VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

Mock JEE Main-2 (CBT) | JEE-2024

Date: 08/01/2024 **Maximum Marks: 300**

Timing: 3:30 PM to 6:30 PM **Duration : 3.0 Hours**

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. You will NOT be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.**
   The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

PART I : PHYSICS	MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. A point charge q is placed at a distance of *r* from the centre of an uncharged conducting sphere of radius $R(<r)$. The potential at any point on the sphere is:

(A) zero **(B)** $\frac{1}{4\pi\varepsilon_0}.\frac{q}{r}$ **(C)** $\frac{1}{4\pi\varepsilon_0}.\frac{qR}{r^2}$ **(D)** $\frac{1}{4\pi\varepsilon_0}.\frac{q}{R}$

2. Vertical displacement of a plank with a body of mass '*m*' on it is varying according to law $y=\sin\omega t+\sqrt{3}\cos\omega t$. The minimum value of ω for which the mass just breaks off the plank and the moment it occurs first after *t* = 0 are given by: (*y* is positive vertically upwards)

(A) $\sqrt{\frac{g}{2}}, \frac{\sqrt{2}}{6}\frac{\pi}{\sqrt{g}}$ **(B)** $\frac{g}{\sqrt{2}}, \frac{2}{3}\sqrt{\frac{\pi}{g}}$ **(C)** $\sqrt{\frac{g}{2}}, \frac{\pi}{2}\sqrt{\frac{2}{g}}$ **(D)** $\sqrt{2g}, \sqrt{\frac{2\pi}{3g}}$

3. Match the following:

	Table-1		**Table-2**
I	Electrical resistance	**(P)**	$\left[M^{-1}L^{-2}T^{4}A^{2}\right]$
II	Capacitance	**(Q)**	$\left[ML^{2}T^{-2}A^{-2}\right]$
III	Magnetic field	**(R)**	$\left[ML^{2}T^{-3}A^{-2}\right]$
IV	Inductance	**(S)**	$\left[MT^{-2}A^{-1}\right]$

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

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

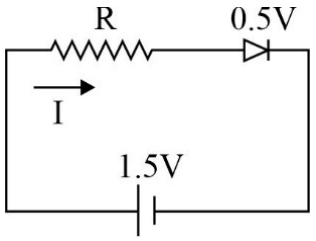
4. The diode used in the circuit shown in figure has a constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milliwatt. What should be the value of the resistor R, connected in series with the diode, for obtaining maximum current?

(A) $1.5\,\Omega$

(B) $5\,\Omega$

(C) $6.67\,\Omega$

(D) $200\,\Omega$



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5. The equation of trajectory of a projectile is $y=\sqrt{3}x-\frac{g\,x^2}{2}$. The velocity of projection is: (all units are SI)

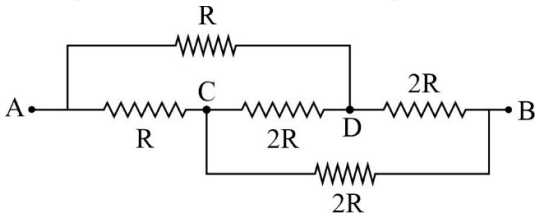
(A) 4 m/s **(B)** 2 m/s **(C)** $\frac{2}{\sqrt{3}}\,\mathrm{m/s}$ **(D)** 20 m/s

6. An excited hydrogen atom returns to the ground state. The wavelength of emitted photon is λ. The principal quantum number of the excited state will be:

(A) $\left(\frac{\lambda R}{\lambda R-1}\right)^{1/2}$ **(B)** $\left(\frac{\lambda R+1}{\lambda R}\right)^{1/2}$

(C) $\left[\lambda R\left(\lambda R+1\right)\right]^{1/2}$ **(D)** $\left[\frac{1}{\lambda R\left(\lambda R+1\right)}\right]^{1/2}$

7. The equivalent resistance between points A and B in the circuit shown in figure is:



(A) $\frac{R}{2}$ **(B)** $2R$ **(C)** $\frac{3R}{2}$ **(D)** $\frac{6R}{5}$

8. In a hydraulic lift at a service station, the radii of the large and small pistons are in the ratio of 20 : 1. What weight placed on the small piston will be sufficient to lift a car of mass 1200 kg?

(A) 3 kgf **(B)** 30 kgf **(C)** 300 kgf **(D)** 3000 kgf

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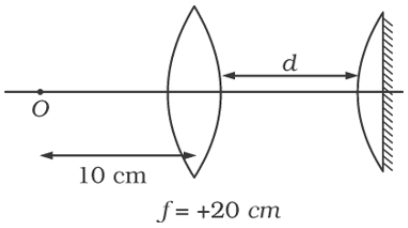
9. A convex lens of focal length 20 cm and another plano-convex lens of focal length 40 *cm* are placed co-axially. The plano-convex lens is silvered on plane surface. What should be the distance *d* (in cm) so that final image of the object 'O' is formed on O itself?



