



JEE Main – 2024

1st February 2024 (Evening Shift)

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300**.
2. The question paper consists of **3 Subjects** (Subject I: **Mathematics**, Subject II: **Physics**, Subject III: **Chemistry**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (1), (2), (3) and (4), 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.

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

- Let α and β be the roots of the equation $px^2 + qx - r = 0$, where $p \neq 0$. If p, q and r be the consecutive terms of a non constant G.P. and $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{3}{4}$, then the value of $(\alpha - \beta)^2$ is:
 (1) $\frac{80}{9}$ (2) $\frac{20}{3}$ (3) 9 (4) 8
- If the mirror image of the point $P(3, 4, 9)$ in the line $\frac{x-1}{3} = \frac{y+1}{2} = \frac{z-2}{1}$ is (α, β, γ) , then $14(\alpha + \beta + \gamma)$ is:
 (1) 138 (2) 132 (3) 102 (4) 108
- Let Ajay will not appear in JEE exam with probability $p = \frac{2}{7}$, while both Ajay and Vijay will appear in the exam with probability $q = \frac{1}{5}$. Then the probability, that Ajay will appear in the exam and Vijay will appear is:
 (1) $\frac{18}{35}$ (2) $\frac{9}{35}$ (3) $\frac{3}{35}$ (4) $\frac{24}{35}$
- Let α be a non-zero real number. Suppose $f: \mathbf{R} \rightarrow \mathbf{R}$ is a differentiable function such that $f(0) = 2$ and $\lim_{x \rightarrow -\infty} f(x) = 1$. If $f'(x) = \alpha f(x) + 3$, for all $x \in \mathbf{R}$, then $f(-\log_e 2)$ is equal to _____.
 (1) 5 (2) 3 (3) 9 (4) 7
- The number of solutions of the equation $4 \sin^2 x - 4 \cos^3 x + 9 - 4 \cos x = 0; x \in [-2\pi, 2\pi]$ is:
 (1) 0 (2) 1 (3) 3 (4) 2
- Let P and Q be the points on the line $\frac{x+3}{8} = \frac{y-4}{2} = \frac{z+1}{2}$ which are at a distance of 6 units from the point R (1, 2, 3). If the centroid of the triangle PQR is (α, β, γ) , then $\alpha^2 + \beta^2 + \gamma^2$ is:
 (1) 24 (2) 36 (3) 26 (4) 18
- Consider 10 observations x_1, x_2, \dots, x_{10} such that $\sum_{i=1}^{10} (x_i - \alpha) = 2$ and $\sum_{i=1}^{10} (x_i - \beta)^2 = 40$, where α, β are positive integers. Let the mean and the variance of the observations be $\frac{6}{5}$ and $\frac{84}{25}$ respectively. Then $\frac{\beta}{\alpha}$ is equal to:
 (1) $\frac{3}{2}$ (2) 2 (3) $\frac{5}{2}$ (4) 1
- Consider the relations R_1 and R_2 defined as $aR_1b \Leftrightarrow a^2 + b^2 = 1$ for all $a, b \in \mathbf{R}$ and $(a, b)R_2(c, d) \Leftrightarrow a + d = b + c$ for all $(a, b), (c, d) \in \mathbf{N} \times \mathbf{N}$. Then:
 (1) Neither R_1 nor R_2 is an equivalence relation
 (2) Only R_2 is an equivalence relation
 (3) Only R_1 is an equivalence relation
 (4) R_1 and R_2 both are equivalence relations

