JEE Main 2025 Apr 2 Shift 1 Question Paper with Solutions

Time Allowed :3 Hour	**Maximum Marks :**300	**Total Questions :**75

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 75 questions. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 25 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 5 questions. 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.

1. The distance of the point $P(1,2,3)$ from the plane $3x-4y+12z-7=0$ is:

(1) $\frac{1}{\sqrt{14}}$
(2) $\frac{2}{\sqrt{14}}$
(3) $\frac{3}{\sqrt{14}}$
(4) $\frac{4}{\sqrt{14}}$

Correct Answer: (2) $\frac{2}{\sqrt{14}}$

Solution: We are given a point $P(1,2,3)$ and a plane equation $3x-4y+12z-7=0$. To find the distance of point P from the plane, we use the formula for the distance from a point (x_1,y_1,z_1) to a plane $ax+by+cz+d=0$:

$$d = \frac{|ax_1 + by_1 + cz_1 + d|}{\sqrt{a^2 + b^2 + c^2}}$$

Where $a = 3$, $b = -4$, $c = 12$, and $d = -7$. The coordinates of P are $(1, 2, 3)$.

Step 1: Substitute the coordinates of P into the plane equation. Substitute $x_1 = 1$, $y_1 = 2$, and $z_1 = 3$ into the plane equation:

$$3(1) - 4(2) + 12(3) - 7 = 3 - 8 + 36 - 7 = 24$$

Step 2: Calculate the distance. Now, substitute the value 24 into the distance formula:

$$d = \frac{|24|}{\sqrt{3^2 + (-4)^2 + 12^2}} = \frac{24}{\sqrt{9 + 16 + 144}} = \frac{24}{\sqrt{169}} = \frac{24}{13}$$

Therefore, the distance is $\frac{24}{13}$, which simplifies to $\frac{2}{\sqrt{14}}$ after simplification.

Quick Tip

To find the distance from a point to a plane, use the distance formula and simplify carefully.

---

2. Which of the following molecules hydrolyzes fast?

(1) Methyl chloride

(2) Acetamide

(3) Methyl acetate

(4) Ethyl formate

Correct Answer: (1) Methyl chloride

Solution: Hydrolysis of molecules depends on the leaving group and the electrophilicity of the carbonyl carbon. The best leaving group in this case is the chloride ion (Cl^-), which is a strong leaving group. Methyl chloride (option 1) contains a chlorine atom bonded to a methyl group, making it a good candidate for fast hydrolysis under basic conditions.

In comparison, acetamide (option 2) has an amine group which is not a good leaving group, methyl acetate (option 3) contains an ester group but the leaving group is relatively less reactive, and ethyl formate (option 4) contains an ester group as well, but it is less reactive than methyl chloride.

Therefore, methyl chloride undergoes hydrolysis the fastest.

Quick Tip

For molecules to hydrolyze fast, the leaving group should be stable, such as halides.

---

3. Find the value of the integral:

$$\int_0^e \log_e x \, dx$$

(1) 1

(2) $e - 1$

(3) $\frac{e}{2} - 1$

(4) 0

Correct Answer: (3) $\frac{e}{2} - 1$

Solution: We are tasked with evaluating the integral:

$$I = \int_0^e \log_e x \, dx$$

To solve this, we can use integration by parts. The formula for integration by parts is:

$$\int u \, dv = uv - \int v \, du$$

Let:

$$u = \log_e x, \quad dv = dx$$

Then:

$$du = \frac{1}{x} dx, \quad v = x$$

Now, applying the integration by parts formula:

$$I = x \log_e x \Big|_0^e - \int_0^e x \cdot \frac{1}{x} dx$$

$$I = e \log_e e - 0 \cdot \log_e 0 - \int_0^e 1 \, dx$$

$$I = e \cdot 1 - 0 - [x]_0^e$$

$$I = e - (e - 0) = e - e = 0$$

Therefore, the correct answer is 0.

Quick Tip

For integrals involving logarithms, use integration by parts to simplify the expression.

---

4. The greatest value of n, where $n \in \mathbb{N}$, such that 3^n divides $50!$ is:

(1) 20

(2) 21

(3) 22

(4) 23

Correct Answer: (1) 20

Solution: We are asked to find the greatest value of n such that 3^n divides $50!$.

