# JEE Main 2023 April 10 Shift 2 Question Paper

| | | |
|---|---|---|
| **Time Allowed :**3 Hours | **Maximum Marks :**300 | **Total Questions :**90 |

## General Instructions

**Read the following instructions very carefully and strictly follow them:**

1. The test is of 3 hours duration.
2. The question paper consists of 90 questions, out of which 75 are to attempted. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage.
4. Each part (subject) has two sections.
   (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and –1 mark for wrong answer.
   (ii) Section-B: This section contains 10 questions. In Section-B, attempt any five questions out of 10. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and –1 mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer

## Mathematics

### Section-A

**1. If the coefficients of $x$ and $x^2$ in $(1+x)^p(1-x)^q$ are 4 and -5 respectively, then $2p+3q$ is equal to:**

(1) 60

(2) 63

(3) 66

(4) 69

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**2. Let $A=\{2,3,4\}$ and $B=\{8,9,12\}$. Then the number of elements in the relation $R=\{((a_1,b_1),(a_2,b_2))\in(A\times B,A\times B):a_1$ divides $b_2$ and $a_2$ divides $b_1\}$ is:**

(1) 18

(2) 24

(3) 12

(4) 36

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**3. Let time image of the point $P(1,2,6)$ in the plane passing through the points A(1, 2, 0), B(1, 4, 1), and C(0, 5, 1) be $Q(\alpha,\beta,\gamma)$. Then $\alpha^2+\beta^2+\gamma^2$ is equal to:**

(1) 70

(2) 76

(3) 62

(4) 65

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**4. The statement $\sim[p\vee(\sim(p\wedge q))]$ is equivalent to:**

(1) $\sim(p\wedge q)\wedge q$

(2) $\sim(p\vee q)$

(3) $\sim(p\wedge q)$

(4) $(p \wedge q) \wedge (\sim p)$

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**5. Let** $S = \left\{x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) : 9^{1-\tan^2 x} + 9^{\tan^2 x} = 10\right\}$

$$b = \sum_{x \in S} \tan^2\left(\frac{x}{3}\right), \text{ then } (\beta - 14)^2 \text{ is equal to:}$$

(1) 16

(2) 32

(3) 8

(4) 64

**6. If the points P and Q are respectively the circumcenter and the orthocenter of a** $\triangle ABC$**, the** $\overrightarrow{PA} + \overrightarrow{PB} + \overrightarrow{PC}$ **is equal to:**

(1) $2\overrightarrow{PQ}$

(2) $\overrightarrow{PQ}$

(3) $2\overrightarrow{PQ}$

(4) $\overrightarrow{PQ}$

---

**7. Let A be the point (1, 2) and B be any point on the curve** $x^2 + y^2 = 16$**. If the centre of the locus of the point P, which divides the line segment AB in the ratio 3:2 is the point C** $(\alpha, \beta)$**, then the length of the line segment AC is:**

(1) $\frac{6\sqrt{5}}{5}$

(2) $\frac{2\sqrt{5}}{5}$

(3) $\frac{3\sqrt{5}}{5}$

(4) $\frac{4\sqrt{5}}{5}$

---

**8. Let** $m$ **be the mean and** $\sigma$ **be the standard deviation of the distribution:**

| $x_i$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| $f_i$ | $k+2$ | $2k$ | $k^2-1$ | $k^2-1$ | $k^2+1$ | $k-3$ |

where $\sum f_i = 62$. If $[x]$ denotes the greatest integer $\leq x$, then $[\mu^2 + \sigma^2]$ is equal to:

(1) 8

(2) 7

(3) 6

(4) 9

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**9. If $S_n = 4 + 11 + 21 + 34 + 50 + \ldots$ to $n$ terms, then $\frac{1}{60}(S_{29} - S_9)$ is equal to:**

(1) 220

(2) 227

(3) 226

(4) 223

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**10. Eight persons are to be transported from city A to city B in three cars of different makes. If each car can accommodate at most three persons, then the number of ways in which they can be transported is:**

(1) 1120

(2) 560

(3) 3360

(4) 1680

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**11. If** $A = \begin{bmatrix} 5! & 6! & 7! \\ 6! & 7! & 8! \\ 7! & 8! & 9! \end{bmatrix}$**, then $|\mathbf{adj}(\mathbf{adj}(2A))|$ is equal to:**

(1) $2^{16}$

(2) $2^8$

(3) $2^{12}$

(4) $2^{20}$

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**12. Let the number $(22)^{2022} + (2022)^{22}$ leave the remainder $\alpha$ when divided by 3 and $\beta$ when divided by 7. Then $(\alpha^2 + \beta^2)$ is equal to:**

(1) 13

(2) 20

(3) 10

(4) 5

---

**13. Let $g(x) = f(x) + f(1-x)$ and $f^{(n)}(x) > 0$, $x \in (0,1)$. If $g$ is decreasing in the interval $(0, \alpha)$ and increasing in the interval $(\alpha, 1)$, then $\tan^{-1}(2\alpha) + \tan^{-1}\left(\frac{\alpha+1}{\alpha}\right)$ is equal to:**