9. Let m and n be the coefficients of seventh and thirteenth terms respectively in the expansion of $\left(\frac{1}{3}x^{\frac{1}{3}} + \frac{1}{2x^3}\right)^{18}$. Then $\left(\frac{n}{m}\right)^{\frac{1}{3}}$ is:
- (1) $\frac{9}{4}$ (2) $\frac{4}{9}$ (3) $\frac{1}{4}$ (4) $\frac{1}{9}$
10. Let the system of equations $x + 2y + 3z = 5, 2x + 3y + z = 9, 4x + 3y + \lambda z = \mu$ have infinite number of solutions. Then $\lambda + 2\mu$ is equal to:
- (1) 28 (2) 17 (3) 22 (4) 15
11. The value of $\int_0^1 (2x^3 - 3x^2 - x + 1)^{\frac{1}{3}} dx$ is equal to:
- (1) -1 (2) 2 (3) 0 (4) 1
12. Let the locus of the midpoints of the chords of the circle $x^2 + (y - 1)^2 = 1$ drawn from the origin intersect the line $x + y = 1$ at P and Q. Then, the length of PQ is:
- (1) 1 (2) $\frac{1}{\sqrt{2}}$ (3) $\frac{1}{2}$ (4) $\sqrt{2}$
13. Let $f(x) = \begin{cases} x-1, & x \text{ is even,} \\ 2x, & x \text{ is odd,} \end{cases} x \in \mathbf{N}$. If for some $a \in \mathbf{N}$, $f(f(f(a))) = 21$, then $\lim_{x \rightarrow a^-} \left\{ \frac{|x|^3}{a} - \left\lfloor \frac{x}{a} \right\rfloor \right\}$, where $[t]$ denotes the greatest integer less than or equal to t , is equal to:
- (1) 225 (2) 121 (3) 169 (4) 144
14. Let $f(x) = |2x^2 + 5|x| - 3|, x \in \mathbf{R}$. If m and n denote the number of points where f is **not** continuous and **not** differentiable respectively, then $m + n$ is equal to:
- (1) 5 (2) 2 (3) 0 (4) 3
15. If the domain of the function $f(x) = \frac{\sqrt{x^2 - 25}}{(4 - x^2)} + \log_{10}(x^2 + 2x - 15)$ is $(-\infty, \alpha) \cup [\beta, \infty)$, then $\alpha^2 + \beta^3$ is equal to:
- (1) 150 (2) 175 (3) 125 (4) 140
16. If $\int_0^{\frac{\pi}{3}} \cos^4 x \, dx = a\pi + b\sqrt{3}$, where a and b are rational numbers, then $9a + 8b$ is equal to:
- (1) 2 (2) 1 (3) $\frac{3}{2}$ (4) 3
17. Let S_n denote the sum of the first n terms of an arithmetic progression. If $S_{10} = 390$ and the ratio of the tenth and the fifth terms is $15 : 7$, then $S_{15} - S_5$ is equal to:
- (1) 790 (2) 690 (3) 800 (4) 890
18. If z is a complex number such that $|z| \geq 1$, then the minimum value of $\left| z + \frac{1}{2}(3 + 4i) \right|$ is:
- (1) $\frac{5}{2}$ (2) 3 (3) $\frac{3}{2}$ (4) 2

- 19.** Let P be a point on the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$. Let the line passing through P and parallel to y -axis meet the circle $x^2 + y^2 = 9$ at point Q such that P and Q are on the same side of the x -axis. Then, the eccentricity of the locus of the point R on PQ such that $PR : RQ = 4 : 3$ as P moves on the ellipse, is:

(1) $\frac{13}{21}$ (2) $\frac{\sqrt{139}}{23}$ (3) $\frac{\sqrt{13}}{7}$ (4) $\frac{11}{19}$

- 20.** Consider a $\triangle ABC$ where $A(1, 3, 2)$, $B(-2, 8, 0)$ and $C(3, 6, 7)$. If the angle bisector of $\angle BAC$ meets the line BC at D, then the length of the project of the vector \vec{AD} on the vector \vec{AC} is:

(1) $\frac{\sqrt{38}}{2}$ (2) $\sqrt{19}$ (3) $\frac{39}{2\sqrt{38}}$ (4) $\frac{37}{2\sqrt{38}}$

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.