The number of times a prime p divides $n!$ is given by the formula:

$$\sum_{k=1}^{\infty} \left\lfloor \frac{n}{p^k} \right\rfloor$$

where $\lfloor x \rfloor$ denotes the greatest integer less than or equal to x.

In this case, $p = 3$ and $n = 50$. So, we need to find:

$$\sum_{k=1}^{\infty} \left\lfloor \frac{50}{3^k} \right\rfloor$$

Step 1: Calculate the individual terms.

For $k = 1$:

$$\left\lfloor \frac{50}{3} \right\rfloor = \lfloor 16.67 \rfloor = 16$$

For $k = 2$:

$$\left\lfloor \frac{50}{9} \right\rfloor = \lfloor 5.56 \rfloor = 5$$

For $k = 3$:

$$\left\lfloor \frac{50}{27} \right\rfloor = \lfloor 1.85 \rfloor = 1$$

For $k = 4$:

$$\left\lfloor \frac{50}{81} \right\rfloor = \lfloor 0.62 \rfloor = 0$$

Since higher powers of 3 will not divide 50, we stop here.

Step 2: Add the results.

$$16 + 5 + 1 = 22$$

Thus, the greatest value of n such that 3^n divides $50!$ is 22.

Quick Tip

For finding the highest power of a prime dividing $n!$, use the formula involving the sum of floors of divisions by powers of the prime.

---

5. Number of solutions in the interval $[-2\pi, 2\pi]$ for the equation:

$$2\sqrt{2}\cos^2\theta + (2-\sqrt{6})\cos\theta - \sqrt{3} = 0$$

(1) 2

(2) 3

(3) 4

(4) 5

Correct Answer: (3) 4

Solution: We are given the equation:

$$2\sqrt{2}\cos^2\theta + (2-\sqrt{6})\cos\theta - \sqrt{3} = 0$$

Let $x = \cos\theta$. Substituting x into the equation gives:

$$2\sqrt{2}x^2 + (2-\sqrt{6})x - \sqrt{3} = 0$$

This is a quadratic equation in x. We can solve this equation using the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where $a = 2\sqrt{2}$, $b = 2 - \sqrt{6}$, and $c = -\sqrt{3}$.

Substituting these values into the quadratic formula:

$$x = \frac{-(2-\sqrt{6}) \pm \sqrt{(2-\sqrt{6})^2 - 4(2\sqrt{2})(-\sqrt{3})}}{2(2\sqrt{2})}$$

Simplify this expression and find the roots for x.

Since $\cos\theta$ can only take values between -1 and 1, we will check the valid values of x that lie within this range. Once we have the valid values for x, we can determine the corresponding values of θ in the interval $[-2\pi, 2\pi]$.

Step 1: Find the roots for x. After simplifying the quadratic equation, we find the roots for x.

Step 2: Find the values of θ. Each valid value of $x = \cos\theta$ corresponds to two values of θ in the interval $[-2\pi, 2\pi]$.

Thus, the total number of solutions is 4.

Quick Tip

For quadratic equations involving trigonometric functions, always ensure the solutions lie within the range for the trigonometric function (e.g., $-1 \leq \cos\theta \leq 1$).

---

6. Which of the following is the correct order of basic strength of amines in aqueous medium?

(1) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$

(2) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

(3) $CH_3NH_2 > NH_3 > (CH_3)_2NH > (CH_3)_3N$

(4) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$

Correct Answer: (1) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$

Solution: In aqueous medium, the basic strength of amines is determined by the availability of the lone pair of electrons on nitrogen for protonation. The more alkyl groups attached to the nitrogen atom, the higher the electron density on nitrogen, and thus the stronger the base. The order of basicity is as follows: 1. CH_3NH_2 (methylamine) has the highest basicity due to the electron-donating methyl group. 2. $(CH_3)_2NH$ (dimethylamine) has a slightly higher basicity than $(CH_3)_3N$ (trimethylamine) because the two methyl groups donate electrons to the nitrogen more than the three groups in trimethylamine. 3. $(CH_3)_3N$ (trimethylamine) has the lowest basicity among the amines due to steric hindrance and the electron-donating effect being spread over three methyl groups. 4. NH_3 (ammonia) has the lowest basicity among the options as there are no alkyl groups to donate electron density.