(1) $\frac{5\pi}{4}$

(2) $\pi$

(3) $\frac{3\pi}{4}$

(4) $\frac{3\pi}{2}$

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**14.** For $\alpha, \beta, \gamma, \delta \in \mathbb{N}$, if

$$\int \left(\frac{x}{e}\right)^{2x} + \left(\frac{e}{x}\right)^{2x} \log x \, dx = \frac{1}{\alpha}\left(\frac{x}{e}\right)^{\beta x} - \frac{1}{\gamma}\left(\frac{e}{x}\right)^{\delta x} + C$$

where $e = \sum_{n=0}^{\infty} \frac{1}{n!}$ and $C$ is the constant of integration, then $\alpha + 2\beta + 3\gamma - 4\delta$ is equal to:

(1) 4

(2) $-4$

(3) 8

(4) 1

---

**15. Let $f$ be a continuous function satisfying**

$$\int_0^{t^2} \left(f(x) + x^2\right) dx = \frac{4}{3}t^3, \, \forall t > 0.$$

**Then $f\left(\frac{\pi^2}{4}\right)$ is equal to:**

(1) $-\pi^2\left(1+\frac{\pi^2}{16}\right)$

(2) $\pi\left(1-\frac{\pi^3}{16}\right)$

(3) $-\pi\left(1+\frac{\pi^3}{16}\right)$

(4) $\pi^2\left(1-\frac{\pi^3}{16}\right)$

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**16. Let a die be rolled $n$ times. Let the probability of getting odd numbers seven times be equal to the probability of getting odd numbers nine times. If the probability of getting even numbers twice is $\frac{k}{2^{15}}$, then $k$ is equal to:**

(1) 60

(2) 30

(3) 90

(4) 15

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**17. Let a circle of radius 4 be concentric to the ellipse $15x^2+19y^2=285$. Then the common tangents are inclined to the minor axis of the ellipse at the angle:**

(1) $\frac{\pi}{6}$

(2) $\frac{\pi}{12}$

(3) $\frac{\pi}{3}$

(4) $\frac{\pi}{4}$

---

**18. Let $\vec{a}=2\hat{i}+7\hat{j}-\hat{k}$, $\vec{b}=3\hat{i}+5\hat{k}$, $\vec{c}=\hat{i}-\hat{j}+2\hat{k}$. Let $\vec{d}$ be a vector which is perpendicular to both $\vec{a}$ and $\vec{b}$, and $\vec{c}\cdot\vec{d}=12$. The value of $\left(\hat{i}+\hat{j}-\hat{k}\right)\cdot\left(\vec{c}\times\vec{d}\right)$ is:**

(1) 24

(2) 42

(3) 48

(4) 44

---

**19. Let** $S = \left\{z = x + iy : \frac{2z-3i}{4z+2i} \text{ is a real number}\right\}$

Then which of the following is NOT correct?

(1) $y \in \left(-\infty, -\frac{1}{2}\right) \cup \left(-\frac{1}{2}, \infty\right)$

(2) $(x, y) = (0, -\frac{1}{2})$

(3) $x = 0$

(4) $y + x^2 + y^2 \neq -\frac{1}{4}$

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**20. Let the line**

$$\frac{x}{1} = \frac{6-y}{2} = \frac{z+8}{5}$$

intersect the lines

$$\frac{x-5}{4} = \frac{y-7}{3} = \frac{z-6}{1}$$

at the points A and B respectively.

Then the distance of the midpoint of the line segment AB from the plane

$$2x - 2y + z = 14$$

is:

(1) 3

(2) $\frac{10}{3}$

(3) 4

(4) $\frac{11}{3}$

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## SECTION-B

**21. The sum of all the four-digit numbers that can be formed using all the digits 2, 1, 2, 3 is equal to _____.**

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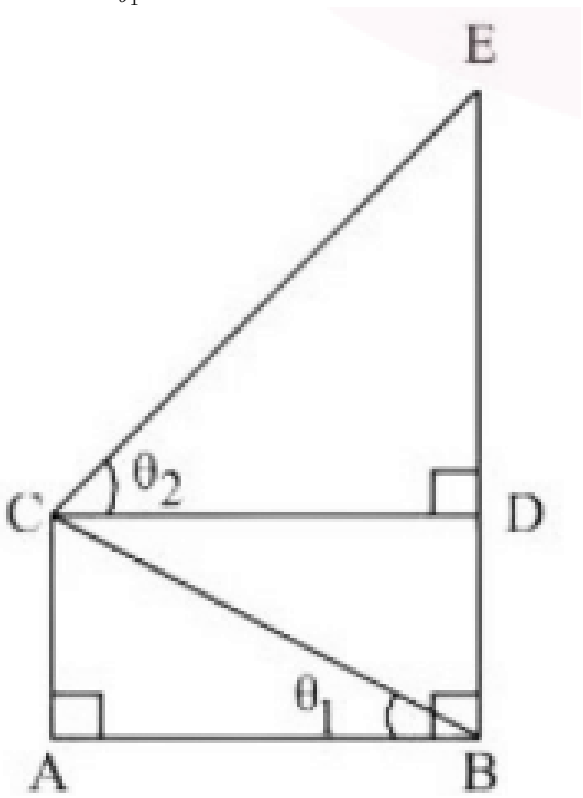
**22. In the figure, $\theta_1 + \theta_2 = \frac{\pi}{2}$ and $\sqrt{3}\,BE = 4\,AB$. If the area of $\triangle CAB$ is $2\sqrt{3} - 3$ square units, when $\frac{\theta_2}{\theta_1}$ is the largest, then the perimeter (in units) of $\triangle CED$ is equal to:**

