# JEE Main 2023 April 6 Shift 1 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

**Question 1: The straight lines $l_1$ and $l_2$ pass through the origin and trisect the line segment of the line $L : 9x + 5y = 45$ between the axes. If $m_1$ and $m_2$ are the slopes of the lines $l_1$ and $l_2$, then the point of intersection of the line $y = (m_1 + m_2)x$ with $L$ lies on:**

**(1)** $6x + y = 10$

**(2)** $6x - y = 15$

**(3)** $y - 2x = 5$

**(4)** $y - x = 5$

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**Question 2:** Let the position vectors of the points A, B, C and D be $5\hat{i} + 5\hat{j} + 2\lambda\hat{k}$, $\hat{i} + 2\hat{j} + 3\hat{k}$, $-2\hat{i} + \lambda\hat{j} + 4\hat{k}$ and $-\hat{i} + 5\hat{j} + 6\hat{k}$. Let the set $S = \{\lambda \in \mathbb{R} :$ the points A, B, C and D are coplanar. Then $\sum_{\lambda \in S}(\lambda + 2)^2$ is equal to:

**(1)** $\frac{37}{2}$

**(2) 13**

**(3) 25**

**(4) 41**

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**Question 3:** Let $I(x) = \int \frac{x^2(x\sec^2 x + \tan x)}{(x\tan x + 1)^2}dx$. If $I(0) = 0$, then $I(\frac{\pi}{4})$ is equal to:

(1) $\log_e \frac{(\pi+4)^2}{16} + \frac{\pi^2}{4(\pi+4)}$

(2) $\log_e \frac{(\pi+4)^2}{32} - \frac{\pi^2}{4(\pi+4)}$

(3) $\log_e \frac{(\pi+4)^2}{16} - \frac{\pi^2}{4(\pi+4)}$

(4) $\log_e \frac{(\pi+4)^2}{32} + \frac{\pi^2}{4(\pi+4)}$

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**Question 4:** The sum of the first 20 terms of the series $5 + 11 + 19 + 29 + 41 + \ldots$ **is:**

**(1) 3450**

**(2) 3420**

**(3) 3520**

**(4) 3250**

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**Question 5: A pair of dice is thrown 5 times. For each throw, a total of 5 is considered a success. If probability of at least 4 successes is $\frac{k}{3^{11}}$, then k is equal to :**

(1) 164

(2) 123

(3) 82

(4) 75

**Question 6: Let** $A = [a_{ij}]_{2 \times 2}$**, where** $a_{ij} \neq 0$ **for all i, j, and** $A^2 = I$**. Let a be the sum of all diagonal elements of A and** $b = |A|$**. Then** $3a^2 + 4b^2$ **is equal to :**

(1) 14

(2) 4

(3) 3

(4) 7

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**Question 7:** Let $a_1, a_2, a_3, \ldots, a_n$ be $n$ positive consecutive terms of an arithmetic progression. If $d > 0$ is its common difference, then:

$$\lim_{n \to \infty} \frac{d}{\sqrt{n}} \left( \frac{1}{\sqrt{a_1} + \sqrt{a_2}} + \frac{1}{\sqrt{a_2} + \sqrt{a_3}} + \cdots + \frac{1}{\sqrt{a_{n-1}} + \sqrt{a_n}} \right) \text{ is}$$

(1) $\frac{1}{\sqrt{d}}$ (2) 1 (3) $\sqrt{d}$ (4) 0

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**Question 8: If** $^{2n}C_3 :^n C_3 : 10 : 1$**, then the ratio** $(n^2 + 3n) : (n^2 - 3n + 4)$ **is:**

(1) $27 : 11$

(2) $35 : 16$

(3) $2 : 1$

(4) $65 : 37$

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**Question 9: Let** $A = \{x \in \mathbb{R} : |x + 3| + |x + 4| \leq 3\}$**,**

$$B = \left\{ x \in \mathbb{R} : 3 \cdot \sum_{r=1}^{\infty} \frac{3^{x-3}}{10^r} < 3^{-3x} \right\},$$

where $[x]$ denotes the greatest integer function. Then,

(1) $A \subset B, A \neq B$

(2) $A \cap B = \phi$

(3) $A = B$

(4) $B \subset C, A \neq B$

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**Question 10: One vertex of a rectangular parallelepiped is at the origin O and the lengths of its edges along x, y and z axes are 3, 4 and 5 units respectively. Let P be the vertex (3,**

**4, 5). Then the shortest distance between the diagonal OP and an edge parallel to z axis, not passing through O or P is :**

    (1) $\frac{12}{5\sqrt{5}}$

(2) $12\sqrt{5}$

(3) $\frac{12}{5}$

(4) $\frac{12}{\sqrt{5}}$

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**Question 11: If the equation of the plane passing through the line of intersection of the planes** $2x - y + z = 3$ **and** $4x - 3y + 5z + 9 = 0$ **and parallel to the line** $\frac{x+1}{-2} = \frac{y+3}{4} = \frac{z-2}{5}$ **is** $ax + by + cz + 6 = 0$, **then** $a + b + c$ **is equal to :**

    (1) 15

(2) 14

(3) 13

(4) 12

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**Question 12: If the ratio of the fifth term from the beginning to the fifth term from the end in the expansion of** $\left( \sqrt[4]{2} + \frac{1}{\sqrt[4]{3}} \right)^{n}$ **is** $\sqrt{6} : 1$, **then the third term from the beginning is :**