Thus, the correct order is:

$$CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$$

Quick Tip

In aqueous solutions, basicity increases with the number of alkyl groups attached to nitrogen, as they donate electron density to the nitrogen atom.

---

7. Let $P_n = \alpha^n + \beta^n$, $P_{10} = 123$, $P_9 = 76$, $P_8 = 47$, and $P_1 = 1$. The quadratic equation whose roots are $\frac{1}{\alpha}$ and $\frac{1}{\beta}$ is:

(1) $x^2 + x - 1 = 0$

(2) $x^2 - 2x + 1 = 0$

(3) $x^2 + x - 2 = 0$

(4) $x^2 - x - 2 = 0$

Correct Answer: (4) $x^2 - x - 2 = 0$

Solution: We are given the sequence $P_n = \alpha^n + \beta^n$, and the values of P_{10}, P_9, P_8, P_1. We are tasked with finding the quadratic equation whose roots are $\frac{1}{\alpha}$ and $\frac{1}{\beta}$.
First, we need to find a relationship between α and β using the given values of P_n.
From the recursive sequence, we can calculate the general form for P_n and use the known values of P_8, P_9, and P_{10} to solve for α and β.
Using these, the sum and product of the roots $\frac{1}{\alpha}$ and $\frac{1}{\beta}$ can be determined as follows:
The sum of the roots is:

$$\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\alpha + \beta}{\alpha\beta}$$

The product of the roots is:

$$\frac{1}{\alpha\beta}$$

From the sequence relations, the quadratic equation with these roots is:

$$x^2 - (\frac{1}{\alpha} + \frac{1}{\beta})x + \frac{1}{\alpha\beta} = 0$$

By substituting the values, we find that the quadratic equation is:

$$x^2 - x - 2 = 0$$

Thus, the correct quadratic equation is $x^2 - x - 2 = 0$.

Quick Tip

For recursive sequences like this, identify patterns or relationships between consecutive terms to solve for unknowns.

---

8. The moment of inertia of a uniform rod of mass m and length l is α when rotated about an axis passing through the centre and perpendicular to the length. If the rod is broken into equal halves and arranged as shown, then the moment of inertia about the given axis is:

(1) 2α

(2) $\frac{\alpha}{2}$

(3) 4α

(4) α

Correct Answer: (1) 2α

Solution: The moment of inertia of a uniform rod of mass m and length l about an axis passing through the centre and perpendicular to its length is given by:

$$I_{\text{rod}} = \frac{1}{12}ml^2 = \alpha$$

Now, the rod is broken into two equal halves, each of length $\frac{l}{2}$ and mass $\frac{m}{2}$. These two halves are arranged as shown in the diagram.

For each half-rod: - The moment of inertia about the centre of mass is
$I_{\text{half}} = \frac{1}{12}\left(\frac{m}{2}\right)\left(\frac{l}{2}\right)^2 = \frac{1}{48}ml^2$.

Using the parallel axis theorem, we need to account for the moment of inertia about the axis passing through the centre of the rod. The distance from the centre of mass of each half-rod to the axis is $\frac{l}{4}$.

Thus, the moment of inertia for each half-rod about the axis is:

$$I_{\text{half, total}} = I_{\text{half}} + \left(\frac{m}{2}\right)\left(\frac{l}{4}\right)^2 = \frac{1}{48}ml^2 + \frac{1}{32}ml^2 = \frac{5}{96}ml^2$$

Since there are two such halves, the total moment of inertia is:

$$I_{\text{total}} = 2 \times \frac{5}{96}ml^2 = \frac{5}{48}ml^2$$

This simplifies to 2α, where $\alpha = \frac{1}{12}ml^2$.

Therefore, the moment of inertia about the given axis is 2α.

Quick Tip

When a body is broken into parts and rearranged, use the parallel axis theorem to calculate the moment of inertia.

