here, W is work done by gas and Q is heat given to the gas.

4. A prism has refracting angle equal to $\frac{\pi}{2}$. It is given that γ is angle of minimum deviation and β is the deviation of ray entering at grazing incidence. Refractive Index of prism is μ. Choose the correct options.

(A) $\sin\gamma = \sin^2\beta$ **(B)** $\sin^2\gamma = \sin\beta$

(C) $\sin\beta = \sqrt{\mu^2 - 1}$ **(D)** $\sin\gamma = \sqrt{\mu^2 - 1}$

5. Two concentric spherical shells have charge +q and $-q$ as shown in figure. Choose the correct options.



(A) At A electric field is zero, but electric potential is non-zero

(B) At B electric field and electric potential both are non-zero

(C) At C electric field is zero but electric potential is non-zero

(D) At C electric field and electric potential both are zero

6. Two radioactive substances have half-lives T and $2T$. Initially, they have equal number of nuclei. After time $t = 4T$, the ratio of their number of nuclei left is x and the ratio of their activity is y. Then choose the correct options.

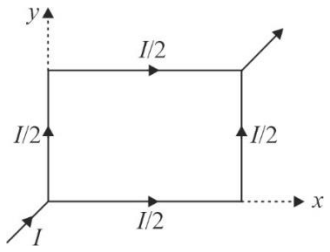
(A) $x = \frac{1}{8}$ **(B)** $x = \frac{1}{4}$ **(C)** $y = \frac{1}{2}$ **(D)** $y = \frac{1}{4}$

SECTION - 2

MATCHING LIST TYPE

This section contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

7. A square loop of uniform conducting wire is as shown in figure. A current I (in ampere) enters the loop from one end and exits the loop from opposite end as shown in figure.



The length of one side of square loop is l metre. The wire has uniform cross-section area and uniform linear mass density.

List-I		List-II	
(I)	$B = B_0\hat{i}$ in tesla	**(P)**	Magnitude of net force on loop is $\sqrt{2}B_0Il$ N
(II)	$B = B_0\hat{j}$ in tesla	**(Q)**	Magnitude of net force on loop is zero N
(III)	$B = B_0(\hat{i}+\hat{j})$ in tesla	**(R)**	Magnitude of force on loop is $2B_0Il$ N
(IV)	$B = B_0\hat{k}$ in tesla	**(S)**	Magnitude of net force on loop is B_0Il N

(A) I-S; II-S; III-Q; IV-P **(B)** I-P; II-S; III-Q; IV-R

(C) I-P, S; II-P, Q; III-R; IV-P **(D)** I-S; II-R; III-P, S; IV-P, R

8. Particle-1 is projected from ground (take it origin) at time $t = 0$, with velocity $(30\hat{i}+30\hat{j})ms^{-1}$. Particle-2 is projected from (130 m, 75 m) at time $t = 1s$ with velocity $\left(-20\hat{i}+20\hat{j}\right)ms^{-1}$. Assuming $\hat{j}$ to be vertically upward and $\hat{i}$ to be in horizontal direction (rightwards), match the following two columns at $t = 2s$.

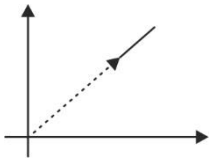
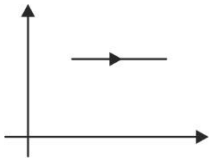
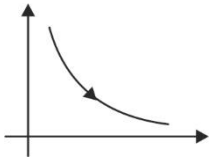
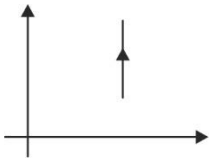
List-I		List-II	
(I)	Horizontal distance between two particles is	**(P)**	30 SI units
(II)	Vertical distance between two particles is	**(Q)**	40 SI units
(III)	Horizontal component of relative velocity between two particles is	**(R)**	50 SI units
(IV)	Vertical component of relative velocity between two particles is	**(S)**	None of these