    (1) $30\sqrt{2}$

(2) $60\sqrt{2}$

(3) $30\sqrt{3}$

(4) $60\sqrt{3}$

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**Question 13: The sum of all the roots of the equation** $|x^2 - 8x + 15| - 2x + 7 = 0$ **is:**

    (1) $11 - \sqrt{3}$

(2) $9 - \sqrt{3}$

(3) $9 + \sqrt{3}$

(4) $11 + \sqrt{3}$

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**Question 14:** From the top A of a vertical wall AB of height 30 m, the angles of depression of the top P and bottom Q of a vertical tower PQ are 15° and 60° respectively. B and Q are on the same horizontal level. If C is a point on AB such that CB = 15 m, then the area (in m²) of the quadrilateral BCPQ is equal to :

**(1)** $300(\sqrt{3} - \sqrt{5})$

**(2)** $300(\sqrt{3} + 1)$

**(3)** $300(\sqrt{3} - 1)$

**(4)** $600(\sqrt{3} - 1)$

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**Question 15:** Let $\vec{a} = 2\hat{i} + 3\hat{j} + 4\hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} - 2\hat{k}$ and $\vec{c} = -\hat{i} + 4\hat{j} + 3\hat{k}$. If $\vec{d}$ is a vector perpendicular to both $\vec{b}$ and $\vec{c}$, and $\vec{a} \cdot \vec{d} = 18$, then $|\vec{a} \times \vec{d}|^2$ is equal to :

**(1)** 760

**(2)** 640

**(3)** 720

**(4)** 680

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**Question 16:** If $2x^y + 3y^x = 20$, then $\frac{dy}{dx}$ at (2, 2) is equal to :

**(1)** $-\frac{3 + \log_e 8}{2 + \log_e 4}$

**(2)** $-\frac{2 + \log_e 8}{3 + \log_e 4}$

**(3)** $-\frac{3 + \log_e 4}{2 + \log_e 8}$

**(4)** $-\frac{3 + \log_e 16}{4 + \log_e 8}$

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**Question 17: If the system of equations**

x + y + az = b

2x + 5y + 2z = 6

x + 2y + 3z = 3

**has infinitely many solutions, then 2a + 3b is equal to :**

**(1) 28**

**(2) 20**

**(3) 25**

**(4) 23**

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**Question 18: Statement (P ⇒ Q) ∧ (R ⇒ Q) is logically equivalent to :**

**(1) (P ∨ R) ⇒ Q**

**(2) (P ⇒ R) ∨ (Q ⇒ R)**

**(3) (P ⇒ R) ∧ (Q ⇒ R)**

**(4) (P ∧ R) ⇒ Q**

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**Question 19: Let** $5f(x) + 4f\left(\frac{1}{x}\right) = \frac{1}{x} + 3$, $x > 0$. **Then** $18 \int_1^2 f(x)\,dx$ **is equal to :**

**(1)** $10 \log_e 2 - 6$

**(2)** $10 \log_e 2 + 6$

**(3)** $5 \log_e 2 - 3$

**(4)** $5 \log_e 2 + 3$

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**Question 20: The mean and variance of a set of 15 numbers are 12 and 14 respectively. The mean and variance of another set of 15 numbers are 14 and $\sigma^2$ respectively. If the variance of all the 30 numbers in the two sets is 13, then $\sigma^2$ is equal to :**

**(1) 12**

**(2) 10**

**(3) 11**

**(4) 9**

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## Section B

**Question 21: Let the tangents to the curve $x^2 + 2x - 4y + 9 = 0$ at the point P(1, 3) on it meet the y-axis at A. Let the line passing through P and parallel to the line $x - 3y = 6$ meet the parabola $y^2 = 4x$ at B. If B lies on the line $2x - 3y = 8$, then $(AB)^2$ is equal to _____.**

6

**Question 22:** Let the point (p, p + 1) lie inside the region E = {(x,y): $3 - x \le y \le \sqrt{9 - x^2}$, $0 \le x \le 3$}. If the set of all values of p is the interval (a, b), then $b^2 + b - a^2$ is equal to

_____.

**Question 23:** Let $y = y(x)$ be a solution of the differential $(x \cos x)dy + (xy \sin x + y \cos x -$ $1)dx = 0$, $0 < x < \frac{\pi}{2}$. If $\frac{\pi}{3}y\left(\frac{\pi}{3}\right) = \sqrt{3}$, then $\left|\frac{\pi}{6}y''\left(\frac{\pi}{6}\right) + 2y'\left(\frac{\pi}{6}\right)\right|$ is equal to _____.

**Question 24:** Let $a \in \mathbb{Z}$ and $[t]$ be the greatest integer $\le t$. Then the number of points, where the function f(x) = $[a + 13 \sin x]$, $x \in (0, \pi)$ is not differentiable, is _____.

**Question 25:** If the area of the region S = {(x, y) : $2y - y^2 \le x \le 2y$, $x \ge y$} is equal to $\frac{n}{n+1} - \frac{\pi}{n-1}$, then the natural number n is equal to _____.

**Question 26:** The number of ways of giving 20 distinct oranges to 3 children such that each child gets at least one orange is _____.

**Question 27:** Let the image of the point P (1, 2, 3) in the plane $2x - y + z = 9$ be Q. If the coordinates of the point R are (6, 10, 7), then the square of the area of the triangle PQR is _____.