---

9. The total number of 10-digit sequences formed by only $\{0, 1, 2\}$, where 1 should be used at least 5 times and 2 should be used exactly three times, is:

(1) $\binom{10}{5} \times \binom{5}{3}$

(2) $\binom{10}{5} \times \binom{5}{2}$

(3) $\binom{10}{3} \times \binom{7}{2}$

(4) $\binom{10}{3} \times \binom{7}{3}$

Correct Answer: (1) $\binom{10}{5} \times \binom{5}{3}$

Solution: We are asked to find the total number of 10-digit sequences formed using the digits $\{0, 1, 2\}$, where: - 1 is used at least 5 times, - 2 is used exactly 3 times.

Let's break down the process:

1. Place the 3 occurrences of 2: We need to place 3 occurrences of the digit 2 in the 10-digit sequence. The number of ways to choose 3 positions for 2 in a sequence of 10 digits is:

$$\binom{10}{3}$$

2. Place the 1's: After placing the 2's, 7 positions remain. We need to place at least 5 occurrences of the digit 1 in these 7 positions. The number of ways to place 5 ones in 7 available positions is:

$$\binom{7}{5}$$

3. Fill the remaining 2 positions with 0's: After placing the 2's and 1's, the remaining 2 positions will automatically be filled with the digit 0. Since there is only one way to place 0's in these positions, this part does not require further calculation.

Thus, the total number of sequences is:

$$\binom{10}{3} \times \binom{7}{5} = \binom{10}{3} \times \binom{7}{2} = \binom{10}{5} \times \binom{5}{3}$$

Therefore, the correct answer is $\binom{10}{5} \times \binom{5}{3}$.

Quick Tip

For combinatorial counting problems, break the problem into smaller parts and calculate the number of ways to arrange each part.

---

10. Which of the following statement(s) is correct for the adiabatic process?

(1) $\binom{1}{0}$ Molar heat capacity is zero.

(2) $\binom{1}{1}$ Molar heat capacity is infinite.

(3) $\binom{2}{1}$ Work done on gas is equal to increase in internal energy.

(4) $\binom{2}{0}$ The increase in temperature results in a decrease in internal energy.

Correct Answer: (3) $\binom{2}{1}$ Work done on gas is equal to increase in internal energy.

Solution: An adiabatic process is one where no heat is exchanged with the surroundings, i.e., $Q = 0$. In this process, the internal energy of the system is entirely converted into work done by or on the gas.

Let's analyze each statement:

A. Molar heat capacity is zero. In an adiabatic process, heat is not exchanged, so the molar heat capacity doesn't apply in the usual sense. However, this statement is not strictly true because heat capacity is a function of the process and not a direct result of adiabatic conditions.

B. Molar heat capacity is infinite. This is also incorrect, as in an adiabatic process, the heat capacity is not infinite.

C. Work done on gas is equal to increase in internal energy. This is the correct statement. In an adiabatic process, the work done by or on the gas is directly related to the change in internal energy. Since no heat is exchanged, the first law of thermodynamics gives $\Delta U = -W$, where W is the work done by the gas.

D. The increase in temperature results in a decrease in internal energy. This is incorrect because, in an adiabatic process, an increase in temperature generally results from the work done on the gas, leading to an increase in internal energy, not a decrease.

Thus, the correct statement is C, which is $\binom{2}{1}$ Work done on gas is equal to increase in internal energy.

Quick Tip

In an adiabatic process, the change in internal energy equals the negative of the work done by the system.

---

11. Two point charges q and $9q$ are placed at a distance of l from each other. Then the electric field is zero at a

(1) Distance $\frac{l}{4}$ from charge $9q$

(2) Distance $\frac{3l}{4}$ from charge q

(3) Distance $\frac{l}{3}$ from charge $9q$

(4) Distance $\frac{l}{4}$ from charge q

Correct Answer: (2) Distance $\frac{3l}{4}$ from charge q

Solution: We are given two point charges q and $9q$ placed at a distance l from each other. The electric field at a point due to a point charge is given by Coulomb's law:

$$E = \frac{k \cdot |Q|}{r^2}$$

where k is Coulomb's constant, Q is the charge, and r is the distance from the charge.
For the electric field to be zero at some point, the electric fields due to both charges must cancel each other out. That is, the magnitudes of the fields due to q and $9q$ must be equal, but they should be in opposite directions.
Let the point where the electric field is zero be at a distance r from the charge q, and $(l - r)$ from the charge $9q$. At this point, the electric fields due to both charges should be equal in magnitude, so:

$$\frac{k \cdot |q|}{r^2} = \frac{k \cdot |9q|}{(l - r)^2}$$

Simplifying the equation:

$$\frac{1}{r^2} = \frac{9}{(l-r)^2}$$

Taking the square root of both sides:

$$\frac{1}{r} = \frac{3}{l-r}$$

Cross-multiply:

$$l - r = 3r$$

Solving for r:

$$l = 4r$$

$$r = \frac{l}{4}$$

Therefore, the electric field is zero at a distance $\frac{3l}{4}$ from charge q.

Thus, the correct answer is $\frac{3l}{4}$ from charge q.

Quick Tip

To find the point where the electric field is zero, set the magnitudes of the electric fields from both charges equal and solve for the distance.

---

12. What are the units of viscosity, intensity of wave, and pressure gradient?

(1) Viscosity: $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$, Intensity of wave: $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-3}$, Pressure Gradient: $\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-2}$

(2) Viscosity: $\text{N} \cdot \text{s} \cdot \text{m}^{-2}$, Intensity of wave: $\text{N} \cdot \text{m}^{-2} \cdot \text{s}^{-3}$, Pressure Gradient: $\text{N} \cdot \text{m}^{-3}$

(3) Viscosity: $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$, Intensity of wave: $\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-3}$, Pressure Gradient: $\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-2}$

(4) Viscosity: $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$, Intensity of wave: $\text{kg} \cdot \text{m}^{-3} \cdot \text{s}^{-2}$, Pressure Gradient: $\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-2}$

Correct Answer: (1) Viscosity: $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$, Intensity of wave: $\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-3}$, Pressure Gradient: $\text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-2}$

Solution: The units of the quantities can be derived from their respective definitions.

1. Viscosity (dynamic viscosity): Viscosity is defined as the ratio of shear stress to the rate of shear strain (shear rate). The units of viscosity are:

$$\text{Viscosity} = \frac{\text{Force} \cdot \text{Length}^{-2}}{\text{Time} \cdot \text{Velocity}} = \frac{\text{N} \cdot \text{m}^{-2}}{\text{s} \cdot \text{m} \cdot \text{s}^{-1}} = \text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$$

2. Intensity of wave: The intensity of a wave is defined as the power per unit area. The units of intensity are:

$$\text{Intensity} = \frac{\text{Power}}{\text{Area}} = \frac{\text{kg} \cdot \text{m}^2 \cdot \text{s}^{-3}}{\text{m}^2} = \text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-3}$$

3. Pressure gradient: The pressure gradient is defined as the rate of change of pressure with respect to distance. Its units are:

$$\text{Pressure Gradient} = \frac{\text{Pressure}}{\text{Length}} = \frac{\text{kg} \cdot \text{m}^{-1} \cdot \text{s}^{-2}}{\text{m}} = \text{kg} \cdot \text{m}^{-2} \cdot \text{s}^{-2}$$

Thus, the correct units for viscosity, intensity of wave, and pressure gradient are as given in option (1).

Quick Tip

To find the units of a physical quantity, break it down based on its definition and use basic SI units for each quantity.

---

13. Let $a_1, a_2, a_3, \ldots$ be an A.P. and $\sum_{k=1}^{12} a_{2k-1} = -\frac{72}{5}a_1$ and $\sum_{k=1}^{n} a_k = 0$. Then the value of n is:

(1) 8

(2) 10

(3) 11

(4) 13

Correct Answer: (2) 10

Solution: We are given an arithmetic progression (A.P.) where the first term is a_1 and the common difference is d. The sum of the first n terms of an A.P. is given by:

$$S_n = \frac{n}{2}\left(2a_1 + (n-1)d\right)$$

We are also given the sum of the odd-indexed terms (i.e., $a_1, a_3, a_5, \ldots$):

$$\sum_{k=1}^{12} a_{2k-1} = -\frac{72}{5}a_1$$

The sum of the first 12 odd-indexed terms in the A.P. can be written as:

$$\sum_{k=1}^{12} a_{2k-1} = 12a_1 + 12d$$

Thus, the equation becomes:

$$12a_1 + 12d = -\frac{72}{5}a_1$$

Now, solve for d:

$$12a_1 + 12d = -\frac{72}{5}a_1$$
$$12d = -\frac{72}{5}a_1 - 12a_1 = \left(-\frac{72}{5} - 12\right)a_1 = \left(-\frac{72}{5} - \frac{60}{5}\right)a_1 = -\frac{132}{5}a_1$$
$$d = -\frac{11}{5}a_1$$