(A) 10 **(B)** 15
(C) 20 **(D)** 25

10. The average kinetic energy of translatory motion of hydrogen molecules at 27°C is $6.2\times10^{-21}J$. The average kinetic energy at 127°C will be:

(A) $30\times10^{-21}J$ **(B)** $8.27\times10^{-21}J$ **(C)** $1.2\times10^{-21}J$ **(D)** $3.1\times10^{-21}J$

11. If R_m is the radius of Moon orbiting round the Earth, a_m the acceleration of Moon towards the centre of Earth, and R_e the radius of Earth. Then a_m is equal to (if g is acceleration due to gravity on the surface of Earth)

(A) $\left(\frac{R_e}{R_m}\right)g$ **(B)** $\left(\frac{R_m}{R_e}\right)g$ **(C)** $\left(\frac{R_m}{R_e}\right)^2 g$ **(D)** $\left(\frac{R_e}{R_m}\right)^2 g$

12. If one mole of a monoatomic gas $\left(\gamma=\frac{5}{3}\right)$ is mixed with one mole of a triatomic gas $\left(\gamma=\frac{4}{3}\right)$, the value of γ for the mixture is:

(A) 1.40 **(B)** 1.44 **(C)** 1.53 **(D)** 3.07

13. Given below are two statements:
Statement I: A body in translatory motion is momentarily at rest when it reverses the direction.
Statement II: A body can not be accelerated if its velocity is zero at a given instant of time.
(A) Both statement I and statement II are true
(B) Both statement I and statement II are false
(C) Statement I is true but statement II is false
(D) Statement I is false but statement II is true

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14. The X-ray beam coming from an X-ray tube will be:

(A) Monochromatic

(B) having all wavelengths smaller than a certain maximum wavelength

(C) having all wavelengths larger than a certain minimum wavelength

(D) having all wavelengths lying between a minimum and a maximum wavelength

15. Green light of wavelength $5100\mathring{A}$ from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 3m away is 3 cm, then the double slit separation is:

(A) 0.051 mm **(B)** 0.51 mm **(C)** 5.1 mm **(D)** 5.1 cm

16. **Assertion:** An object moving with a velocity of magnitude 10 m/s is subjected to a uniform acceleration $2m/s^2$ at right angle to the initial motion. Its velocity after 5s has a magnitude nearly 14 m/s.

Reason: The equation $\vec{v} = \vec{u} + \vec{a}t$ can be applied to obtain $\vec{v}$ if $\vec{a}$ is constant.

(A) Both Assertion and Reason are correct and Reason is correct explanation of Assertion

(B) Both Assertion and Reason are correct but Reason is not correct explanation of Assertion

(C) Assertion is correct but Reason is incorrect

(D) Assertion is incorrect and Reason is correct

17. In a photoelectric cell, the wavelength of incident light is changed from $4000\mathring{A}\ to\ 3600\mathring{A}$. The change in stopping potential will be:

(A) 1.14 V **(B)** 0.24 V **(C)** 0.35 V **(D)** 0.44 V

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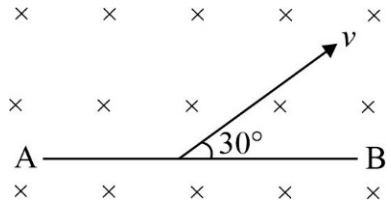
18. A conducting rod AB of length $l = 1\ m$ is moving at a velocity $v = 4\ m/s$ making an angle 30° with its length. A uniform magnetic field $B = 2T$ exists in a direction perpendicular to the plane of motion. Then:



(A) $V_A - V_B = 8V$ **(B)** $V_A - V_B = 4V$ **(C)** $V_B - V_A = 8V$ **(D)** $V_B - V_A = 4V$

19. The rear side of a truck is open and a box of mass 20 kg is placed on the truck 4m away from the open end. If $\mu = 0.15$ and $g = 10\ ms^{-2}$ and the truck starts from rest with an acceleration of $2m\ s^{-2}$ on a straight road, then the box will fall off the truck when the truck is at a distance of x metre from the starting point. The value of *x* is:

(A) 4 **(B)** 8 **(C)** 16 **(D)** 32

20. The magnetic field in a plane electromagnetic wave is given by:

$B_y = 2\times10^{-7}\sin\left(\pi\times10^3 x + 3\pi\times10^{11}t\right)T$. Calculate the wavelength.

(A) $\pi\times10^{-3}m$ **(B)** $2\times10^{-3}m$ **(C)** $2\times10^{3}m$ **(D)** $\pi\times10^{3}m$

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SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

1. An rms voltage of 110V is applied across a series circuit having a resistance 11Ω and impedance 22Ω. The power consumed is _____ watt.