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**23. Let the tangent at any point P on a curve passing through the points (1, 1) and $\left(\frac{1}{10}, 100\right)$, intersect positive x-axis and y-axis at the points A and B respectively. If $PA : PB = 1 : k$ and $y = y(x)$ is the solution of the differential equation $e^{\frac{dy}{dx}} = kx + \frac{k}{2}$, $y(0) = k$, then $4y(1) - 5\log 3$ is equal to:**

(1) 1

(2) 2

(3) 3

(4) 4

---

**24. Suppose $a_1, a_2, a_3, a_4$ be in an arithmetico-geometric progression. If the common ratio of the corresponding geometric progression in 2 and the sum of all 5 terms of the arithmetico-geometric progression is $\frac{49}{2}$, then $a_4$ is equal to _____.**

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**25. If the area of the region**

$$\{(x, y) : |x^2 - 2| \leq x\}$$

is A, then $6A + 16\sqrt{2}$ is equal to:

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**26. Let the foot of perpendicular from the point A(4, 3, 1) on the plane $P : x - y + 2z + 3 = 0$ be N. If B(5, $\alpha$, $\beta$) is a point on plane P such that the area of triangle ABN is $3\sqrt{2}$, then $\alpha^2 + \beta^2 + \alpha\beta$ is equal to:**

---

**27. Let $S$ be the set of values of $\lambda$, for which the system of equations**

$$6\lambda x - 3y + 3z = 4\lambda^2, \quad 2x + 6\lambda y + 4z = 1, \quad 3x + 2y + 3\lambda z = \lambda$$

**has no solution. Then $12 \sum_{\lambda \in S} |\lambda|$ is equal to:**

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**28. If the domain of the function $f(x) = \sec^{-1}\left(\frac{2x}{5x+3}\right)$ is $[\alpha, \beta] \cup (\gamma, \delta)$, then $|3\alpha + 10(\beta + \gamma) + 21\delta|$ is equal to:**

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**29. Let the quadratic curve passing through the point $(-1, 0)$ and touching the line $y = x$ at $(1, 1)$ be $y = f(x)$. Then the x-intercept of the normal to the curve at the point $(\alpha, \alpha + 1)$ in the first quadrant is:**

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**30. Let the equations of two adjacent sides of a parallelogram ABCD be $2x - 3y = -23$ and $5x + 4y = 23$. If the equation of its one diagonal AC is $3x + 7y = 23$ and the distance of A from the other diagonal is $d$, then $50d^2$ is equal to:**

(1) 529

(2) 625

(3) 490

(4) 512

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## Physics

### Section-A

**31. Given below are two statements:**

**Statement I: Rotation of the earth shows effect on the value of acceleration due to gravity (g)**

**Statement II: The effect of rotation of the earth on the value of 'g' at the equator is minimum and that at the pole is maximum.**

In the light of the above statements, choose the correct answer from the options given below.

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is false but statement II is true

(4) Statement I is true but statement II is false

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**32. The ratio of intensities at two points P and Q on the screen in a Young's double slit experiment where phase difference between two waves of same amplitude are $\frac{\pi}{3}$ and $\frac{\pi}{2}$, respectively, are:**

(1) $3:2$

(2) $3:1$

(3) $2:3$

(4) $1:3$

---

**33. The time period of a satellite, revolving above Earth's surface at a height equal to $R$ will be (Given $g = \pi^2$ m/s$^2$, $R =$ radius of earth):**

(1) $\sqrt{32R}$

(2) $\sqrt{4R}$

(3) $\sqrt{2R}$

(4) $\sqrt{8R}$

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**34. In a metallic conductor, under the effect of applied electric field, the free electrons of the conductor:**

(1) Move with the uniform velocity throughout from lower potential to higher potential

(2) Move in the curved paths from lower potential to higher potential

(3) Move in the straight line paths in the same direction

(4) Drift from higher potential to lower potential

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**35. A message signal of frequency 3kHz is used to modulate a carrier signal of frequency 1.5 MHz. The bandwidth of the amplitude modulated wave is:**

(1) 6 kHz

(2) 3 kHz

(3) 6 MHz

(4) 3 MHz

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**36. In an experiment with vernier calipers of least count 0.1 mm, when two jaws are joined together the zero of the vernier scale lies right to the zero of the main scale and 6th division of vernier scale coincides with the main scale division. While measuring the diameter of a spherical bob, the zero of the vernier scale lies in between 3 cm and 3.3 cm marks, and 4th division of vernier scale coincides with the main scale division. The diameter of the bob is measured as:**

(1) 3.25 cm

(2) 3.22 cm

(3) 3.18 cm

(4) 3.26 cm

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**37. Two projectiles are projected at $30^\circ$ and $60^\circ$ with the horizontal the same speed. The ratio of the maximum height attained by the two projectiles respectively is:**