- 21.** The lines L_1, L_2, \dots, L_{20} are distinct. For $n = 1, 2, 3, \dots, 10$ all the lines L_{2n-1} are parallel to each other and all the lines L_{2n} pass through a given P. The maximum number of points of intersection of pairs of lines from the set $\{L_1, L_2, \dots, L_{20}\}$ is equal to _____.
- 22.** Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = -\hat{i} - 8\hat{j} + 2\hat{k}$ and $\vec{c} = 4\hat{i} + c_2\hat{j} + c_3\hat{k}$ be three vectors such that $\vec{b} \times \vec{a} = \vec{c} \times \vec{a}$. If the angle between vector \vec{c} and the vector $3\hat{i} + 4\hat{j} + \hat{k}$ is θ , then the greatest integer less than or equal to $\tan^2 \theta$ is _____.
- 23.** If $\frac{dx}{dy} = \frac{1+x-y^2}{y}$, $x(1) = 1$, then $5x(2)$ is equal to _____.
- 24.** Let $f : (0, \infty) \rightarrow \mathbf{R}$ and $F(x) = \int_0^x t f(t) dt$. If $F(x^2) = x^4 + x^5$, then $\sum_{r=1}^{12} f(r^2)$ is equal to _____.
- 25.** Three points $O(0,0), P(a, a^2), Q(-b, b^2), a > 0, b > 0$, are on the parabola $y = x^2$. Let S_1 be the area of the region bounded by the line PQ and the parabola, and S_2 be the area of the triangle OPQ. If the minimum value of $\frac{S_1}{S_2}$ is $\frac{m}{n}$, $\gcd(m, n) = 1$, then $m + n$ is equal to _____.
- 26.** Let $A = I_2 - 2MM^T$ where M is a real matrix of order 2×1 such that the relation $M^T M = I_1$ holds. If λ is a real number such that the relation $AX = \lambda X$ holds for some non-zero real matrix X of order 2×1 , then the sum of squares of all possible values of λ is equal to _____.
- 27.** The sum of squares of all possible values of k , for which area of the region bounded by the parabolas $2y^2 = kx$ and $2y^2 = 2(y - x)$ is maximum, is equal to _____.
- 28.** If three successive terms of G.P. with common ratio $r(r > 1)$ are the lengths of the sides of a triangle and $[r]$ denotes the greatest integer less than or equal to r , then $3[r] + [-r]$ is equal to _____.
- 29.** If $y = \frac{(\sqrt{x} + 1)(x^2 - \sqrt{x})}{x\sqrt{x} + x + \sqrt{x}} + \frac{1}{15}(3\cos^2 x - 5)\cos^3 x$, then $96y' \left(\frac{\pi}{6} \right)$ is equal to _____.
- 30.** Let ABC be an isosceles triangle in which A is at $(-1, 0)$, $\angle A = \frac{2\pi}{3}$, $AB = AC$ and B is on the positive x-axis. If $BC = 4\sqrt{3}$ and the line BC intersects the line $y = x + 3$ at (α, β) then $\frac{\beta^4}{\alpha^2}$ is _____.

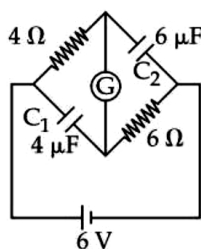
SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

31. Conductivity of a photodiode starts changing only if the wavelength of incident light is less than 660 nm. The band gap of photodiode is found to be $\left(\frac{X}{8}\right)eV$. The value of X is:

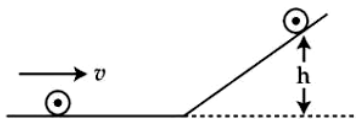
(Given, $h = 6.6 \times 10^{-34} \text{ Js}$, $e = 1.6 \times 10^{-19} \text{ C}$)

- (1) 11 (2) 13 (3) 21 (4) 15
32. A diatomic gas ($\gamma = 1.4$) does 200 J of work when it is expanded isobarically. The heat given to the gas in the process is:
- (1) 700 J (2) 600 J (3) 800 J (4) 850 J
33. In an ammeter, 5% of the main current passes through the galvanometer. If resistance of the galvanometer is G, the resistance of ammeter will be:
- (1) $\frac{G}{199}$ (2) 199 G (3) 200 G (4) $\frac{G}{200}$
34. A galvanometer (G) of 2Ω resistance is connected in the given circuit. The ratio of charge stored in C_1 and C_2 is:

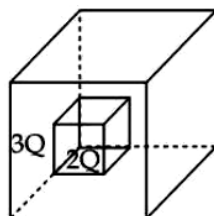


- (1) 1 (2) $\frac{1}{2}$ (3) $\frac{3}{2}$ (4) $\frac{2}{3}$
35. From the statements given below:
- (A) The angular momentum of an electron in n^{th} orbit is an integral multiple of \hbar .
- (B) Nuclear forces do not obey inverse square law.
- (C) Nuclear forces are spin dependent.
- (D) Nuclear forces are central and charge independent.
- (E) Stability of nucleus is inversely proportional to the value of packing fraction.
- Choose the **correct** answer from the options given below:
- (1) (A), (C), (D), (E) only (2) (A), (B), (C), (E) only
- (3) (A), (B), (C), (D) only (4) (B), (C), (D), (E) only
36. A body of mass 4 kg experiences two forces $\vec{F}_1 = 5\hat{i} + 8\hat{j} + 7\hat{k}$ and $\vec{F}_2 = 3\hat{i} - 4\hat{j} - 3\hat{k}$. The acceleration acting on the body is:
- (1) $4\hat{i} + 2\hat{j} + 2\hat{k}$ (2) $2\hat{i} + \hat{j} + \hat{k}$ (3) $2\hat{i} + 3\hat{j} + 3\hat{k}$ (4) $-2\hat{i} - \hat{j} - \hat{k}$

37. A disc of radius R and mass M is rolling horizontally without slipping with speed v . It then moves up an inclined smooth surface as shown in figure. The maximum height that the disc can go up the incline is:

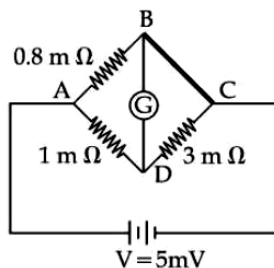


- (1) $\frac{3v^2}{4g}$ (2) $\frac{v^2}{g}$ (3) $\frac{1}{2} \frac{v^2}{g}$ (4) $\frac{2}{3} \frac{v^2}{g}$
38. In a metre-bridge when a resistance in the left gap is 2Ω and unknown resistance in the right gap, the balance length is found to be 40 cm. On shunting the unknown resistance with 2Ω , the balance length changes by:
- (1) 22.5 cm (2) 62.5 cm (3) 65 cm (4) 20 cm
39. A cricket player catches a ball of mass 120 g moving with 25 m/s speed. If the catching process is completed in 0.1 s then the magnitude of force exerted by the ball on the hand of player will be:
(in SI unit):
- (1) 12 (2) 30 (3) 25 (4) 24
40. If frequency of electromagnetic wave is 60 MHz and it travels in air along z direction then the corresponding electric and magnetic field vectors will be mutually perpendicular to each other and the wavelength of the wave (in m) is:
- (1) 10 (2) 2.5 (3) 5 (4) 2
41. C_1 and C_2 are two hollow concentric cubes enclosing charges $2Q$ and $3Q$ respectively as shown in figure. The ratio of electric flux passing through C_1 and C_2 is:



- (1) 2 : 5 (2) 3 : 2 (3) 2 : 3 (4) 5 : 2
42. Train A is moving along two parallel rail tracks towards north with speed 72 km/h and train B is moving towards south with speed 108 km/h. Velocity of train B with respect to A and velocity of ground with respect to B are (in ms^{-1}):
- (1) -50 and -30 (2) -50 and 30 (3) 50 and -30 (4) -30 and 50
43. A microwave of wavelength 2.0 cm falls normally on a slit of width 4.0 cm. The angular spread of the central maxima of the diffraction pattern obtained on a screen 1.5 m away from the slit, will be:
- (1) 45° (2) 60° (3) 30° (4) 15°
44. A light planet is revolving around a massive star in a circular orbit of radius R with a period of revolution T . If the force of attraction between planet and star is proportional to $R^{-3/2}$ then choose the correct option:
- (1) $T^2 \propto R^{7/2}$ (2) $T^2 \propto R^{5/2}$ (3) $T^2 \propto R^3$ (4) $T^2 \propto R^{3/2}$