2. The frequency of a sonometer wire is 100 Hz. Another sonometer wire of same material but double the length has a frequency 75 Hz. The ratio of tensions in the first wire to the second wire is $\frac{4}{k}$. Find the value of *k*.

3. The value of wavelength of radiation emitted due to transition of electrons from $n=4$ to $n=2$ state in hydrogen atom will be $\frac{16}{xR}$ (where R is Rydberg constant). Find the value of *x*.

4. A metal wire carries a charge of 1200 C in 20 minutes. If the area of the cross-section of the wire is $25\ mm^2$ and the material of the metal contains 6.0×10^{22} free electrons/cm^3, the drift velocity of the electrons in the wire is $4.2\times10^{-p}\ m/s$. Find the value of p.

5. A uniform metal rod of $2\ mm^2$ cross-section fixed at both the ends is heated from $0°C$ to $20°C$. The coefficient of linear expansion of the rod is 12×10^{-6} per $°C, Y=10^{11}N/m^2$. The energy stored per unit volume of the rod is _____ Jm^{-3}.

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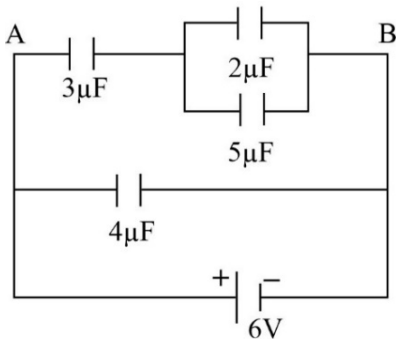
6. An inclined plane makes an angle of 30° with the horizontal. A solid sphere rolling down on this inclined plane from rest without slipping, has a linear acceleration equal to $\frac{xg}{14}$. Find the value of *x*.

7. A 1kg block moving with a velocity of $4\ ms^{-1}$ collides with a stationary 2kg block. The lighter block comes to rest after the collision. Find loss of kinetic energy of the system in joule.

8. A circuit is shown in figure. Find the charge (in μC) on the condenser having a capacity of $5\ \mu F$.



9. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in glass. A point object *P* placed in air is found to have a real image *Q* in the glass. The line *PQ* cuts the surface at a point *O* and *PO* = *OQ*. The distance *PO* is equal to *aR*. Find the value of a.

10. The magnetic moment of a current carrying loop is $2.1\times10^{-25}\ Am^2$. The magnetic field at a point on its axis at a distance of $1\mathring{A}$ is $x\times10^{-3}$ weber/m^2. Find the value of *x*.

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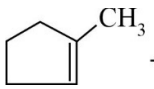
PART II : CHEMISTRY	MARKS: 100

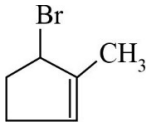
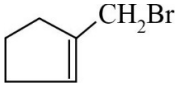
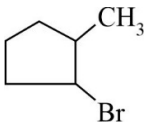
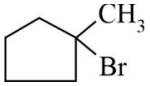
SECTION 1

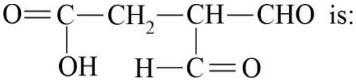
This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. 6g of NaCl was dissolved in water and then treated with excess of silver nitrate solution. If it gives 14 g of AgCl then % purity of NaCl solution would be:

(A) 95% **(B)** 85% **(C)** 75% **(D)** 65%

2.  ?, Major product of the reaction is:

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

3. The correct IUPAC name of the following compound  is:

(A) 3-Formyl-3-oxopropanoic acid **(B)** 3-Formyl-4-oxobutanoic acid

(C) 3, 3-Dioxopropanoic acid **(D)** 3, 3-Dicarbaldehydepropanoic acid

4. 2 mole of an ideal gas at 27°C expands isothermally and reversibly from a volume of 4 litre to 40 litre. The work done (in kJ) by the gas is:

(A) $w = -28.72$ kJ **(B)** $w = -11.488$ kJ

(C) $w = -5.736$ kJ **(D)** $w = -4.988$ kJ

SPACE FOR ROUGH WORK

5. Given below are two statements:

Statement I: Phenolphthalein is a weak organic base.

Statement II: The ionized form of Phenolphthalein is colourless.

In the light of the above statement, choose the most appropriate answer from the options given below:

(A) Statement I is correct but Statement II is incorrect

(B) Statement I is incorrect but statement II is correct

(C) Both Statement I and Statement II are incorrect

(D) Both statement I and Statement II are correct

6. Given below are two statements:

Statement I- In redox titration, the $KMnO_4$ acts as self indicator.