(1) $2 : \sqrt{3}$

(2) $1 : \sqrt{3}$

(3) $\sqrt{3} : 1$

(4) $1 : 3$

---

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

**Assertion A: An electric fan continues to rotate for some time after the current is switched off.**

**Reason R: Fan continues to rotate due to inertia of motion.**

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

(1) A is not correct but R is correct

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

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

(4) A is correct but R is not correct

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**39. The distance between two plates of a capacitor is $d$ and its capacitance is $C_1$, when air is the medium between the plates. If a metal sheet of thickness $\frac{2d}{3}$ and of the same area as the plate is introduced between the plates, the capacitance of the capacitor becomes $C_2$. The ratio $\frac{C_2}{C_1}$ is:**

(1) $4 : 1$

(2) $3 : 1$

(3) $2 : 1$

(4) $1:1$

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**40. The amplitude of magnetic field in an electromagnetic wave propagating along y-axis is $6.0 \times 10^{-7}$ T. The maximum value of electric field in the electromagnetic wave is:**

(1) $2 \times 10^{15}\,\mathrm{Vm}^{-1}$

(2) $2 \times 10^{14}\,\mathrm{Vm}^{-1}$

(3) $6.0 \times 10^{-7}\,\mathrm{Vm}^{-1}$

(4) $180\,\mathrm{Vm}^{-1}$

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**41. If each diode has a forward bias resistance of 25 $\Omega$ in the below circuit,**

(1) $\frac{I_1}{I_2} = 2$

(2) $\frac{I_2}{I_3} = 1$

(3) $\frac{I_3}{I_4} = 1$

(4) $\frac{I_1}{I_2} = 1$

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**42. A gas mixture consists of 2 moles of oxygen and 4 moles of neon at temperature $T$. Neglecting all vibrational modes, the total internal energy of the system will be:**

(1) $4RT$

(2) $11RT$

(3) $8RT$

(4) $16RT$

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**43. For a periodic motion represented by the equation $y = \sin\omega t + \cos\omega t$, the amplitude of the motion is:**

(1) 0.5

(2) 1

(3) 2

(4) $\sqrt{2}$

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**44. A person travels $x$ distance with velocity $v_1$ and then $x$ distance with velocity $v_2$ in the same direction. The average velocity of the person is $v$, then the relation between $v$, $v_1$, and $v_2$ will be:**

(1) $v = v_1 + v_2$

(2) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(3) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(4) $v = \frac{v_1+v_2}{2}$

---

**45. The half-life of a radioactive substance is $T$. The time taken for disintegrating $\frac{7}{8}$ part of its original mass will be:**

(1) $T$

(2) $2T$

(3) $3T$

(4) $8T$

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**46. A gas is compressed adiabatically, which one of the following statements is NOT true.**

(1) There is no change in the internal energy

(2) The temperature of the gas increases

(3) The change in the internal energy is equal to the work done on the gas

(4) There is no heat supplied to the system

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**47. Given below are two statements:**

**Statement I: For diamagnetic substance, $-1 \leq X < 0$, where $X$ is the magnetic susceptibility.**

**Statement II: Diamagnetic substances when placed in an external magnetic field, tend to move from stronger to weaker part of the field.**

**In the light of the above statements, choose the correct answer from the options given below.**

(1) Both Statement I and Statement II are false

(2) Statement I is incorrect but Statement II is true

(3) Both Statement I and Statement II are true

(4) Statement I is correct but Statement II is false

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**48. Young's moduli of the material of wires A and B are in the ratio 1:4, while its area of cross sections are in the ratio 1:3. If the same amount of load is applied to both the wires, the amount of elongation produced in the wires A and B will be in the ratio of:**

[Assume length of wires A and B are same]

(1) 12 : 1

(2) 1 : 36

(3) 1 : 12

(4) 36 : 1

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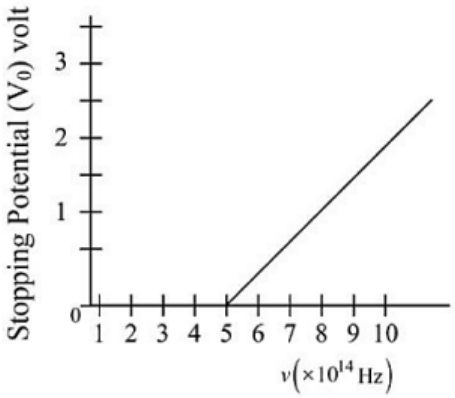
**49. The variation of stopping potential ($V_0$) as a function of the frequency ($\upsilon$) of the incident light for a metal is shown in the figure. The work function of the surface is:**




(1) 2.07 eV

(2) 18.6 eV

(3) 2.98 eV

(4) 1.36 eV

**50. A bar magnet is released from rest along the axis of a very long vertical copper tube. After some time, the magnet will:**