**Question 28:** A circle passing through the point $P(\alpha, \beta)$ in the first quadrant touches the two coordinate axes at the points A and B. The point P is above the line AB. The point Q on the line segment AB is the foot of perpendicular from P on AB. If PQ is equal to 11 units, then value of $\alpha\beta$ is _____.

**Question 29:** The coefficient of $x^{18}$ in the expansion of $\left(x^4 - \frac{1}{x^3}\right)^{15}$ is _____.

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**Question 30:** Let **A** = $\{1, 2, 3, 4, \ldots, 10\}$ and **B** = $\{0, 1, 2, 3, 4\}$. The number of elements in the relation **R** = $\{(a, b) \in A \times A : 2(a - b)^2 + 3(a - b) \in B\}$ is _____.

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# Physics

## Section A

**Question 31:** The kinetic energy of an electron, an $\alpha$-particle, and a proton are given as **4K, 2K, and K respectively. The de-Broglie wavelength associated with electron ($\lambda_e$), $\alpha$-particle ($\lambda_\alpha$), and the proton ($\lambda_p$) are as follows:**

(1) $\lambda_\alpha > \lambda_p > \lambda_e$

(2) $\lambda_\alpha = \lambda_p > \lambda_e$

(3) $\lambda_\alpha = \lambda_p < \lambda_e$

(4) $\lambda_\alpha < \lambda_p < \lambda_e$

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**Question 32: Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.**

**Assertion A:** Earth has atmosphere whereas moon doesn't have any atmosphere.

**Reason R:** The escape velocity on moon is very small as compared to that on earth.

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

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

(2) A is false but R is true

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

(4) A is true but R is false

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**Question 33: A source supplies heat to a system at the rate of 1000 W. If the system performs work at a rate of 200 W. The rate at which internal energy of the system increase is**

**(1) 500 W**

**(2) 600 W**

**(3) 800 W**

**(4) 1200 W**

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**Question 34: A small ball of mass M and density $\rho$ is dropped in a viscous liquid of density $\rho_o$. After some time, the ball falls with a constant velocity. What is the viscous force on the ball?**

**(1)** $F = Mg(1 + \frac{\rho_o}{\rho})$

**(2)** $F = Mg(1 + \frac{\rho}{\rho_o})$

**(3)** $F = Mg(1 - \frac{\rho_o}{\rho})$

**(4)** $F = Mg(1 + \rho\rho_o)$

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**Question 35: A small block of mass 100 g is tied to a spring of spring constant 7.5 N/m and length 20 cm. The other end of spring is fixed at a particular point A. If the block moves in a circular path on a smooth horizontal surface with constant angular velocity 5 rad/s about point A, then tension in the spring is –**

**(1) 0.75 N**

**(2) 1.5 N**

**(3) 0.25 N**

**(4) 0.50 N**

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**Question 36: A particle is moving with constant speed in a circular path. When the particle turns by an angle $90°$, the ratio of instantaneous velocity to its average velocity is $\pi : x\sqrt{2}$. The value of x will be -**

**(1) 7**

**(2) 2**

**(3) 1**

**(4) 5**

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**Question 37: Two resistances are given as $R_1 = (10 \pm 0.5)\,\Omega$ and $R_2 = (15 \pm 0.5)\,\Omega$. The percentage error in the measurement of equivalent resistance when they are connected**

in parallel is -

(1) 2.33

(2) 4.33

(3) 5.33

(4) 6.33

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Question 38: For a uniformly charged thin spherical shell, the electric potential (V) radially away from the entire (O) of shell can be graphically represented as –
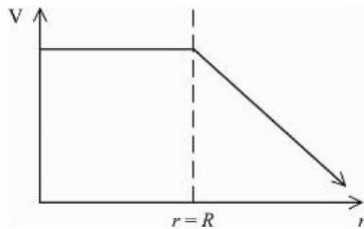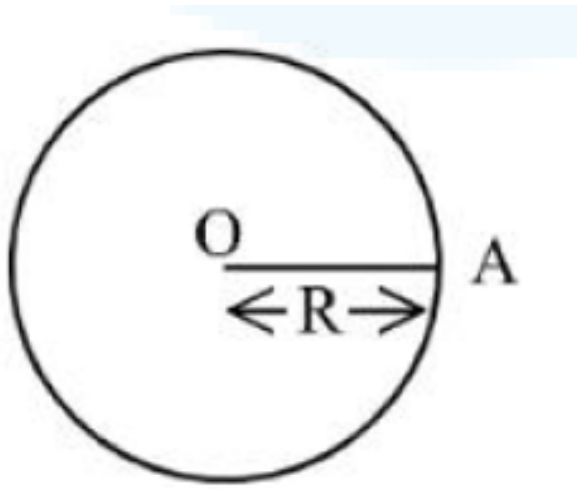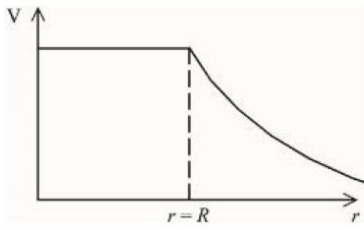