Statement II- In titration of weak acid versus strong base, pH at equivalence point is greater than 7

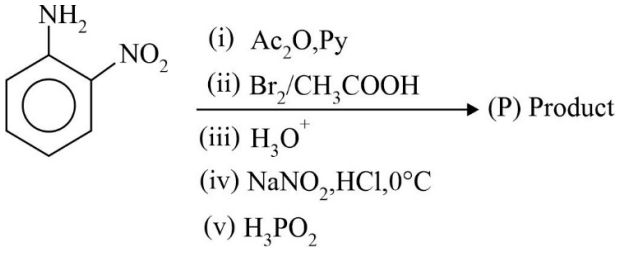
(A) Both statement I and statement II are correct

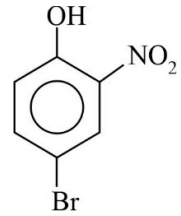
(B) Statement I is incorrect but Statement II is correct

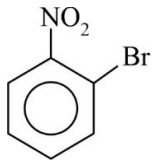
(C) Statement I is correct but Statement II is incorrect

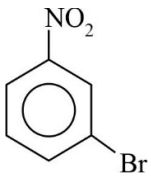
(D) Both Statement I and statement II are incorrect

7. The product (P) formed from the following multistep reaction is:



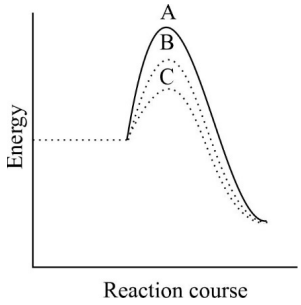
(A) 

(B) 

(C) 

(D) 

8. A homogeneous catalytic reaction takes place through the three alternative plots A, B and C shown in the given figure. Which one of the following indicates the relative ease with which the reaction can take place?



(A) A > B > C **(B)** C > B > A

(C) A > C > B **(D)** A = B = C

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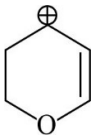
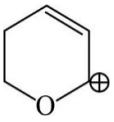
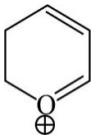
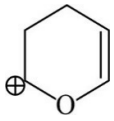
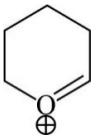
9. Most stable resonating structure of cation  is:

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

10. Choose the correct code of characteristics for the given order of hybrid orbitals of same atom,

$sp < sp^2 < sp^3$

(i) Electronegativity (ii) Bond angle between same hybrid orbitals

(iii) Size (iv) Energy level

(A) (ii), (iii) and (iv) **(B)** (iii), (iv)

(C) (ii) and (iv) **(D)** (i), (ii), (iii) and (iv)

11. Match List-I and List-II:

List-I (Complex ion)		**List-II** (Orbital involve in hybridization by central metal)	
(I)	$[NiCl_4]^{2-}$	**(p)**	$3d_{z^2}, 3d_{x^2-y^2}$
(II)	$[Ni(NH_3)_6]^{2+}$	**(q)**	$4d_{z^2}, 4d_{x^2-y^2}$
(III)	$[Ni(CN)_4]^{2-}$	**(r)**	Two 4p-orbitals
(IV)	$[Fe(CN)_6]^{3-}$	**(s)**	No d-orbital

Select **CORRECT** code of your answer.

	I	**II**	**III**	**IV**		**I**	**II**	**III**	**IV**
(A)	p	q	r	s	**(B)**	p	r	s	q
(C)	s	r	q	p	**(D)**	s	q	r	p

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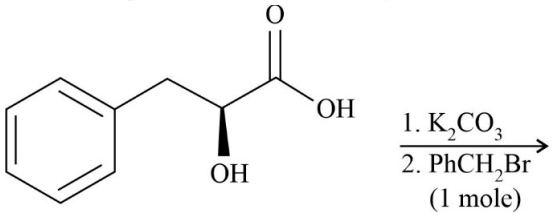
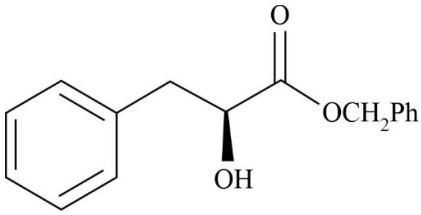
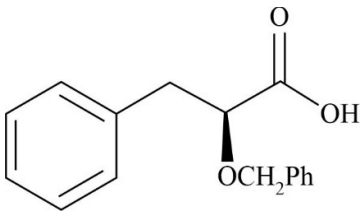
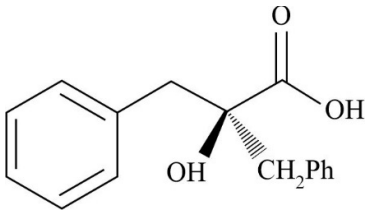
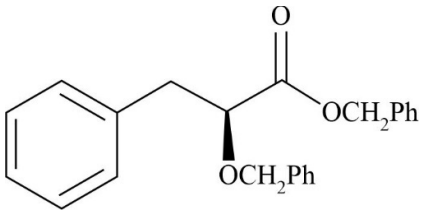
12. The major product in the following reaction



(A)


(B)


(C)


(D)


13. The incorrect statement regarding 15^{th} group hydrides (EH_3). [E = N, P, As, Sb, Bi]

(A) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$: Thermal stability

(B) $N-H > P-H > As-H > Sb-H > Bi-H : E-H$ bond dissociation enthalpy

(C) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$: Reducing character

(D) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$: Basicity

14. Given below are two statements: One is labelled as
Assertion A and the other is labelled as Reason R
Assertion (A) : The first ionization enthalpy of aluminium is lower than that of magnesium.
Reason (R): Ionic radius of Al^{3+} is smaller than that of Mg^{2+}.
In the light of above statements, choose the correct answer from the options given below.