(A) I-P, S; II-P, Q; III-P, R; IV-P, S **(B)** I-R; II-R; III-R; IV-S

(C) I-P, S; II-P, Q; III-R; IV-P **(D)** I-S; II-R; III-P, S; IV-P, R

9. Corresponding to isobaric process, match the following two Lists.

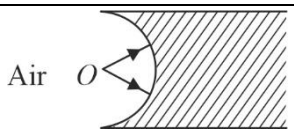
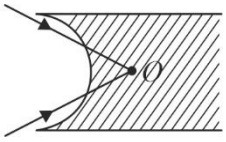
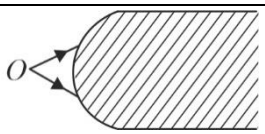
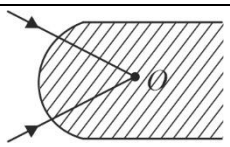
(P = Pressure, V = Volume, T = Temperature and ρ = Density)

List-I		List-II	
(I)	*P*-*T* graph	**(P)**	
(II)	*P*-V graph	**(Q)**	
(III)	*T*-*V* graph	**(R)**	
(IV)	*T*-ρ graph	**(S)**	

(A) I-Q; II-Q; III-P; IV-R **(B)** I-P; II-S; III-Q; IV-R

(C) I-R; II-P; III-S; IV-Q **(D)** I-P; II-R; III-Q; IV-S

10. *O* is a point object. There are curved interfaces in various options given below. Refractive index of the material (shaded region) is μ. Now match the following two Lists.

List-I		List-II	
(I)		**(P)**	Real image of *O*
(II)		**(Q)**	Virtual image of *O*
(III)		**(R)**	May be real or virtual image of *O*
(IV)		**(S)**	Image of *O* is at infinity

(A) I-Q; II-P; III-R; IV-S **(B)** I-P; II-S; III-Q; IV-R

(C) I-Q; II-R; III-R; IV-P **(D)** I-P; II-R; III-Q; IV-S

SECTION 3

NUMERICAL VALUE TYPE

This section contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

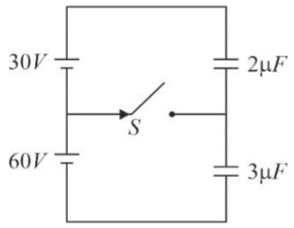
1. One milliwatt of light of wavelength 4965Å is incident on a caesium surface. Calculate the photoelectric current $(in\,\mu A)$ liberated by the surface if quantum efficiency is 0.5%. Given plank's constant $h = 6.62\times10^{-34}\,J\,s$ and velocity of light = $3\times10^{8}\,m/s$.

2. Neon-23 decays in the following way,

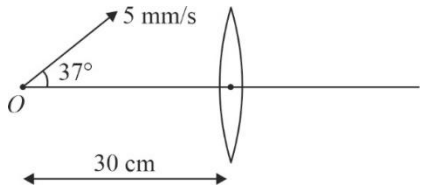
$^{23}_{10}Ne \longrightarrow {}^{23}_{11}Na + {}^{0}_{-1}e + \bar{\nu}$. The maximum kinetic energy that the beta particle $\left({}^{0}_{-1}e\right)$ can have is $\frac{x}{10}MeV$. Find *x* to nearest integer.

The atomic masses of $^{23}_{10}Ne$ and $^{23}_{11}Na$ are 22.9945u and 22.9898u, respectively.

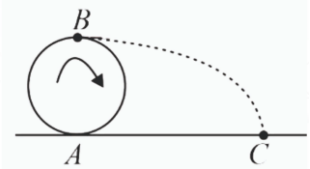
3. The circuit shown in the figure is at steady state. The amount of charge that will flow through switch *S* after it is closed is $x\,\mu C$. Here *x* is _____.