(1)
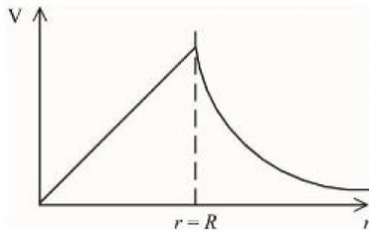


(2)
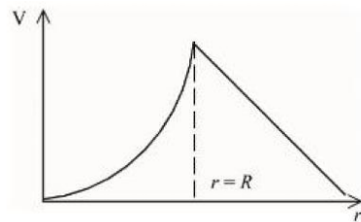


(3)

**(4)**

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**Question 39: A long straight wire of circular cross-section (radius a) is carrying steady current I. The current I is uniformly distributed across this cross-section. The magnetic field is**

**(1) zero in the region r < a and inversely proportional to r in the region r > a**

**(2) inversely proportional to r in the region r < a and uniform throughout in the region r > a**

**(3) directly proportional to r in the region r < a and inversely proportional to r in the region r > a**

**(4) uniform in the region r < a and inversely proportional to distance r from the axis, in the region r > a**

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**Question 40: By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21%?**

**(1) 12%**

**(2) 15%**

**(3) 14%**

**(4) 10%**

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**Question 41: The number of air molecules per cm$^3$ increased from $3 \times 10^{19}$ to $12 \times 10^{19}$. The ratio of collision frequency of air molecules before and after the increase in the number respectively is :**

**(1) 0.25**

**(2) 0.75**

**(3) 1.25**

**(4) 0.50**

**Question 42:** The energy levels of an hydrogen atom are shown below. The transition corresponding to emission of shortest wavelength is

(1) A

(2) D

(3) C

(4) B
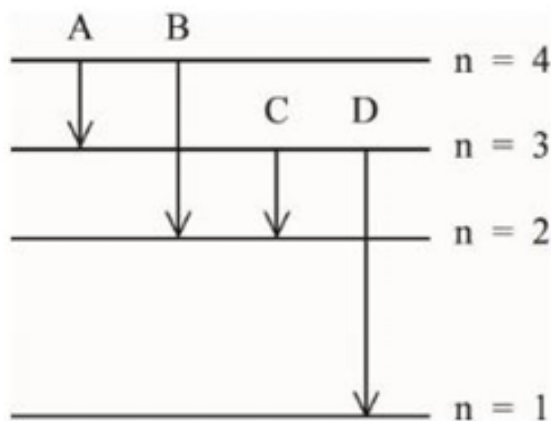


**Question 43:** For the plane electromagnetic wave given by $E = E_0 \sin(\omega t - kx)$ and $B = B_0 \sin(\omega t - kx)$, the ratio of average electric energy density to average magnetic energy density is
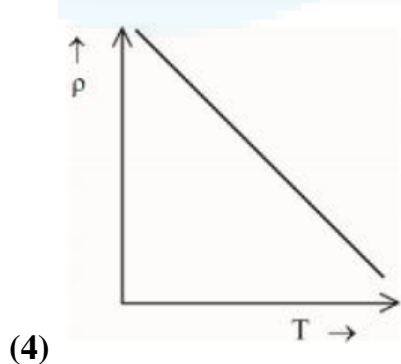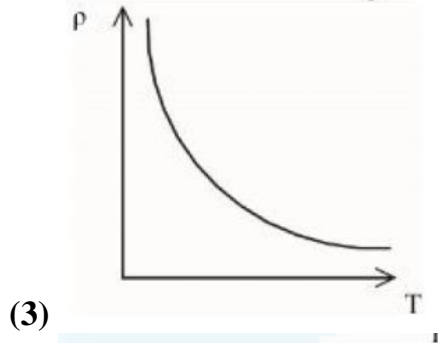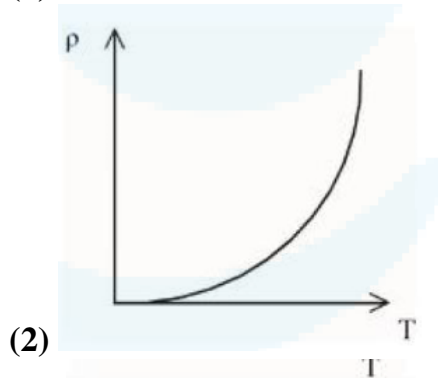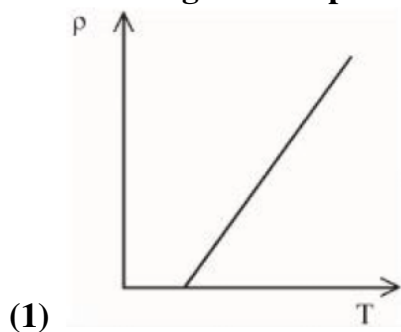
(1) 2

(2) 1/2

(3) 1

(4) 4

**Question 44:** A planet has double the mass of the earth. Its average density is equal to that of the earth. An object weighing W on earth will weigh on that planet:

(1) $2^{1/3}$ W

(2) 2 W

(3) W

(4) $2^{2/3}$ W

**Question 45:** The resistivity ($\rho$) of semiconductor varies with temperature. Which of the following curve represents the correct behavior

**(1)**



**(2)**



**(3)**



**(4)**



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**Question 46: A monochromatic light wave with wavelength $\lambda_1$ and frequency $\nu_1$, in air, enters another medium. If the angle of incidence and angle of refraction at the interface are 45° and 30° respectively, then the wavelength $\lambda_2$ and frequency $\nu_2$ of the refracted wave are:**