(A) Both A and R are true and R is the correct explanation of A.

(B) A is true but R is false.

(C) A is false but R is true

(D) Both A and R are true but R is NOT the correct explanation of A

SPACE FOR ROUGH WORK

15. Match the column I with column II and select the correct option:

	Column-I		**Column-II**
(I)	Nucleoside	**(p)**	Sugar + base + phosphoric acid group
(II)	Nucleotide	**(q)**	Cytosine + uracil
(III)	DNA	**(r)**	Sugar + base
(IV)	RNA	**(s)**	Cytosine + thymine

(A) $(I) \rightarrow (r); (II) \rightarrow (p); (III) \rightarrow (s); (IV) \rightarrow (q)$

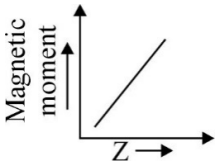
(B) $(I) \rightarrow (p); (II) \rightarrow (r); (III) \rightarrow (s); (IV) \rightarrow (q)$

(C) $(I) \rightarrow (p); (II) \rightarrow (r); (III) \rightarrow (q); (IV) \rightarrow (s)$

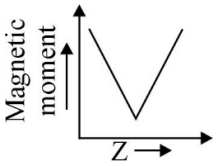
(D) $(I) \rightarrow (r); (II) \rightarrow (p); (III) \rightarrow (q); (IV) \rightarrow (s)$

16. Which of the following graph is the most appropiate representation between atomic number (Z) and magnetic moment of d-block elements while moving from left to right in 4^{th} period?

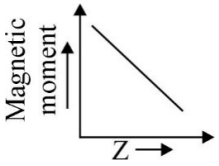
(A)



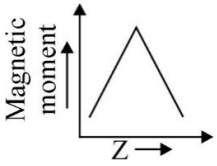
(B)



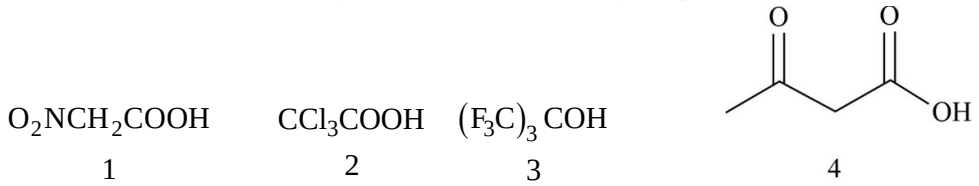
(C)



(D)



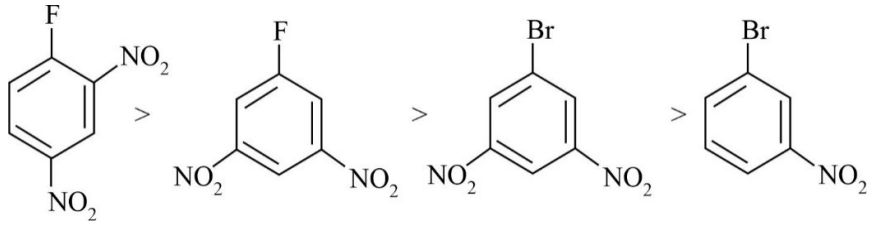
17. The correct order of decreasing acidity for the following compound is:

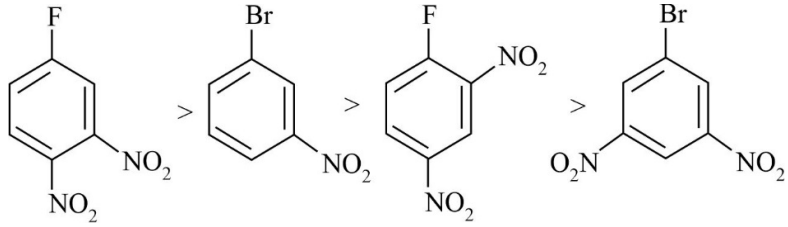


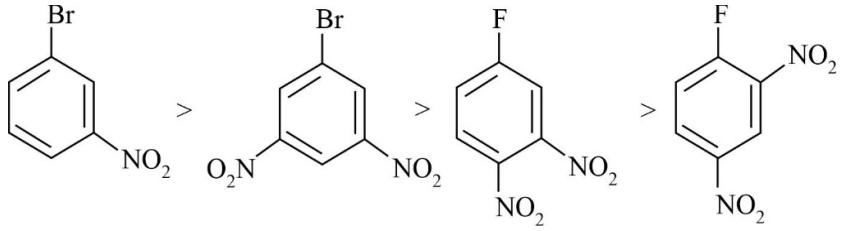
(A) 1 > 3 > 2 > 4 **(B)** 3 > 1 > 2 > 4 **(C)** 2 > 1 > 4 > 3 **(D)** 3 > 1 > 4 > 2