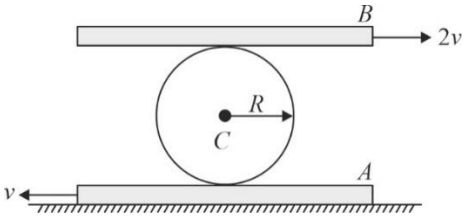
4. Focal length of the convex lens shown in figure is 20 cm. The image velocity at the moment shown is $\sqrt{x}\,mm/s$. Here *x* is _____.



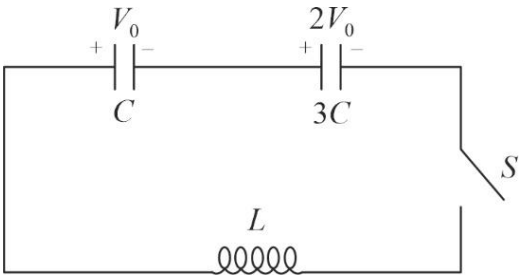
5. A wheel of radius '*r*' rolls without slipping with a speed v on a horizontal road. When it is at a point A on the road, a small lump of mud separates from the wheel at its highest point B and drops at Point C on the ground. The distance *AC* is $nv\sqrt{\frac{r}{g}}$, then the value of *n* is _____.



6. A cylinder *C* of mass 8*m* is rolling without sliding over two horizontal planks *A* and *B* having masses 2*m* and *m*, moving with uniform velocities $-v\hat{i}$ and $2v\hat{i}$ respectively. The total kinetic energy of the system is $n\frac{1}{2}mv^2$. The value of *n* is _____.



7. Two capacitors of capacitance *C* and 3*C* are charged to potential difference V_0 and $2V_0$ respectively, and connected to an inductor of inductance *L* as shown in figure. Initially the current in the inductor is zero. When, the switch *S* is closed, the maximum current in the inductor is $\frac{n}{2}V_0\sqrt{\frac{3C}{L}}$, then the value of *n* is _____.



8. A projectile of mass *m* is fired from the surface of the earth at an angle $\alpha = 60°$ from the vertical. The initial speed v_0 is equal to $\sqrt{\frac{GM_e}{R_e}}$. The height through which projectile will rise is $\frac{R_e}{x}$. Here *x* is_____.

SUBJECT II : CHEMISTRY 60 MARKS

SECTION 1

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

1. For diatomic molecules, the correct statement(s) about the molecular orbitals formed by the overlap of two 1s orbitals is(are):

(A) σ^* orbital has a total of two nodal planes

(B) σ^* orbital has one nodal plane

(C) σ orbital has one node in the plane which is perpendicular to the molecular axis

(D) σ orbital has zero nodal plane

2. The correct option(s) related to physisorption process is (are):

(A) Physisorption results in unimolecular layer

(B) The enthalpy change during physisorption is in the range of 100 to $140\ \text{kJ mol}^{-1}$

(C) Physisorption is an exothermic process

(D) Physisorption results in multimolecular layer

3. Which of the following reaction (s) occurs during calcination?

(A) $CaCO_3 \rightarrow CaO + CO_2$

(B) $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$

(C) $2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$

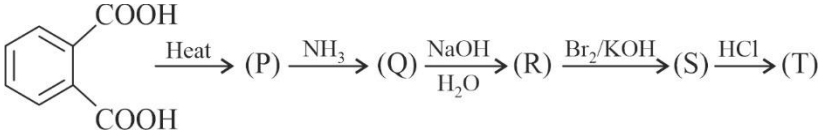
(D) $CuS + CuSO_4 \rightarrow 2Cu + 2SO_2$