(1) $\lambda_2 = \frac{1}{\sqrt{2}}\lambda_1, \nu_2 = \nu_1$

(2) $\lambda_2 = \lambda_1, \lambda_2 = \frac{1}{\sqrt{2}}\nu_1$

(3) $\lambda_2 = \lambda_1, \nu_2 = \sqrt{2}\nu_1$

(4) $\lambda_2 = \sqrt{2}\lambda_1, \nu_2 = \nu_1$

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**Question 47: A mass m is attached to two strings as shown in figure. The spring constants of two springs are $K_1$ and $K_2$. For the frictionless surface, the time period of oscillation of mass m is**
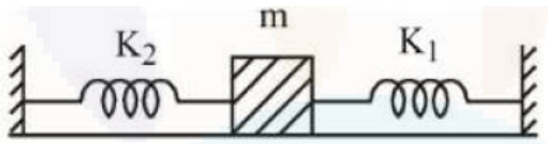


(1) $2\pi\sqrt{\frac{m}{K_1 - K_2}}$

(2) $\frac{1}{2\pi}\sqrt{\frac{K_1 - K_2}{m}}$

(3) $\frac{1}{2\pi}\sqrt{\frac{K_1 + K_2}{m}}$

(4) $2\pi\sqrt{\frac{m}{K_1 + K_2}}$

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**Question 48: Name the logic gate equivalent to the diagram attached**



(1) NOR

(2) OR

(3) NAND

14
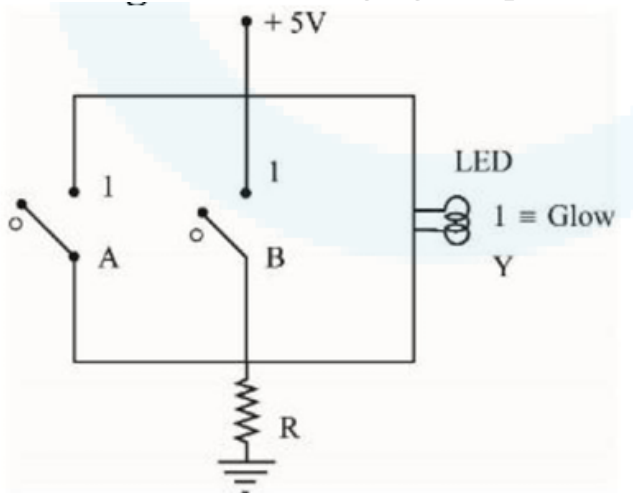
**(4) AND**

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Question 49: The induced emf can be produced in a coil by

A. moving the coil with uniform speed inside uniform magnetic field

B. moving the coil with non uniform speed inside uniform magnetic field

C. rotating the coil inside the uniform magnetic field

D. changing the area of the coil inside the uniform magnetic field

Choose the correct answer from the options given below :

(1) B and D only

(2) C and D only

(3) B and C only

(4) A and C only

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Question 50: Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : When a body is projected at an angle $45°$, it's range is maximum.

Reason R : For maximum range, the value of $\sin 2\theta$ should be equal to one.

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

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

(2) A is false but R is true

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

(4) A is true but R is false

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## Section B

Question 51: Two identical circular wires of radius 20 cm and carrying current $\sqrt{2}$ A are placed in perpendicular planes as shown in figure. The net magnetic field at the centre of the circular wires is ____ $\times 10^{-8}$ T.

(Take $\pi = 3.14$)

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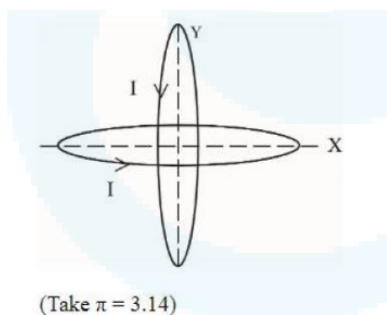
**Question 52: A steel rod has a radius of 20 mm and a length of 2.0 m. A force of 62.8 kN stretches it along its length. Young's modulus of steel is $2.0 \times 10^{11}$ N/m$^2$. The longitudinal strain produced in the wire is \_\_\_\_ $\times 10^{-5}$.**

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**Question 53: The length of a metallic wire is increased by 20% and its area of cross section is reduced by 4%. The percentage change in resistance of the metallic wire is \_\_\_\_.**

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**Question 54: The radius of fifth orbit of the Li$^{++}$ is \_\_\_\_ $\times 10^{-12}$ m.**
**Take : radius of hydrogen atom = 0.51 Å**

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**Question 55: A particle of mass 10 g moves in a straight line with retardation 2x, where x is the displacement in SI units. Its loss of kinetic energy for above displacement is $\left(\frac{10}{x}\right)^{-n}$ J. The value of n will be \_\_\_\_.**

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**Question 56: An ideal transformer with purely resistive load operates at 12 kV on the primary side. It supplies electrical energy to a number of nearby houses at 120 V. The average rate of energy consumption in the houses served by the transformer is 60 kW. The value of resistive load ($R_s$) required in the secondary circuit will be \_\_\_\_\_ m$\Omega$.**

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**Question 57: A parallel plate capacitor with plate area A and plate separation d is filled with a dielectric material of dielectric constant K = 4. The thickness of the dielectric material is x, where x < d.**

[scale=0.6] [fill=black] (0,2) rectangle (4,3); at (5,2.5) Plate-1; [pattern=north west lines] (0,0) rectangle (4,1); at (5,0.5) Plate-2; [fill=gray] (0,1) rectangle (4,2); at (2,1.5) Dielectric;

16

[———] (-1,0) – (-1,3); at (-1.3,1.5) $d$; [——] (-0.5,0) – (-0.5,2); at (-0.8,1) $x$;

Let $C_1$ and $C_2$ be the capacitance of the system for $x = \frac{1}{3}d$ and $x = \frac{2}{3}d$, respectively. If $C_1 = 2\mu F$, the value of $C_2$ is _____ $\mu F$.