(1) Oscillate inside the tube

(2) Move down with an acceleration greater than $g$

(3) Move down with almost constant speed

(4) Move down with an acceleration equal to $g$

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## SECTION-B

**51. If 917 Å be the lowest wavelength of Lyman series, then the lowest wavelength of Balmer series will be** _____ Å.

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**52. A square loop of side 2.0 cm is placed inside a long solenoid that has 50 turns per centimeter and carries a sinusoidally varying current of amplitude 2.5 A and angular frequency** $700\,\text{rad/s}^{-1}$**. The central axes of the loop and solenoid coincide. The amplitude of the emf induced in the loop is** $x \times 10^{-4}$ **V. The value of** $x$ **is:**

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**53. A rectangular parallelepiped is measured as 1 cm × 1 cm × 100 cm. If its specific resistance is** $3 \times 10^{-7}\,\Omega$**-cm, then the resistance between its two opposite rectangular faces will be:** _____ $\times 10^{-7}\,\Omega$**.**

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**54. A force of** $-P\hat{k}$ **acts on the origin of the coordinate system. The torque about the point** $(2, -3)$ **is** $P(a\hat{i} + b\hat{j})$**. The ratio of** $\frac{a}{b}$ **is** $\frac{x}{2}$**. The value of** $x$ **is:**

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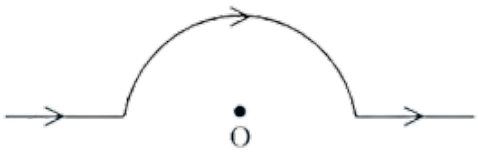
**55. A straight wire carrying a current of 14 A is bent into a semicircular arc of radius 2.2 cm as shown in the figure. The magnetic field produced by the current at the centre** $O$ **of the arc is** _____ $\times 10^{-4}$ **T.**

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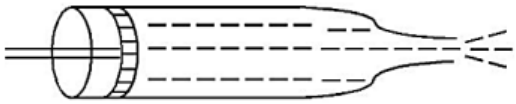
**56. Figure below shows a liquid being pushed out of the tube by a piston having area of cross section 2.0 cm$^2$. The area of cross section at the outlet is 10 mm$^2$. If the piston is pushed at a speed of 4 cm/s$^-1$, the speed of the outgoing fluid is _____ cm/s$^-1$.**



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**57. A rectangular block of mass 5 kg attached to a horizontal spiral spring executes simple harmonic motion of amplitude 1 m and time period 3.14 s. The maximum force exerted by the spring on the block is _____ N.**

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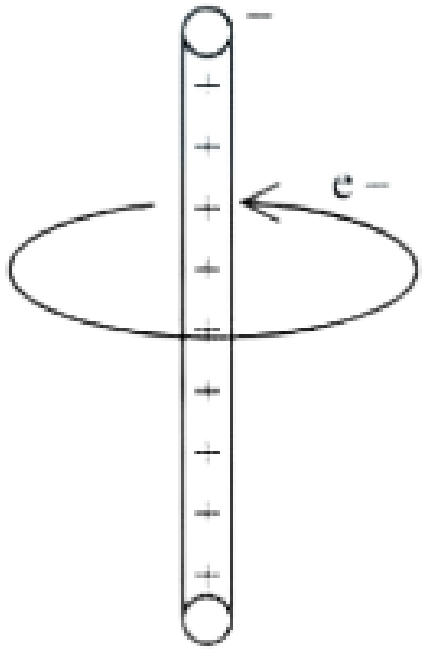
**58. An electron revolves around an infinite cylindrical wire having uniform linear charge density $2 \times 10^{-8}$ C/m$^{-1}$ in a circular path under the influence of an attractive electrostatic field as shown in the figure. The velocity of the electron with which it is revolving is _____ $\times 10^6$ m/s$^{-1}$. Given mass of the electron $= 9 \times 10^{-31}$ kg**



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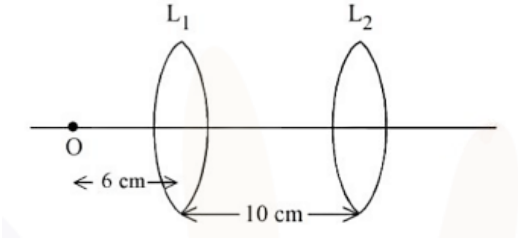
**59. A point object, 'O' is placed in front of two thin symmetrical coaxial convex lenses $L_1$ and $L_2$ with focal lengths of 24 cm and 9 cm respectively. The distance between the two lenses is 10 cm, and the object is placed 6 cm away from lens $L_1$ as shown in the figure. The distance between the object and the image formed by the system of two lenses is _____ cm.**




(1) 8 cm

(2) 18 cm

(3) 12 cm

(4) 34 cm

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**60. If the maximum load carried by an elevator is 1400 kg (600 kg - Passengers + 800 kg - elevator), which is moving up with a uniform speed of 3 m $s^{-1}$ and the frictional**

**force acting on it is 2000 N, then the maximum power used by the motor is ____ kW (g = 10 m/s$^2$).**

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## Chemistry

### Section-A

**61. The correct relationships between unit cell edge length 'a' and radius of sphere 'r' for face-centred and body-centred cubic structures respectively are:**