45. If the root mean square velocity of hydrogen molecule at a given temperature and pressure is 2 km/s, the root mean square velocity of oxygen at the same condition in km/s is:
- (1) 0.5 (2) 1.0 (3) 1.5 (4) 2.0
46. A big drop is formed by coalescing 1000 small droplets of water. The surface energy will become:
- (1) 100 times (2) $\frac{1}{100}$ th (3) 10 times (4) $\frac{1}{10}$ th
47. To measure the temperature coefficient of resistivity α of a semiconductor, an electrical arrangement shown in the figure is prepared. The arm BC is made up of the semiconductor. The experiment is being conducted at 25° and resistance of the semiconductor arm is $3\text{ m}\Omega$. Arm BC is cooled at a constant rate of 2°C/s . If the galvanometer G shows no deflection after 10 s. then α is:



- (1) $-1.5 \times 10^{-2} ^\circ\text{C}^{-1}$ (2) $-2 \times 10^{-2} ^\circ\text{C}^{-1}$
- (3) $-1 \times 10^{-2} ^\circ\text{C}^{-1}$ (4) $-2.5 \times 10^{-2} ^\circ\text{C}^{-1}$
48. Match List-I with List-II.

List-I (Number)		List-II (Significant figure)	
(A)	1001	(I)	3
(B)	010.1	(II)	4
(C)	100.100	(III)	5
(D)	0.0010010	(IV)	6

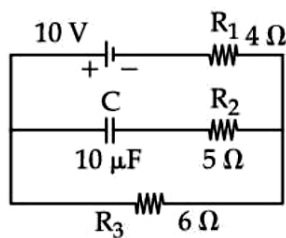
Choose the **correct** answer from the options given below:

- (1) (A)-(IV), (B)-(III), (C)-(I), (D)-(II) (2) (A)-(III), (B)-(IV), (C)-(III), (D)-(I)
- (3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III) (4) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
49. Monochromatic light of frequency 6×10^{14} Hz is produced by a laser. The power emitted is $2 \times 10^{-3} \text{ W}$. How many photons per second on an average, are emitted by the source?
- (1) 7×10^{16} (2) 9×10^{18} (3) 6×10^{15} (4) 5×10^{15}
50. A transformer has an efficiency of 80% and works at 10 V and 4 kW. If the secondary volage is 240 V, then the current in the secondary coil is:
- (1) 13.13 A (2) 1.33 A (3) 15.1 A (4) 1.59 A

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.

51. In an electrical circuit drawn below the amount of charge stored in the capacitor is _____ μC .



52. A particle initially at rest starts moving from reference point $x = 0$ along x -axis, with velocity v that varies as $v = 4\sqrt{x} \text{ m/s}$. The acceleration of the particle is _____ ms^{-2} .
53. A mass m is suspended from a spring of negligible mass and the system oscillates with a frequency f_1 . The frequency of oscillations if a mass $9m$ is suspended from the same spring is f_2 . The value of $\frac{f_1}{f_2}$ is _____.
54. One end of a metal wire is fixed to a ceiling and a load of 2 kg hangs from the other end. A similar wire is attached to the bottom of the load and another load of 1 kg hangs from this lower wire. Then the ratio of longitudinal strain of upper wire to that of the lower wire will be _____.
[Area of cross section of wire = 0.005 cm^2 ; $Y = 2 \times 10^{11} \text{ Nm}^{-2}$ and $g = 10 \text{ ms}^{-2}$]
55. A coil of 200 turns and area 0.20 m^2 is rotated at half a revolution per second and is placed in uniform magnetic field of 0.01 T perpendicular to axis of rotation of the coil. The maximum voltage generated in the coil is $\frac{2\pi}{\beta}$ volt. The value of β is _____.
56. A moving coil galvanometer has 100 turns and each has an area of 2.0 cm^2 . The magnetic field produced by the magnet is 0.01 T and the deflection in the coil is 0.05 radian when a current of 10 mA is passed through it. The torsional constant of the suspension wire is $x \times 10^{-5} \text{ N-m/rad}$. The value of x is _____.
57. A uniform rod AB of mass 2 kg and length 30 cm at rest on a smooth horizontal surface. An impulse of force 0.2 Ns is applied to end B . The time taken by the rod to turn through at right angles will be $\frac{\pi}{x} \text{ s}$, where $x =$ _____.
58. A particular hydrogen-like ion emits the radiation of frequency $3 \times 10^{15} \text{ Hz}$ when it makes transition from $n = 2$ to $n = 1$. The frequency of radiation emitted in transition from $n = 3$ to $n = 1$ is $\frac{x}{9} \times 10^{15} \text{ Hz}$, when $x =$ _____.
59. In Young's double slit experiment, monochromatic light of wavelength 5000 \AA is used. The slits are 1.0 mm apart and screen is placed at 1.0 m away from slits. The distance from the centre of the screen where intensity becomes half of the maximum intensity for the first time is _____ $\times 10^{-6} \text{ m}$.
60. Suppose a uniformly charged wall provides a uniform electric field of $2 \times 10^4 \text{ N/C}$ normally. A charged particle of mass 2 g being suspended through a silk thread of length 20 cm and remain stayed at a distance of 10 cm from the wall. Then the charge on the particle will be $\frac{1}{\sqrt{x}} \mu\text{C}$ where $x =$ _____.
[use $g = 10 \text{ m/s}^2$]