4. The treatment of H_2S with HNO_3 produces a gas that is:

(A) Paramagnetic **(B)** Bent in geometry

(C) An acidic oxide **(D)** Reddish brown gas

5. Considering the reaction sequence given below, the correct statement(s) is(are):



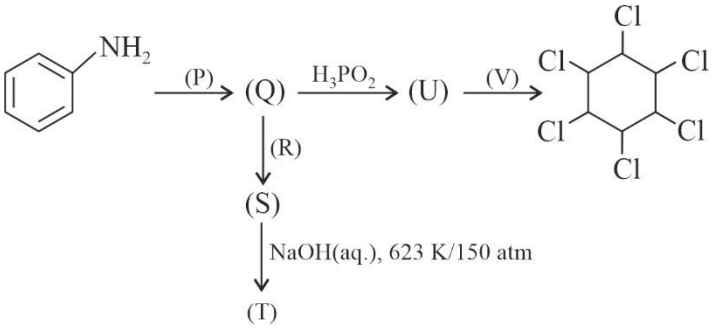
(A) P is a phthalic anhydride

(B) R to S conversion is a step-down reaction

(C) T is a dicarboxylic acid

(D) Treating T with excess of CH_3MgX gives 2 moles of Methane

6. Considering the following reaction sequence,



The correct option(s) is(are)

(A) $P = NaNO_2 / HCl / 0-5^0C,\ R = Cu / HCl,\ V = Cl_2 / \text{sun light}$

(B) $P = NaNO_2 / HCl / 0-5^0C,\ T = C_6H_6,\ U = C_6H_5 - OH$

(C) $Q = C_6H_5N_2^+Cl^-,\ T = C_6H_5 - OH,\ U = C_6H_6$

(D) $P = NaNO_2 / HCl / 0-5^0C,\ S = C_6H_6,\ V = Cl_2 / \text{sun light}$

SECTION - 2

MATCHING LIST TYPE

This section contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

7. Match the following:

List-I		List-II	
(I)	$A + B \rightarrow C + D$ $r = k_1[A][B]$	**(P)**	Unit of rate constant is same as that rate of reaction
(II)	$A + B \rightarrow C + D$ $r = k_2[A][B]^0$	**(Q)**	Rate Constant for the reaction is independent of initial concentration of reaction
(III)	$A + B \rightarrow C + D$ $r = k_3[A]^0[B]^0$	**(R)**	Rate of consumption of at least one of the reactants is equal to rate of production of at least one of the products
(IV)	$2A + B \rightarrow 2C + 3D$ $r = k_3[A]^0[B]^0$	**(S)**	If both reactants are taken in equimolar amount, half-life for both reactants are equal

Choose the correct option(s)

(A) I-P; II-Q; III-S; IV-R

(B) I-R; II-Q; III-S; IV-P

(C) I-P; II-Q; III-Q; IV-P

(D) I-R; II-P; III-R; IV-R

8. Match the characteristics given in column-I with the compound(s) given in the column-II. And choose the correct option(s)

List-I		List-II	
(I)	Imparts colour to the Bunsen flame	**(P)**	$NaHCO_3$
(II)	Shows amphoteric character	**(Q)**	$LiCl$
(III)	Alkaline solution in water	**(R)**	$CaCO_3$
(IV)	Evolves CO_2 on heating	**(S)**	$Be(OH)_2$

(A) I $\rightarrow$ P,Q,R; II $\rightarrow$ S; III $\rightarrow$ P; IV $\rightarrow$ P,R **(B)** I $\rightarrow$ P,Q,R; II $\rightarrow$ P; III $\rightarrow$ S; IV $\rightarrow$ P,R

(C) I $\rightarrow$ P,S; II $\rightarrow$ S; III $\rightarrow$ P; IV $\rightarrow$ P,R **(D)** I $\rightarrow$ P,Q,R; II $\rightarrow$ S; III $\rightarrow$ Q,R,S; IV $\rightarrow$ P,R

9. Match the pair of complexes given in column-I and the characteristic(s) given in column-II and choose the correct option(s).