(1) $2\sqrt{2}r = a$ and $\sqrt{3}r = 4a$

(2) $r = 2\sqrt{2}a$ and $4r = \sqrt{3}a$

(3) $r = 2\sqrt{2}a$ and $3r = 4a$

(4) $2\sqrt{2}r = a$ and $4r = \sqrt{3}a$

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**62. The reaction used for preparation of soap from fat is:**

(1) an addition reaction

(2) an oxidation reaction

(3) alkaline hydrolysis reaction

(4) reduction reaction

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**63. Match List I with List II**

| LIST I | | LIST II | |
|---|---|---|---|
| A | 16 g of $CH_4$ (g) | I. | Weight 28 g |
| B | 1 g of $H_2$ (g) | II | $60.2 \times 10^{23}$ electrons |
| C | 1 mole of $N_2$ (g) | III | Weight 32 g |
| D | 0.5 mol of $SO_2$ (g) | IV | Occupies 11.4 L volume at STP |

Choose the correct answer from the options given below:

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

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

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

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

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**64. The correct order of metallic character is:**

(1) K > Be > Ca

(2) Be > Ca > K

(3) K > Ca > Be

(4) Ca > K > Be

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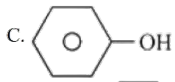
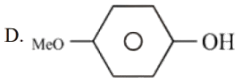
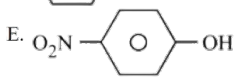
**65. The correct order for acidity of the following hydroxyl compounds is:**

A. $CH_3OH$

B. $(CH_3)_3COH$

C. 

D. 

E. 

Choose the correct answer from the options given below:

(1) E > C > D > A > B

(2) D > E > C > A > B

(3) E > D > C > B > A

(4) C > E > D > B > A

---

**66. Match List I with List II**

| LIST I Complex | | LIST II Crystal Field splitting energy ($\Delta_0$) | |
|---|---|---|---|
| A | $[Ti(H_2O)_6]^{2+}$ | I. | – 1.2 |
| B | $[V(H_2O)_6]^{2+}$ | II | – 0.6 |
| C | $[Mn(H_2O)_6]^{3+}$ | III | 0 |
| D | $[Fe(H_2O)_6]^{3+}$ | IV | – 0.8 |

Choose the correct answer from the options given below:

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

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

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

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

---

**67. In Carius tube, an organic compound 'X' is treated with sodium peroxide to form a mineral acid 'Y'. The solution of $BaCl_2$ is added to 'Y' to form a precipitate 'Z'. 'Z' is used for the quantitative estimation of an extra element. 'X' could be:**

(1) Chloroxyleneol

(2) Methionine

(3) A nucleotide

(4) Cytosine

---

**68. Number of water molecules in washing soda and soda ash respectively are:**

(1) 1 and 0

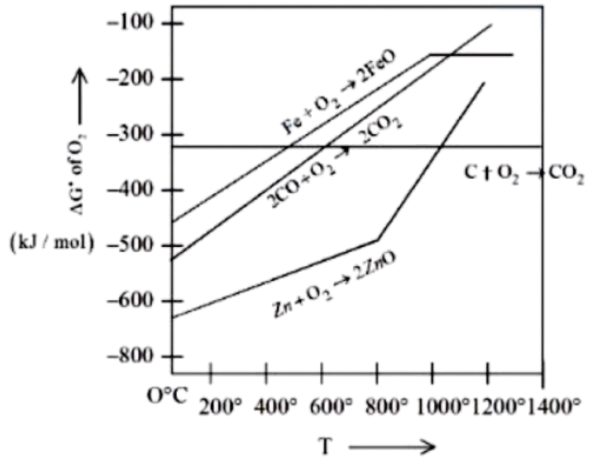
(2) 1 and 10

(3) 10 and 0

(4) 10 and 1

---

**69. Gibbs energy vs T plot for the formation of oxides is given below. For the given diagram, the correct statement is:**




(1) At 600°C, C can reduce ZnO

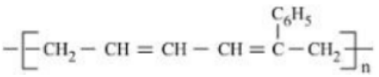
(2) At 600°C, C can reduce FeO

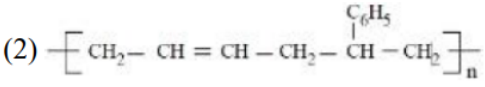
(3) At 600°C, CO cannot reduce FeO

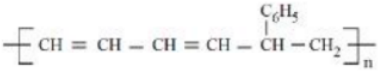
(4) At 600°C, CO can reduce ZnO

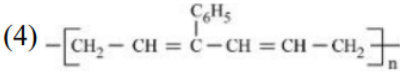
---

**70. Buna-S can be represented as:**

(1) 

(2) 

(3) 

(4) 

---

**71. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.**

Assertion A: Physical properties of isotopes of hydrogen are different.

Reason R: Mass difference between isotopes of hydrogen is very large.