SUBJECT III: CHEMISTRY

MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

61. Given below are two statements:

Statement (I): Both metals and non-metals exist in p and d-block elements.

Statement (II): Non-metals have higher ionization enthalpy and higher electronegativity than the metals.

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

- (1) **Statements I** is true but **Statement II** is false
- (2) **Statement I** is false but **Statement II** is true
- (3) Both **Statement I** and **Statement II** are true
- (4) Both **Statement I** and **Statement II** are false

62. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): In aqueous solutions Cr^{2+} is reducing while Mn^{3+} is oxidizing in nature.

Reason (R): Extra stability to half filled electronic configuration is observed than incompletely filled electronic configuration.

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

- (1) **(A)** is true but **(R)** is false
- (2) **(A)** is false but **(R)** is true
- (3) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
- (4) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**

63. Given below are two statements:

Statement (I): SiO_2 and GeO_2 are acidic while SnO and PbO are amphoteric in nature.

Statement (II): Allotropic forms of carbon are due to property of catenation and $p\pi-d\pi$ bond formation.

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

- (1) **Statements I** is true but **Statement II** is false
- (2) Both **Statement I** and **Statement II** are false
- (3) **Statement I** is false but **Statement II** is true
- (4) Both **Statement I** and **Statement II** are true

64. The number of radial node/s for 3p orbital is:

- (1) 4
- (2) 3
- (3) 2
- (4) 1

65. Solubility of calcium phosphate (molecular mass, M) in water is W_g per 100 mL at 25 °C. Its solubility product at 25 °C will be approximately.

- (1) $10^3 \left(\frac{W}{M} \right)^5$
- (2) $10^5 \left(\frac{W}{M} \right)^5$
- (3) $10^7 \left(\frac{W}{M} \right)^5$
- (4) $10^7 \left(\frac{W}{M} \right)^5$

66. Match List-I with List-II.

List-I Compound		List-II Use	
(A)	Carbon tetrachloride	(I)	Paint remover
(B)	Methylene chloride	(II)	Refrigerators and air conditioners
(C)	DDT	(III)	Fire extinguisher
(D)	Freons	(IV)	Non Biodegradable insecticide

Choose the **correct** answer from the options given below:

(1) (A)-(IV), (B)-(III), (C)-(II), (D)-(I) (2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

(3) (A)-(II), (B)-(III), (C)-(I), (D)-(IV) (4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

67. The functional group that shows negative resonance effect is:

(1) -OR (2) -OH (3) -COOH (4) -NH₂68. $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{CoF}_6]^{3-}$ are respectively known as:

- (1) Inner orbital complex, Spin paired Complex
 (2) Spin paired Complex, Spin free Complex
 (3) Outer orbital Complex Inner orbital Complex
 (4) Spin free Complex, Spin paired Complex

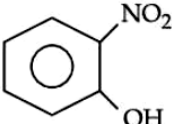
69. Which of the following compounds show colour due to d-d transition?