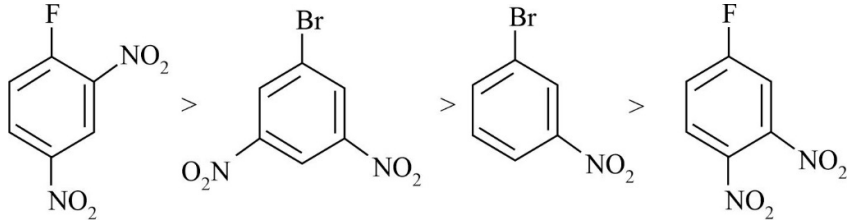
SPACE FOR ROUGH WORK

18. Which of the following correctly ranks the aryl halides in decreasing order of reactivity toward sodium methoxide in methanol?

(A) 

(B) 

(C) 

(D) 

19. The common oxidation state of the elements of lanthanide series is:

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

20. A compound 'X' when treated with chloral in presence of concentrated H_2SO_4 yields 'Y'. 'Y' act as disinfectant. 'X' and 'Y' are respectively:

(A) Chlorobenzene, DDT **(B)** Phenol, DDT

(C) Salicylaldehyde, Phenolphthalein **(D)** Chlorobenzene, Chloropicrin

SPACE FOR ROUGH WORK

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

1. The molar solubility of $Ag_2CO_3\left(K_{sp} = 4\times10^{-13}\right)$ in 0.1 M Na_2CO_3 solution is 10^{-x} then value of x is _____.

2. At 300 K, the half-life of a sample of a gaseous compound initially at 1 atm is 100 sec. When the pressure is 0.5 atm, the half-life is 50 sec. The order of reaction is _____.

3. The number of atomic orbitals from the following having at least one angular node
7s, 7p, 6s, 8p, 8d.

4. x g sample of an organic compound (Molar mass $80\,g\,mol^{-1}$) is burnt in a Bomb calorimeter. The temperature of calorimeter increase by 4°C. The heat capacity of the system is 1.25 kJ/°C. Calculate the value of *x*. Given molar heat of combustion of the compound at constant volume is $400\ kJ\ mol^{-1}$.

5. Among $SF_3Cl, XeO_2F_2, [ICl_4]^-, [NH_4]^+, [ICl_6]^-, XeO_3, SF_4, [XeF_5]^+$ and $[XeO_6]^{4-}$, the total number of species having sp^3d hybridized central atom is _____.

SPACE FOR ROUGH WORK

6. For a sparingly soluble salt AB_2, concentration of AB_2 in aqueous solution is written as $y \times 10^{-3}$M. If saturated aqueous solution shows elevation in boiling point equal to 0.0065 K then find 'y'.

[Given : Molal elevation constant (K_b) of $H_2O = 0.5K - kg/mol$, solubility product of AB_2 is 2.56×10^{-7}]

7. The sum of oxidation state of the metals in $V_2O_5, Mn_2(CO)_{10}, MnO_2$ is _____.

8. The observed magnetic moment of the complex $\left[Pt(SCN)_2(OX)_2\right]^{x-}$ is zero B.M. The numerical value of x is _____.

9. The number of incorrect statements regarding cathode in a voltaic cell is _____.

(A) It may gain weight during reaction

(B) Electrons flow to it through the external circuit

(C) It is where oxidation occurs

(D) It receives electrons from ions in solution

10. The maximum number of atoms that can be in same plane in a molecule of B_2H_6 are _____.

SPACE FOR ROUGH WORK

PART III : MATHEMATICS	MARKS: 100

SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE CHOICE is correct.

1. If $\frac{3}{2+\cos\theta+i\sin\theta}=a+ib$, then $(a-2)^2+b^2$ equal to λ, then range of $\frac{1}{\lambda-2\sin\alpha}$ is:

(A) $(0,\infty)$ **(B)** $(-\infty,1]\cup[3,\infty)$

(C) $(-\infty,-1]\cup\left[\frac{1}{3},\infty\right)$ **(D)** $[2,4]\cup[5,\infty)$