In the light of the above statements, choose the correct answer from the options given below:

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

(2) A is false but R is true

(3) A is true but R is false

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

---

**72. The correct order of the number of unpaired electrons in the given complexes is**

A. $[Fe(CN)_6]^{3-}$

B. $[FeF_6]^{3-}$

C. $[CoF_6]^{3-}$

D. $[Cr(oxalate)_3]^{3-}$

E. $[Ni(CO)_4]$

Choose the correct answer from the options given below:

(1) E < A < D < C < B

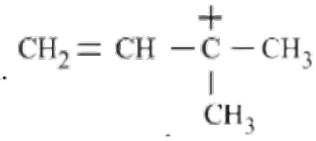
(2) A < E < C < B < D

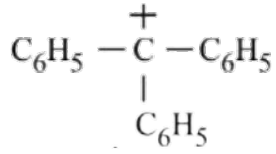
(3) A < E < D < C < B

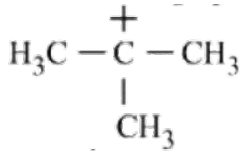
(4) E < A < B < D < C

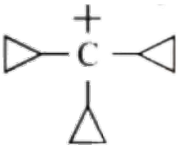
---

**73. The decreasing order of hydride affinity for following carbonations is:**

A. 

B. 

C. 

D. 

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

(1) C, A, D, B

(2) A, C, B, D

(3) A, C, D, B

(4) C, A, B, D

---

**74. Incorrect method of preparation for alcohols from the following is:**

(1) Ozonolysis of alkene.

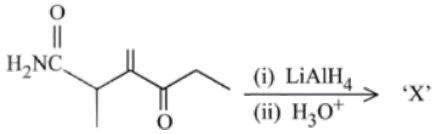
(2) Hydroboration-oxidation of alkene.

(3) Reaction of alkyl halide with aqueous NaOH.

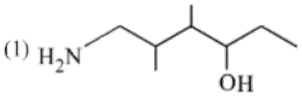
(4) Reaction of Ketone with RMgBr followed by hydrolysis.

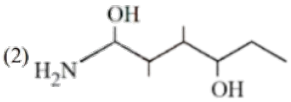
---

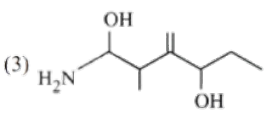
**75. In the reaction given below:**

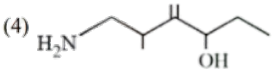



The product 'X' is:

(1) 

(2) 

(3) 

(4) 

**The product 'X' is:**

(1) $H_2N - CH_2 - CH_2OH$

(2) $H_2N - CH_2 - OH$

(3) $H_2N - CH_3$

(4) $H_2N - CH_2OH$

---

**76. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.** Assertion A: The energy required to form $Mg^{2+}$ from Mg is much higher than that required to produce $Mg^{+}$. Reason R: $Mg^{2+}$ is a small ion and carries more charge than $Mg^{+}$.

In the light of the above statements, choose the correct answer from the options given below:

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

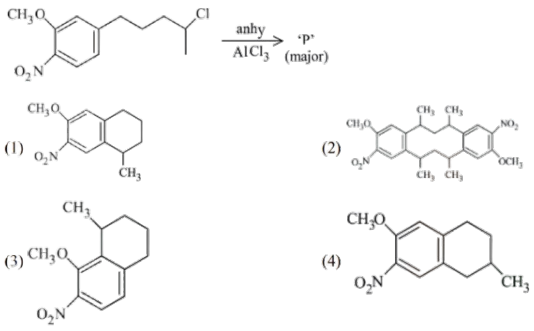
(2) A is true but R is false

(3) A is false but R is true

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

---

**77. The major product 'P' formed in the given reaction is:**




---

**78. Ferric chloride is applied to stop bleeding because -**

(1) Blood absorbs $FeCl_3$ and forms a complex.

(2) $FeCl_3$ reacts with the constituents of blood which is a positively charged sol.

(3) $Fe^{3+}$ ions coagulate blood which is a negatively charged sol.

(4) $Cl^{-}$ ions cause coagulation of blood.

**79. The delicate balance of $CO_2$ and $O_2$ is NOT disturbed by**

(1) Burning of Coal

(2) Deforestation

(3) Burning of petroleum

(4) Respiration

---

**80. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.**

Assertion A: 3.1500 g of hydrated oxalic acid dissolved in water to make 250.0 mL solution will result in 0.1M oxalic acid solution.

Reason R: Molar mass of hydrated oxalic acid is 126 g $mol^{-1}$

In the light of the above statements, choose the correct answer from the options given below:

(1) A is false but R is true

(2) A is true but R is false

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

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

---

## SECTION-B

**81. The number of molecules from the following which contain only two lone pair of electrons is:**

$H_2O$, $N_2$, CO, $XeF_4$, $NH_3$, NO, $CO_2$, $F_2$

---

**82. The specific conductance of 0.0025M acetic acid is $5 \times 10^{-5}$ S $cm^{-1}$ at a certain temperature. The dissociation constant of acetic acid is _____ $\times 10^{-7}$. (Nearest integer)**

Consider limiting molar conductivity of $CH_3COOH$ as 400 S $cm^2$ $mol^{-1}$.