(1) K_2CrO_4 (2) $\text{K}_2\text{Cr}_2\text{O}_7$ (3) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (4) KMnO_4

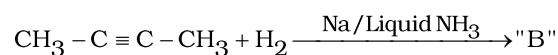
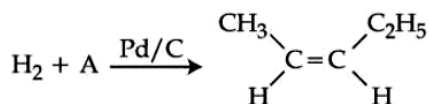
70. Lassaigne's test is used for detection of :

- (1) Phosphorous and halogens only
 (2) Nitrogen, Sulphur and Phosphorous only
 (3) Nitrogen, Sulphur and Phosphorous halogens
 (4) Nitrogen and Sulphur only

71. Select the compound from the following that will show intramolecular hydrogen bonding.

(1) $\text{C}_2\text{H}_5\text{OH}$ (2)  (3) NH_3 (4) H_2O

72. In the given reaction identify A and B



- (1) A : 2 - Pentyne B : Cis - 2 - butene
 (2) A : n - Pentane B : Cis - 2 - butene
 (3) A : 2 - Pentyne B : trans - 2 - butene
 (4) A : n - Pentane B : trans - 2 - butene

73. The set of meta directing functional groups from the following sets is:
 (1) $-\text{NO}_2, -\text{CHO}, -\text{SO}_3\text{H}, -\text{COR}$ (2) $-\text{CN}, -\text{NH}_2, -\text{NHR}, -\text{OCH}_3$
 (3) $-\text{CN}, -\text{CHO}, -\text{NHCOCH}_3, -\text{COOR}$ (4) $-\text{NO}_2, -\text{NH}_2, -\text{COOH}, -\text{COOR}$
74. Which among the following has highest boiling point?
 (1) $\text{H}_5\text{C}_2 - \text{O} - \text{C}_2\text{H}_5$ (2) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
 (3) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ (4) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2 - \text{OH}$
75. Given below are two statements:
Statement (I): A π bonding MO has lower electron density above and below the inter-nuclear axis.
Statement (II): The π^* antibonding MO has a node between the nuclei.
 In the light of the above statements, choose the **most appropriate** answer from the options given below:
 (1) Both **Statement I** and **Statement II** are true
 (2) **Statement I** is true but **Statement II** is false
 (3) **Statement I** is false but **Statement II** is true
 (4) Both **Statement I** and **Statement II** are false
76. The transition metal having highest 3rd ionisation enthalpy is:
 (1) V (2) Fe (3) Mn (4) Cr
77. $\text{C}_2\text{H}_5\text{Br} \xrightarrow{\text{alc. KOH}} \text{A} \xrightarrow[\text{CCl}_4]{\text{Br}_2} \text{B} \xrightarrow[\text{Excess}]{\text{KCN}} \text{C} \xrightarrow[\text{Excess}]{\text{H}_3\text{O}^+} \text{D}$
 Acid D formed in above reaction is:
 (1) Succinic acid (2) Oxalic acid (3) Gluconic acid (4) Malonic acid
78. Given below are two statements:
Statement (I): Dimethyl glyoxime forms a six-membered covalent chelate when treated with NiCl_2 solution in presence of NH_4OH .
Statement (II): Prussian blue precipitate contains ion both in (+2) and (+3) oxidation states.
 In the light of the above statements, choose the **most appropriate** answer from the options given below:
 (1) **Statement I** is true but **Statement II** is false
 (2) Both **Statement I** and **Statement II** are false
 (3) Both **Statement I** and **Statement II** are true
 (4) **Statement I** is false but **Statement II** is true
79. The strongest reducing agent among the following is:
 (1) PH_3 (2) NH_3 (3) BiH_3 (4) SbH_3
80. Match List-I with List-II.