2. The reflection of the point P(1, 0, 0) in the line $\frac{x-1}{2}=\frac{y+1}{-3}=\frac{z+10}{8}$ is:

(A) $(3,-4,-2)$ **(B)** $(5,-8,-4)$ **(C)** $(1,-1,-10)$ **(D)** $(2,-3,-8)$

3. If $A=\begin{pmatrix}a & b\\ c & d\end{pmatrix}$ is such that $|A|=0$ and $A^2-(a+d)A+kI=0$, then k is equal to:

(A) $b+c$ **(B)** $a+d$ **(C)** $ab+cd$ **(D)** 0

4. If $\vec{a}$ and $\vec{b}$ are vectors such that $\left|\vec{a}+\vec{b}\right|=\sqrt{29}$ *and* $\vec{a}\times\left(2\hat{i}+3\hat{j}+4\hat{k}\right)=\left(2\hat{i}+3\hat{j}+4\hat{k}\right)\times\vec{b}$, then a possible value of $\left(\vec{a}+\vec{b}\right)\cdot(-7i+2j+3k)$ is:

(A) 0 **(B)** 3 **(C)** 4 **(D)** 8

5. The coefficient of t^{50} in $\left(1+t^2\right)^{25}\left(1+t^{25}\right)\left(1+t^{40}\right)\left(1+t^{45}\right)\left(1+t^{47}\right)$ is:

(A) $1+{}^{25}C_5$ **(B)** $1+{}^{25}C_5+{}^{25}C_7$

(C) $1+{}^{25}C_7$ **(D)** 1

SPACE FOR ROUGH WORK

6. If common chord of the circle C with centre at (2, 1) and radius r and the circle $x^2 + y^2 - 2x - 6y + 6 = 0$ is a diameter of the second circle, then value of *r* is:

(A) 3 **(B)** 2 **(C)** $\frac{3}{2}$ **(D)** 1

7. If 1, $\log_y x, \log_z y, -15\log_x z$ are in A.P., then:

(A) $z^3 = x$ **(B)** $x = y^{-2}$ **(C)** $z^{-2} = y$ **(D)** $x = y$

8. Let $f(x) = \left\{\frac{\log(1+x)^{1+x}}{x^2} - \frac{1}{x}\right\}$. If function f is continuous at $x = 0$ then

$1 + 2f(0) + 3f^2(0) + 4f^3(0)....\infty$ is:

(A) 1 **(B)** $\frac{1}{2}$ **(C)** $\frac{1}{4}$ **(D)** 4

9. The number of ways in which we can arrange 4 letters of the word MATHEMATICS is given by:

(A) 136 **(B)** 2454 **(C)** 1680 **(D)** 192

10. Let S denote the sum of all the values of θ $(0 \le \theta \le 2\pi)$ for which the system of equations

$(1+\lambda)x_1 + x_2 + x_3 = 1$

$x_1 + (1+\lambda)x_2 + x_3 = \lambda$

$x_1 + x_2 + (1+\lambda)x_3 = \lambda^2$

is inconsistent where $\tan\theta = \frac{\lambda}{3}$. Then S is:

(A) 3π **(B)** $\frac{5\pi}{4}$ **(C)** $\frac{9\pi}{4}$ **(D)** $\frac{11\pi}{2}$

SPACE FOR ROUGH WORK

11. A line makes angles α, β, γ with the coordinate axes. If $\alpha + \beta = \frac{\pi}{2}$, then $\left(\cos\alpha + \cos\beta + \cos\gamma\right)^2$ is equal to:

(A) $1+\sin 2\alpha$ **(B)** $1+\cos 2\alpha$ **(C)** $1-\sin 2\alpha$ **(D)** $1-\cos 2\alpha$

12. If $4\hat{i}+7\hat{j}+8\hat{k},\ 2\hat{i}+3\hat{j}+4\hat{k}$ *and* $2\hat{i}+5\hat{j}+7\hat{k}$ are the position vectors of the vertices A, B and C, respectively, of triangle ABC, then the position vector of the point where the bisector of angle A meets BC is:

(A) $\frac{2}{3}\left(-6\hat{i}-8\hat{j}-6\hat{k}\right)$ **(B)** $\frac{2}{3}\left(6\hat{i}+8\hat{j}+6\hat{k}\right)$

(C) $\frac{1}{3}\left(6\hat{i}+13\hat{j}+18\hat{k}\right)$ **(D)** $\frac{1}{3}\left(5\hat{j}+12\hat{k}\right)$

13. In the expansion of $\left(\frac{1}{x^2}-x^3\right)^n, n \in N,$ if the sum of the coefficients of x^5 and x^{10} is 0 (which itself are non zero), then term independent of x in the expansion of $\left(x^2+\frac{1}{x^2}+2\right)^n$ is:

(A) $\frac{20!}{(10!)^2}$ **(B)** $\frac{1.3.5....15}{2^{15}}$ **(C)** $\frac{30!}{(10!)^2}$ **(D)** $\frac{30!}{(15!)^2}$