**83. An aqueous solution of volume 300 cm$^3$ contains 0.63 g of protein. The osmotic pressure of the solution at 300 K is 1.29 mbar. The molar mass of the protein is _____ g mol$^{-1}$.**

Given: $R = 0.083\,\text{L bar K}^{-1}\text{mol}^{-1}$

**Solution: Given:**

- Volume (V) = 300 cm³ = 0.3 L
- Mass (m) = 0.63 g
- Osmotic pressure ($\pi$) = 1.29 mbar = 1.29 × 10³ bar
- Temperature (T) = 300 K
- R = 0.083 L bar K¹ mol¹

**Solution:** Using the formula: $\pi = cRT$, where c is the molarity.

1. Calculate molarity (c):

$$c = \frac{\pi}{RT} = \frac{1.29 \times 10^{-3}\ \text{bar}}{0.083\ \text{L bar K}^{-1}\text{mol}^{-1} \times 300\ \text{K}}$$

$$c \approx 5.18 \times 10^{-5}\ \text{mol/L}$$

2. Calculate moles (n):

$$n = c \times V = 5.18 \times 10^{-5}\ \text{mol/L} \times 0.3\ \text{L}$$

$$n \approx 1.554 \times 10^{-5}\ \text{mol}$$

3. Calculate molar mass (M):

$$M = \frac{m}{n} = \frac{0.63\ \text{g}}{1.554 \times 10^{-5}\ \text{mol}}$$

$$M \approx 40540\ \text{g/mol}$$

**Answer:** The molar mass of the protein is approximately 40540 g/mol.

Quick Tip

To calculate the molar mass from osmotic pressure, use the formula $n = \frac{\pi V}{RT}$, and then calculate molar mass as molar mass $= \frac{\text{mass}}{n}$.

---

**84. The difference in the oxidation state of Xe between the oxidised product of Xe formed on complete hydrolysis of $XeF_4$ and $XeF_4$ is _____**

---

**85. The number of endothermic process/es from the following is**

(A) $I_2$ (g) $\rightarrow$ 2I (g)

(B) HCl (g) $\rightarrow$ H (g) + Cl (g)

(C) $H_2O$ (l) $\rightarrow$ $H_2O$ (g)

(D) C (s) + $O_2$ (g) $\rightarrow$ $CO_2$ (g)

(E) Dissolution of ammonium chloride in water

---

**86. The number of incorrect statement/s from the following is**

(A) The successive half lives of zero order reactions decreases with time.

(B) A substance appearing as reactant in the chemical equation may not affect the rate of reaction.

(C) Order and molecularity of a chemical reaction can be a fractional number.

(D) The rate constant units of zero and second order reaction are mol $L^{-1}$ $s^{-1}$ and $mol^{-1}$ L $s^{-1}$ respectively.

---

**87. The electron in the $n$th orbit of $Li^{2+}$ is excited to $(n+1)$th orbit using the radiation of energy $1.47 \times 10^{-17}$ J. The value of $n$ is _____.**

Given: $R_H = 2.18 \times 10^{-18}$ J

---

**88. For a metal ion, the calculated magnetic moment is 4.90 BM. This metal ion has _____ number of unpaired electrons.**

---

**89. In alkaline medium, the reduction of permanganate anion involves a gain of ____ electrons.**

**Solution:**

The reduction of permanganate anion ($MnO_4^-$) in alkaline medium involves the following process:

$$MnO_4^- \text{ (oxidation state of Mn} = +7) \rightarrow Mn^{4+} \text{ (oxidation state of Mn} = +4)$$

The reduction from $Mn^{7+}$ to $Mn^{4+}$ involves the gain of 3 electrons, as the change in oxidation number is from +7 to +4. Therefore, the reduction of permanganate anion involves the gain of 3 electrons.

**Quick Tip**

The number of electrons involved in the reduction process corresponds to the change in the oxidation state of the element. In this case, Mn changes from +7 to +4, which requires the gain of 3 electrons.

---

**90.**

$$\mathrm{A(g) \rightleftharpoons 2B(g) + C(g)}$$

**For the given reaction, if the initial pressure is 450 mmHg and the pressure at time t is 720 mmHg at a constant temperature T and constant volume V. The fraction of A(g) decomposed under these conditions is $x \times 10^{-1}$. The value of x is _____ (nearest integer)**

**Solution:**

The reaction is given as:

$$A(g) \rightleftharpoons 2B(g) + C(g)$$

At time $t = 0$, the pressure of A is 450 mmHg, and at time $t = t$, the total pressure is 720 mmHg.

Let the extent of decomposition at time $t$ be $2x$, so that the pressures of $A$, $B$, and $C$ at time $t$ are:

- Pressure of A = $450 - x$
- Pressure of B = $2x$
- Pressure of C = $x$

Thus, the total pressure at time $t$ is:

$$P_t = P_A + P_B + P_C = (450 - x) + 2x + x = 720\,\text{mmHg}$$

Now, solving for $x$:

$$720 = 450 - x + 2x + x$$

$$720 = 450 + 2x$$

$$270 = 2x$$

$$x = 135$$

The fraction of A decomposed is:

$$\text{Fraction of A decomposed} = \frac{x}{450} = \frac{135}{450} = 0.3 = 3 \times 10^{-1}$$

Thus, the value of $x$ is 3.

**Quick Tip**

For reactions involving changes in pressure, the change in pressure can be used to determine the extent of reaction. Here, the total pressure is related to the individual pressures of reactants and products at equilibrium.