List-I Reactants		List-II Product	
(A)	Phenol, Zn/Δ	(I)	Salicylaldehyde
(B)	Phenol, $\text{CHCl}_3, \text{NaOH}, \text{HCl}$	(II)	Salicylic acid
(C)	Phenol, $\text{CO}_2, \text{NaOH}, \text{HCl}$	(III)	Benzene
(D)	Phenol, Conc. HNO_3	(IV)	Picric acid

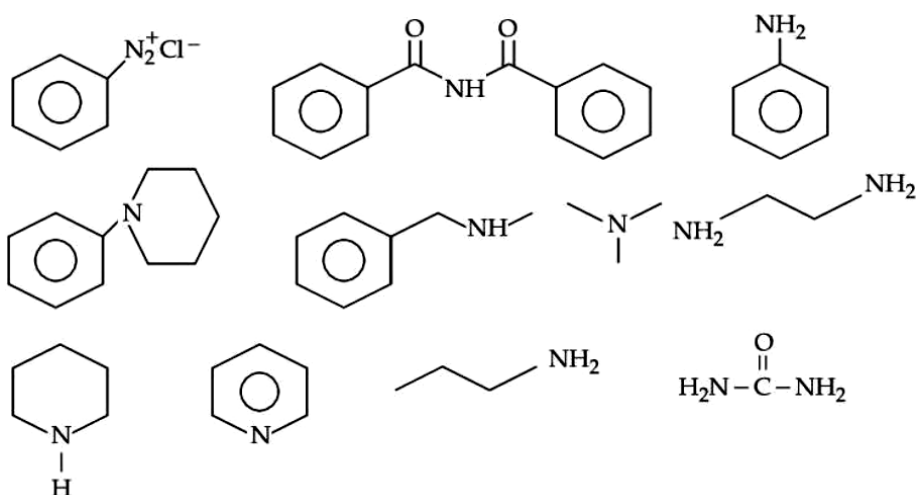
Choose the **correct** answer from the options given below:

- (1) (A)-(IV), (B)-(II), (C)-(I), (D)-(III) (2) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (3) (A)-(IV), (B)-(I), (C)-(II), (D)-(III) (4) (A)-(III), (B)-(I), (C)-(III), (D)-(IV)

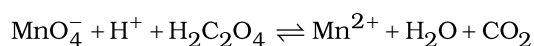
SECTION-2

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.

81. Total number of isomeric compounds (including stereoisomers) formed by monochlorination of 2-methylbutane is _____.
82. Mass of ethylene glycol (antifreeze) to be added to 18.6 kg of water to protect the freezing point at -24°C is _____ kg (Molar mass in g mol^{-1} for ethylene glycol 62, K_f of water = $1.86 \text{ K kg mol}^{-1}$)
83. For a certain reaction at 300 K, $K = 10$, then ΔG° for the same reaction is _____ $\times 10^{-1} \text{ kJ mol}^{-1}$. (Given $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)
84. The number of tripeptides formed by three different amino acids using each amino acid once is _____.
85. 10 mL of gaseous hydrocarbon on combustion gives 40 mL of $\text{CO}_2(\text{g})$ and 50 mL of water vapour. Total number of carbon and hydrogen atoms in the hydrocarbon is _____.
86. The amount of electricity in Columb required for the oxidation of 1 mol of H_2O to O_2 is _____ $\times 10^5 \text{ C}$.
87. Number of compounds which give reaction with Hinsberg's reagent is _____.



88. Following Kjeldahl's method, 1g of organic compound released ammonia, that neutralised 10 mL of 2M H_2SO_4 . The percentage of nitrogen in the compound is _____%.
89. Consider the following redox reaction:



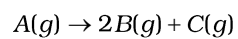
The standard reduction potentials are given as below (E_{red}°):

$$E_{\text{MnO}_4^-/\text{Mn}^{2+}}^{\circ} = +1.51 \text{ V}$$

$$E_{\text{CO}_2/\text{H}_2\text{C}_2\text{O}_4}^{\circ} = -0.49 \text{ V}$$

In the equilibrium constant of the above reaction is given as $K_{\text{eq}} = 10^x$, then the value of $x =$ _____.
(nearest Integer)

- 90.** The following data were obtained during the first order thermal decomposition of a gas A at constant volume:



S. No.	Time/s	Total pressure/(atm)
1.	0	0.1
2.	115	0.28

The rate constant of the reaction is _____ $\times 10^{-2} \text{ s}^{-1}$ (nearest integer)