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**Question 58:** Two identical solid spheres each of mass 2 kg and radii 10 cm are fixed at the ends of a light rod. The separation between the centres of the spheres is 40 cm. The moment of inertia of the system about an axis perpendicular to the rod passing through its middle point is _____ $\times 10^{-3}$ **kg-m$^2$.**

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**Question 59:** A person driving car at a constant speed of 15 m/s is approaching a vertical wall. The person notices a change of 40 Hz in the frequency of his car's horn upon reflection from the wall. The frequency of horn is _____ Hz.

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**Question 60:** A pole is vertically submerged in swimming pool, such that it gives a length of shadow 2.15 m within water when sunlight is incident at an angle of 30° with the surface of water. If swimming pool is filled to a height of 1.5 m, then the height of the pole above the water surface in centimeters is (n$_w$ = 4/3) _____.

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# Chemistry

## Section A

**Question 61: Match List I with List II**

| List I (Natural Amino acid) | List II (One Letter Code) |
|---|---|
| (A) Arginine | (I) D |
| (B) Aspartic acid | (II) N |
| (C) Asparagine | (III) A |
| (D) Alanine | (IV) R |

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

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

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

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

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

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**Question 62: Formation of which complex, among the following, is not a confirmatory test of $Pb^{2+}$ ions**

(1) lead sulphate

(2) lead nitrate

(3) lead chromate

(4) lead iodide

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**Question 63: The volume of 0.02 M aqueous HBr required to neutralize 10.0 mL of 0.01 M aqueous $Ba(OH)_2$ is (Assume complete neutralization)**

(1) 5.0 mL

(2) 10.0 mL

(3) 2.5 mL

(4) 7.5 mL

---

**Question 64: Group-13 elements react with $O_2$ in amorphous form to form oxides of type $M_2O_3$ (M = element). Which among the following is the most basic oxide?**

(1) $Al_2O_3$

(2) $Tl_2O_3$

(3) $Ga_2O_3$

(4) $B_2O_3$

---

**Question 65: The IUPAC name of $K_3[Co(C_2O_4)_3]$ is -**

(1) Potassium tris(oxalate)cobaltate(III)

**(2) Potassium trioxalatocobalt(III)**

**(3) Potassium tris(oxalato)cobaltate(III)**

**(4) Potassium tris(oxalate)cobalt(III)**

---

**Question 66: If the radius of the first orbit of hydrogen atom is $a_0$, then de Broglie's wavelength of electron in $3^{rd}$ orbit is**

**(1)** $\frac{\pi a_0}{6}$

**(2)** $\frac{\pi a_0}{3}$

**(3)** $6\pi a_0$

**(4)** $3\pi a_0$

---

**Question 67: The group of chemicals used as pesticide is**

**(1) Sodium chlorate, DDT, PAN**

**(2) DDT, Aldrin**

**(3) Aldrin, Sodium chlorate, Sodium arsinite**

**(4) Dieldrin, Sodium arsinite, Tetrachloroethene**

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**Question 68: From the figure of column chromatography given below, identify incorrect statements.**



19
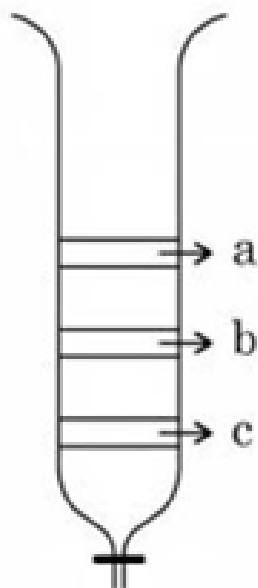
A. Compound 'c' is more polar than 'a' and 'b'.

B. Compound 'a' is least polar.

C. Compound 'b' comes out of the column before 'c' and after 'a'.

D. Compound 'a' spends more time in the column.

Choose the correct answer from the options given below:

(1) A, B and D only

(2) A, B and C only

(3) B and D only

(4) B, C and D only

---

**Question 69:** Ion having highest hydration enthalpy among the given alkaline earth metal ions is:
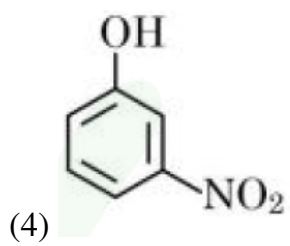
(1) $Be^{2+}$

(2) $Ba^{2+}$

(3) $Ca^{2+}$

(4) $Sr^{2+}$

---

**Question 70:** The strongest acid from the following is

OH

(1)

OH

Cl

(2)

OH

CH$_3$

(3)

OH



(4)