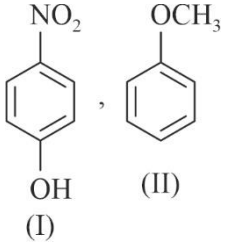
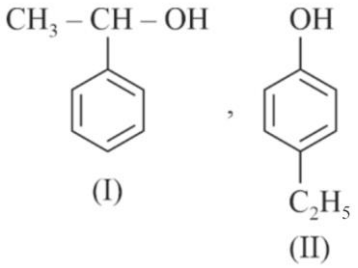
List-I		List-II	
(I)	$(NH_4)_2[NiCl_4]$ and $(NH_4)_2[Ni(CN)_4]$	**(P)**	Both show similar electrical conductance
(II)	$[Co(NH_3)_6]Cl_3$ and $[Pt(NH_3)_5Cl]Cl_3$	**(Q)**	Both show same effective atomic number
(III)	$[Pt(NH_3)_2Cl_2]$ and $(NH_4)_2[PtCl_4]$	**(R)**	Both show same primary valencies
(IV)	$K_2[Fe(H_2O)_6]$ and $K_4[FeCl_6]$	**(S)**	Both gives white participate with $AgNO_3$ solution

Choose the correct option(s)

(A) I-P, Q, R; II-P, S; III-Q, R; IV-Q, R **(B)** I-R, S; II-P; III-P,Q; IV-Q

(C) I-P, R; II-R, S; III-R; IV-P **(D)** I-Q; II-P, S; III-S; IV-Q, R

10. Match the compounds of List-I with the reagent of List-II, which can distinguish between the compounds of List-I

List-I		List-II	
(I)	$CH_3-C\equiv C-H$ (I) $\quad CH_3-CH=O$ (II)	**(P)**	Tollen's reagent
(II)	 (I) (II)	**(Q)**	I_2 / NaOH
(III)	$CH_3-\underset{(I)}{\underset{\vert}{C}H(OH)}-CH_3$, $CH_3-\underset{(II)}{\overset{\Vert}{C}(O)}-CH_3$	**(R)**	Lucas reagent
(IV)	 (I) (II)	**(S)**	Neutral $FeCl_3$
		(T)	2, 4-DNP

Choose the correct option(s)

(A) I-P, Q, T; II-S; III-R, T; IV-P **(B)** I-Q, T; II-S; III-R, T; IV-Q, R, S

(C) I-Q, S; II-P, T; III-P; IV-S **(D)** I-P, S; II-T; III-Q, R; IV-P

SECTION 3

NUMERICAL VALUE TYPE

This section contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

1. 1 mol of $Zn(g)$ is combusted in a fixed volume bomb calorimeter with excess of O_2 at 298 K and 1 atm into $ZnO(s)$. During the reaction, temperature increases from 298.0 K to 308.0 K. If heat capacity of the bomb calorimeter and enthalpy of formation of $Zn(g)$ are $20.00\ KJ\ K^{-1}$ and $130.7 KJ\ mol^{-1}$ at 298 K, respectively, the calculated standard molar enthalpy of formation of $ZnO(s)$ at 298 K is $X\ kJ\ mol^{-1}$. The value of $|X|$ is _____.

[Given: Gas constant $R = 8.3\ J\ K^{-1}mol^{-1}$]

2. The reduction potential $\left(E^0 \text{in mV}\right)$ of $Cr^{2+}(aq.)/Cr(s)$ is:

[Given $E^0_{Cr^{3+}(aq.)/Cr(s)} = 0.74V, E^0_{Cr^{3+}(aq.)/Cr^{2+}(aq.)} = 0.41V$]

3. A solution is prepared by mixing 0.02 mol each of H_2S, KHS , KOH and 0.04 mol K_2S, in 500 ml of water. pH of the resulting solution is _____.

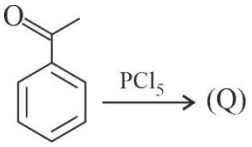
[Given: pKa_1 and pKa_2 of H_2S are 7.04 and 11.96, respectively]

4. The treatment of an aqueous solution of 1.51 g of $MnSO_4$ with excess of mixture of Na_2CO_3 and KNO_3 results in a green solution along with the formation of KNO_2, CO_2 and Na_2SO_4. Further green solution reacts with H_2SO_4 and gives another compound X with by products. Compound X is responsible for pink colour of solution. The amount of X (in g) is _____.