14. The relation R given by $\left\{(x,y): x^2-3xy+2y^2=0, \forall x,\ y \in R\right\}$ is:

(A) reflexive but not symmetric **(B)** symmetric but not transitive
(C) symmetric and transitive **(D)** an equivalence relation

15. Three numbers are chosen at random from the set of integers 1, 2, 3, …., 39. Then probability that number are in AP is:

(A) $\frac{1}{247}$ **(B)** $\frac{2}{247}$ **(C)** $\frac{19}{481}$ **(D)** $\frac{5}{741}$

SPACE FOR ROUGH WORK

16. $\int a^x \left(\ln x + \ln a . \ln \left(\frac{x}{e} \right)^x \right) dx =$

(A) $a^x \ln \left(\frac{e}{x} \right)^{2x} + C$ **(B)** $a^x \ln \left(\frac{x}{e} \right)^x + C$

(C) $a^x + \ln \left(\frac{x}{e} \right)^x + C$ **(D)** $a^x \ln (ex)^x + C$

17. The value of the expression $\left(2\sin^2 91° - 1\right)\left(2\sin^2 92° - 1\right)....\left(2\sin^2 180° - 1\right)$ is equal to:

(A) 0 **(B)** 1 **(C)** 2^{90} **(D)** $2^{90} - 90$

18. PSQ is a focal chord of a parabola whose focus is S and vertex is A. PA and QA are produced to meet the directrix in R and T, respectively. Then $\angle RST =$

(A) 30° **(B)** 90° **(C)** 60° **(D)** 45°

19. Consider the triangles with vertices A(2, 1), B(0, 0) and C(t, 4), t = [0, 4]. If the maximum and the minimum perimeters of such triangles are obtained at $t = \alpha$ *and* $t = \beta$ respectively then $6\alpha + 21\beta$ is equal to:

(A) 27 **(B)** 33 **(C)** 39 **(D)** 48

20. A number equal to 2 times the mean and with a frequency equal to k is inserted in a data having n observations. If the new mean is $\frac{4}{3}$ times the old mean, then the value of $\frac{k}{n}$ is:

(A) 1 **(B)** 2 **(C)** $\frac{1}{3}$ **(D)** $\frac{1}{2}$

SPACE FOR ROUGH WORK

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

1. Let $f(x)=\frac{9^x}{9^x+3}$ then the value of $f\left(\frac{1}{1996}\right)+f\left(\frac{2}{1996}\right)+f\left(\frac{3}{1996}\right)+...+f\left(\frac{1995}{1996}\right)$ is k then $\left|k-\frac{1}{2}\right|$ will be _____.

2. If x_1, x_2, x_3 are such that $x_1+x_2+x_3=2$

$x_1^2+x_2^2+x_3^2=6$

$x_1^3+x_2^3+x_3^3=8$

then value of $\left|(x_2-x_3)(x_3-x_1)(x_1-x_2)\right|$ is _____.

3. The perpendicular bisector of a line segment with end point (1, 2, 6) and (–3, 6, 2) passes through (–6, 2, 4) and has the equation of the form $\frac{x+6}{l}=\frac{y-2}{m}=\frac{z-4}{n}$ (where l, m, n are integers, l is a prime number and $l > 0$), then the value of $(l+m+n)-lmn$ equals to _____.

4. The domain of definition of the function $f(x)=\sqrt{\log_{(|x|-1)}\left(x^2+4x+4\right)}$, is $(-\infty, a]\cup(b,c)\cup(d,\infty)$ then $|a+b+c+d|=$_____.

5. If the area bounded by $y=x^2$ *and* $y=\frac{2}{1+x^2}$ is $\left(K_1\pi-\frac{K_2}{3}\right)$*sq.* units (where $K_1, K_2 \in Z$), then the value of (K_1+K_2) is equal to _____.

SPACE FOR ROUGH WORK

6. In an increasing sequence of four positive integers, the first 3 terms are in A.P., the last 3 terms are in G.P. and the fourth term exceed the first term by 30, then the common difference of A.P. lying in interval [1, 9] is _____.

7. Let $\frac{dy}{dx}=\frac{y\phi'(x)-y^2}{\phi(x)}$, where $\phi(x)$ is a specified function satisfying $\phi(1)=1,\phi(4)=1296$. If $y(1)=1$ then $\frac{1}{81}y(4)$ is equal to _____.

8. If $\int_{200\pi}^{0}[\sin x+\cos x]dx=A\pi$ and [x] denotes the greatest integer function than A is equal to _____.

9. If the parabola $x^2=4y$ and the circle $x^2+(y-7)^2=r^2$ have maximum number of common chords, then least value of [r] ([x] denotes the greatest integer $\le x$).

10. If the function $f(x)=x^3+e^{\frac{x}{2}}$ *and* $g(x)=f^{-1}(x)$, then the value of $g'(1)$ is _____.

SPACE FOR ROUGH WORK

End of 2024-Mock JEE Main - 2