---
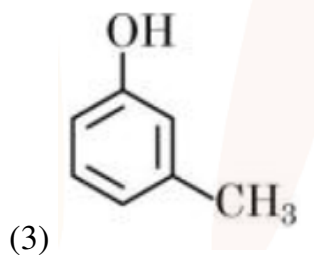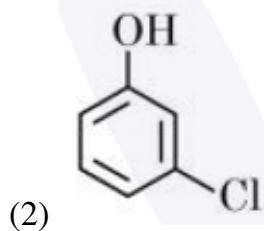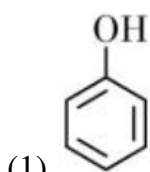
**Question 71: In the following reaction, 'B' is**
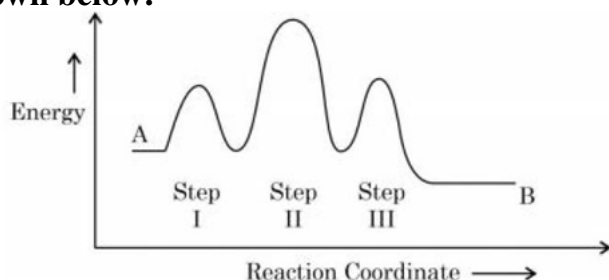


$H_3O^+$ → 'B' major

(1)


(2)


(3)


(4)
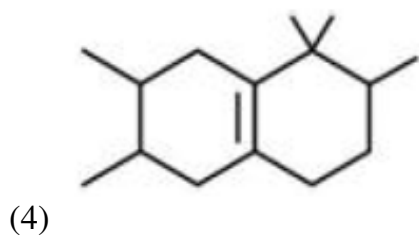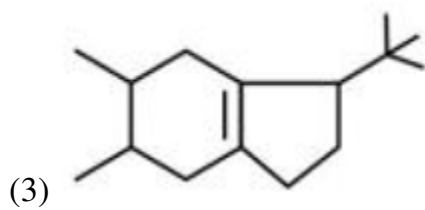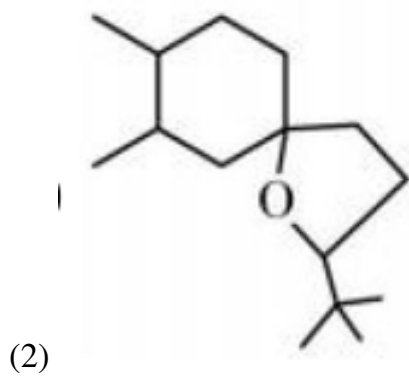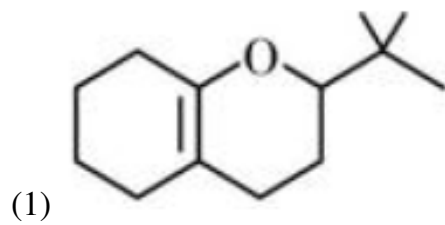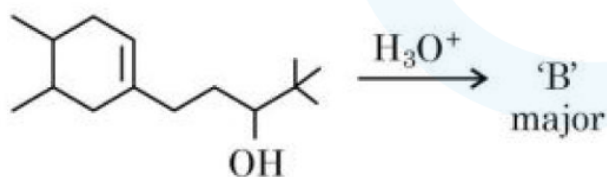
**Question 72: Structures of BeCl$_2$ in solid state, vapour phase and at very high temperature respectively are:**

(1) Polymeric, Dimeric, Monomeric

(2) Dimeric, Polymeric, Monomeric

(3) Monomeric, Dimeric, Polymeric

(4) Polymeric, Monomeric, Dimeric

**Question 73: Consider the following reaction that goes from A to B in three steps as shown below:**



**Choose the correct option**

| Number of Intermediates | Number of Activated complex | Rate determining step |
|---|---|---|
| (1) 2 | 3 | II |
| (2) 3 | 2 | II |
| (3) 2 | 3 | III |
| (4) 2 | 3 | I |

**Question 74: The product, which is not obtained during the electrolysis of brine solution is**

(1) HCl

(2) NaOH

(3) Cl$_2$

(4) H$_2$

**Question 75: Which one of the following elements will remain as liquid inside pure boil-**

**ing water?**

(1) Li

(2) Ga

(3) Cs

(4) Br

---

**Question 76: Given below are two statements: one is labelled as "Assertion A" and the other is labelled as "Reason R"**

**Assertion A:** In the complex $Ni(CO)_4$ and $Fe(CO)_5$, the metals have zero oxidation state.

**Reason R:** Low oxidation states are found when a complex has ligands capable of $\pi$-donor character in addition to the $\sigma$-bonding.

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

**(1) A is not correct but R is correct.**

**(2) A is correct but R is not correct**

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

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

---

**Question 77: Given below are two statements:**

**Statement I:** Morphine is a narcotic analgesic. It helps in relieving pain without producing sleep.

**Statement II:** Morphine and its derivatives are obtained from opium poppy.

In the light of the above statements, choose the correct answer from the options given below **(1) Statement I is true but statement II is false**

**(2) Both statement I and statement II are true**

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

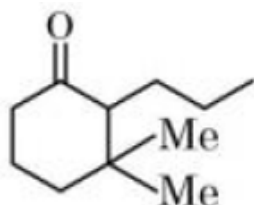**(4) Both Statement I and Statement II are false**