(Molar mass of $MnSO_4 = 151\,g$)

5. 2.8 grams of CaO reacts with excess carbon at 1000°C temperature to give product P and gas Q. Product P again reacts with nitrogen to give carbon and new product R. The amount (in gm) of gas formed by hydrolysis of R is _____.

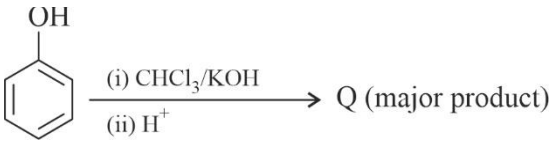
6. Consider the following reaction.



On estimation of chlorine in 3.5 gm of Q using Carius method, the amount of AgCl formed (in gm) is _____.

[Given Atomic mass of H = 1, C= 12, O =16, P= 31, Cl = 35.5, Ag = 108]

7. The weight percentage of oxygen in **Q**, formed in the following reaction sequence, is _____.



8. If the reaction sequence given below is carried out with 1 moles of n- heptane, the amount of the product D formed (in g) is _____.

$$\text{n-Heptane} \xrightarrow[600°C/15\,atm]{Cr_2O_3/Al_2O_3} \underset{(50\%)}{(A)} \xrightarrow[\text{Sun light}]{2\,\text{mole}\,Cl_2} \underset{(100\%)}{(B)} \xrightarrow{\text{Hydrolysis}} \underset{(25\%)}{(C)} \xrightarrow{\text{Red P/HI}} \underset{(50\%)}{(D)}$$

The yields of A, B, C and D are given in parentheses.

[Given: Atomic mass of $H = 1, C = 12, O = 16, Cl = 35.5$]

SUBJECT III : MATHEMATICS 60 MARKS

SECTION 1

MULTIPLE CORRECT ANSWERS TYPE

This Section contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

1. The value of $\int_1^e \left(\left(\frac{x}{e}\right)^{2x} + \left(\frac{e}{x}\right)^{x}\right)\log_e x\,dx = A + Be + \frac{C}{e^2}$: (A, B, C are rational numbers)

(A) $A+B+C=0$ **(B)** $A+C=-1$ **(C)** $B=0$ **(D)** $A=1$

2. Let $a_1 = 50$ and $a_1, a_2 .... a_n$ be a sequence of number satisfying $n\left(a_n - a_{n+1}\right) = n^3 + n^2 - a_n$, then which of following is true.

(A) $\frac{a_{16}}{16} = -70$ **(B)** $a_{11} = -55$ **(C)** $a_{10} = 50$ **(D)** $\frac{a_{12}}{12} = -16$

3. If plane P is containing lines $L_1 : \frac{x-1}{k} = \frac{y-2}{2} = \frac{z-3}{3}$ and $L_2 : \frac{x-2}{2} = \frac{y-3}{k} = \frac{z-4}{3}$, then:

(A) L_1 and L_2 can be parallel

(B) L_1 and L_2 can be intersecting

(C) Equation of plane P can be $x - y + 1 = 0$

(D) Equation of plane P can be $x + y - 2z + 3 = 0$

4. Consider $A(1,2,-3), B(4,-1,7)$ and line $L : \frac{x-10}{9} = \frac{y-1}{-1} = \frac{z+6}{-3}$. Let image of A in plane P is point B.

(A) Equation of plane P is $3x - 3y + 10z - 26 = 0$

(B) If L' is image of line L in plane P then distance between L & L' is $\sqrt{118}$

(C) Equation of plane P is $3x + 3y - 10z + 26 = 0$

(D) Distance between L and L' is $\frac{\sqrt{118}}{2}$

5. Tangents are drawn to parabola $y^2 = 4x$ from the point $P(-1,2)$ intersects the line $x = 2$ at *A* and *B* meets the parabola at *C* and *D*. *S* is the focus of parabola.

(A) Area of ΔPAB is $9\sqrt{2}$

(B) Centroid of triangle ΔPAB coincide with focus of parabola

(C) $\angle PSC = \angle PSD$

(D) *SC*, *SP*, *SD* are in G.P.

6. $f(\theta) = \begin{vmatrix} 1+\sin^2\theta & \sin^2\theta & \sin^2\theta \\ \cos^2\theta & 1+\cos^2\theta & \cos^2\theta \\ 4\sin 2\theta & 4\sin 2\theta & 1+4\sin 2\theta \end{vmatrix} + \begin{vmatrix} 0 & \sin^2\theta-\tan^2\theta & \dfrac{1+\sin\theta}{\cos\theta} \\ \tan^2\theta\sin^2\theta & 0 & \cos^2\theta-1 \\ \dfrac{\cos\theta}{\sin\theta-1} & \tan^2\theta\cos^2\theta & 0 \end{vmatrix}$ where $\theta \in \left[0, \dfrac{\pi}{2}\right)$.

(A) Maximum value of $f(\theta) = 6$

(B) Maximum value of $f(\theta)$ occurs at $\theta = \dfrac{\pi}{4}$

(C) Number of solutions of $f(x) = 7$ is 0

(D) Number of solutions of $f(x) = 4$ is 2

SECTION - 2

MATCHING LIST TYPE

This section contains **4** Matching List sets. Each set has **TWO** lists: **List I** and **List II**. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

7. Consider the following list:

List-I		List-II	
(I)	Number of solutions of the equation $e^x + e^{-x} = \tan x \forall x \in \left[0, \frac{\pi}{2}\right)$	**(P)**	Zero
(II)	Number of solutions of the equation $x + y = \frac{2\pi}{3}$ and $\cos x + \cos y = \frac{3}{2}$ is	**(Q)**	One
(III)	Number of solutions of the equation $\cos x + 2\sin x = 1, x \in (0, 2\pi]$ is	**(R)**	Two
(IV)	Number of solutions of the equation $\left(\sqrt{3}\sin x + \cos x\right)^2 = 4$ is	**(S)**	Infinite

(A) I-Q; II-P; III-R; IV-S **(B)** I-P; II-S; III-R; IV-R

(C) I-Q; II-P; III-Q; IV-Q **(D)** I-P; II-R; III-Q; IV-S

8. Box I contains three cards bearing numbers 1, 3, 5; box II contains five cards bearing number 1, 3, 5, 7, 9 and box III contain seven cards bearing numbers 1, 2, 3, 4, 5, 6, 7. A card is drawn from each of the boxes. Let x_i be the number on the card drawn from boxes I, II and III respectively for $i = 1, 2, 3$. Match the column-I with respective probabilities in Column-II.

List-I		List-II	
(I)	The probability that $x_1 + x_2 + x_3$ is odd	**(P)**	$\frac{3}{7}$
(II)	The probability that x_1, x_2, x_3 are in A.P.	**(Q)**	$\frac{2}{35}$
(III)	The probability that $x_1 + x_2 + x_3$ is even	**(R)**	$\frac{4}{7}$
(IV)	The conditional probability that at least one of x_1, x_2, x_3 is 5 provided that x_1, x_2, x_3 are in A.P. is	**(S)**	$\frac{1}{21}$
		(T)	$\frac{2}{3}$

(A) I-T; II-Q; III-P; IV-S **(B)** I-R; II-Q; III-P; IV-T

(C) I-T; II-R; III-Q; IV-P **(D)** I-R; II-S; III-P; IV-T

9. Consider the system of equations:

$a^2x+\left(a^2-(b-c)^2\right)y+bcz=0$

$b^2x+\left(b^2-(c-a)^2\right)y+caz=0$

$c^2x+\left(c^2-(a-b)^2\right)y+abz=0$, then

List-I		List-II	
(I)	If $a+b+c=0$ and no two out of a,b,c are equal then	**(P)**	System of equations have unique solution
(II)	If $a=b=c=0$, then	**(Q)**	System of equations have infinite number of solutions
(III)	If $a=b=c, a+b+c\neq 0$, then	**(R)**	$\forall x,y,z\in R$, the system of equations will be true
(IV)	If $a+b+c\neq 0$ and no two out of a,b,c are equal, then	**(S)**	Solutions of system of equations are in the form $(\lambda_1,\lambda_2,-\lambda_1-\lambda_2)$, where $\lambda_1,\lambda_2\in R$
		(T)	Solutions of system of equations are $(\lambda_1,\lambda_2,\lambda_1+\lambda_2)$, where $\lambda_1,\lambda_2\in R$