**Question 78: Find out the major product from the following reaction.**

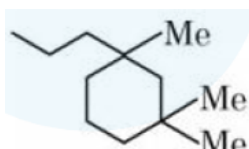$$\xrightarrow[\text{(2) n Pr1}]{\text{(1) MeMgBr/CuI}}$$
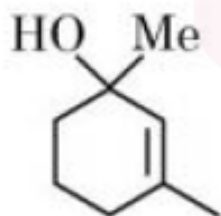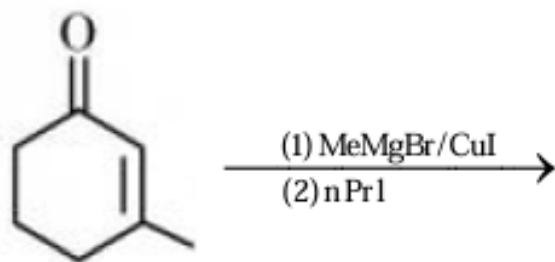
(1)
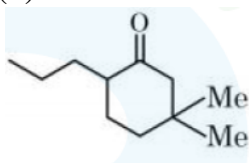
(2)

(3)

(4)

---

**Question 79: During the reaction of permanganate with thiosulphate, the change in oxidation of manganese occurs by value of 3. Identify which of the below medium will favour the reaction**

(1) aqueous neutral

(2) aqueous acidic

(3) both aqueous acidic and neutral
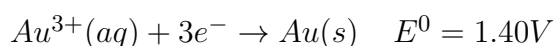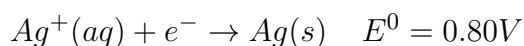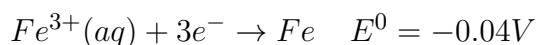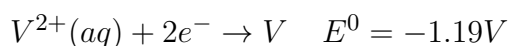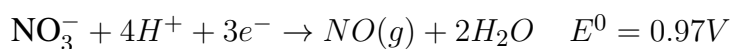
(4) both aqueous acidic and faintly alkaline

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**Question 80: Element not present in Nessler's reagent is**

(1) K

(2) N

(3) I

(4) Hg

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## Section B

**Question 81: The standard reduction potentials at 298 K for the following half cells are given below:**

$$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O \quad E^0 = 0.97V$$

$$V^{2+}(aq) + 2e^- \rightarrow V \quad E^0 = -1.19V$$

$$Fe^{3+}(aq) + 3e^- \rightarrow Fe \quad E^0 = -0.04V$$

$$Ag^+(aq) + e^- \rightarrow Ag(s) \quad E^0 = 0.80V$$

$$Au^{3+}(aq) + 3e^- \rightarrow Au(s) \quad E^0 = 1.40V$$

**The number of metal(s) which will be oxidized by $NO_3^-$ in aqueous solution is _____**

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**Question 82: Number of crystal system from the following where body centred unit cell can be found, is _____**

Cubic, tetragonal, orthorhombic, hexagonal, rhombohedral, monoclinic, triclinic

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**Question 83: Among the following the number of compounds which will give positive iodoform reaction is _____**

(a) 1-Phenylbutan-2-one

(b) 2-Methylbutan-2-ol

(c) 3-Methylbutan-2-ol

(d) 1-Phenylethanol

(e) 3,3-dimethylbutan-2-one

(f) 1-Phenylpropan-2-ol

**Question 84: Number of isomeric aromatic amines with molecular formula $C_8H_{11}N$, which can be synthesized by Gabriel Phthalimide synthesis is** _____

**Question 85: Consider the following pairs of solution which will be isotonic at the same temperature. The number of pairs of solutions is/are** _____

A. 1 M aq. NaCl and 2 M aq. Urea

B. 1 M aq. $CaCl_2$ and 1.5 M aq. KCl

C. 1.5 M aq. $AlCl_3$ and 2 M aq. $Na_2SO_4$

D. 2.5 M aq. KCl and 1 M aq. $Al_2(SO_4)_3$

**Question 86: The number of colloidal systems from the following, which will have 'liquid' as the dispersion medium, is** _____

Gem stones, paints, smoke, cheese, milk, hair cream, insecticide sprays, froth, soap lather

**Question 87: In an ice crystal, each water molecule is hydrogen bonded to neighbouring molecules.**

**Question 88: Consider the following data**

Heat of combustion of $H_2(g) = -241.8$ kJ mol$^{-1}$

Heat of combustion of $C(s) = -393.5$ kJ mol$^{-1}$

Heat of combustion of $C_2H_5OH(l) = -1234.7$ kJ mol$^{-1}$

**The heat of formation of $C_2H_5OH(l)$ is (-)** _____ kJ mol$^{-1}$ (Nearest integer).

**Question 89: The equilibrium composition for the reaction $PCl_3 + Cl_2 \rightleftharpoons PCl_5$ at 298 K is given below:**

$PCl_3]_{eq} = 0.2$ mol L$^{-1}$, $[Cl_2]_{eq} = 0.1$ mol L$^{-1}$, $[PCl_5]_{eq} = 0.40$ mol L$^{-1}$

**If 0.2 mol of Cl$_2$ is added at the same temperature, the equilibrium concentrations of PCl$_5$ is** _____ **$\times$ 10$^{-2}$ mol L$^{-1}$**

Given: K$_c$ for the reaction at 298 K is 20

---

**Question 90: The number of species having a square planar shape from the following is**

_____

XeF$_4$, SF$_4$, SiF$_4$, BrF$_4^-$, [Cu(NH$_3$)$_4$]$^{2+}$, [FeCl$_4$]$^{2-}$, [PtCl$_4$]$^{2-}$

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