(A) I-Q; II-QR; III-QS; IV-P **(B)** I-QR; II-Q; III-PS; IV-T

(C) I-P; II-P; III-Q; IV-T **(D)** I-QR; II-Q; III-P; IV-P

10. A tangent having slope $\frac{-4}{3}$ touches the ellipse $\frac{x^2}{18}+\frac{y^2}{32}=1$ at point *P* and intersects the major and minor axes at *A* and *B* respectively, where *O* is the centre of the ellipse.

List-I		List-II	
(I)	The distance between the parallel tangents having slopes $\frac{-4}{3}$ is	**(P)**	24
(II)	Area of ΔAOB is	**(Q)**	$\frac{7}{24}$
(III)	If the tangent in first quadrant touches the ellipse at (*h*, *k*), the value of *hk* is	**(R)**	$\frac{48}{5}$
(IV)	If the equation of the tangent intersecting positive axes is $lx+my=1$, the value of $l+m$ is	**(S)**	12

(A) I-P; II-R; III-S; IV-Q **(B)** I-R; II-P; III-Q; IV-S

(C) I-R; II-P; III-S; IV-Q **(D)** I-S; II-R; III-P; IV-Q

SECTION 3

NUMERICAL VALUE TYPE

This section contains **8 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

1. $\alpha = 3\cos^{-1}\left(\frac{5}{\sqrt{28}}\right) + 3\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ and $\beta = 4\sin^{-1}\left(\frac{7\sqrt{2}}{10}\right) - 4\tan^{-1}\left(\frac{3}{4}\right)$ then

$\cos(\alpha - \beta)$ _____.

2. Let for $x > 1$, $f(x) = \tan\left(\frac{\pi x}{12}\right)$ and $g(x) = \frac{\sin\left(e^{x-2} - 1\right)}{\log(x-1)}$, then value of $\left[\lim_{x \to 2} f\left(g(x)\right)\right]$

is _____. (Where [.] denotes GIF)

3. The probability that a student passes in at least one of the three independent exams A, B, C is 0.75, the probability that he passes in atleast two of the exams is 0.5 and the probability that he passes exactly two of the exams is 0.4. If P_1, P_2 and P_3 denotes the probabilities of the student passing in A, B and C respectively if P_1, P_2, P_3 are the roots of equation $ax^3 + bx^2 + cx + d = 0$ then

$|a + b + c + d|$ _____. (Where $a, b, c, d \in I$)

4. Let z be a complex number such that $z \notin R$ and $\frac{1 + z + z^2}{1 - z + z^2} \in R$. Then the value of $|z|$ _____.

5. Let λ be a real number and n let $n \geq 2$ be an integer. Roots of equation $\lambda\left(\bar{z} + z^n\right) = i\left(\bar{z} - z^n\right)$ lies on a circle ($z \neq 0$). Then radius of the circle _____.

6. Each element of arithmetic sequence 101, 102, 103 ……. 201 is multiplied to each element of the arithmetic sequence 212, 222, 232 …… 302. If the sum when all these product are added is λ, then sum of digits appeared in λ is _____.

7. Number of 4 digit number of the form $N = x_1x_2x_3x_4$ such that $2000 \leq N \leq 5000, 4 \leq x_2 < x_3 \leq 8$ and N is multiple of 5 is _____.

8. A line AB is divided at C such that $AC = 3CB$. Circles are described on AC and CB, as diameter and common tangent meets AB produced at D. The radius of the smaller circle is equal to λ times BD. Then λ is equal to _____.