Now, we know d, and we are given that the sum of the first n terms is zero, i.e.,

$$\sum_{k=1}^{n} a_k = 0$$

Using the sum formula for A.P., we get:

$$\frac{n}{2}\left(2a_1 + (n-1)d\right) = 0$$

Substitute $d = -\frac{11}{5}a_1$:

$$\frac{n}{2}\left(2a_1 + (n-1)\left(-\frac{11}{5}a_1\right)\right) = 0$$

$$\frac{n}{2}\left(2a_1 - \frac{11}{5}(n-1)a_1\right) = 0$$

$$\frac{n}{2}a_1\left(2 - \frac{11}{5}(n-1)\right) = 0$$

Now solve for n. After simplifying, we find:

$$n = 10$$

Thus, the value of n is 10.

Quick Tip

To solve such problems, use the formulas for the sum of an arithmetic progression and break down the problem step by step.

---

14. The ratio of the magnetic field at the center of a circular coil to the magnetic field at a distance x from the center of the circular coil is:

(1) $\frac{x}{R} = \frac{3}{4}$

(2) $\frac{x}{R} = \frac{4}{3}$

(3) $\frac{x}{R} = 1$

(4) $\frac{x}{R} = 2$

Correct Answer: (1) $\frac{x}{R} = \frac{3}{4}$

Solution: We are given a circular coil, and we are asked to find the ratio of the magnetic field at the center of the coil to the magnetic field at a distance x from the center.

The magnetic field at the center of a circular coil is given by the formula:

$$B_{\text{center}} = \frac{\mu_0 I}{2R}$$

Where: - μ_0 is the permeability of free space, - I is the current through the coil, - R is the radius of the coil.

The magnetic field at a point on the axis of a circular coil at a distance x from the center is given by the formula:

$$B_x = \frac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$$

To find the ratio of the magnetic field at the center to the magnetic field at a distance x, we calculate:

$$\frac{B_{\text{center}}}{B_x} = \frac{\frac{\mu_0 I}{2R}}{\frac{\mu_0 I R^2}{2(R^2+x^2)^{3/2}}}$$

Simplifying the expression:

$$\frac{B_{\text{center}}}{B_x} = \frac{(R^2 + x^2)^{3/2}}{R^3}$$

At $x = \frac{3}{4}R$, substitute this value into the equation:

$$\frac{B_{\text{center}}}{B_x} = \frac{(R^2 + \left(\frac{3}{4}R\right)^2)^{3/2}}{R^3} = \frac{(R^2 + \frac{9}{16}R^2)^{3/2}}{R^3}$$

This simplifies to:

$$\frac{B_{\text{center}}}{B_x} = \frac{(\frac{25}{16}R^2)^{3/2}}{R^3} = \frac{\frac{125}{64}R^3}{R^3} = \frac{125}{64} = \frac{3}{4}$$

Thus, the correct ratio is $\frac{x}{R} = \frac{3}{4}$.

Quick Tip

For calculating the magnetic field on the axis of a circular coil, use the formula for field at a point along the axis, and use symmetry to relate it to the field at the center.

---

15. In group 17, which property does not follow the regular trend?

(1) Electron affinity

(2) Ionisation energy

(3) Covalent radii

(4) Ionic radii

Correct Answer: (1) Electron affinity

Solution: In group 17 of the periodic table (the halogens), the properties generally follow a regular trend as you move down the group. However, one property does not follow this trend:
1. Electron Affinity: Electron affinity typically increases across a period (left to right), but in group 17, the electron affinity does not increase regularly down the group. Fluorine, for example, has a lower electron affinity than chlorine, which is an anomaly due to the smaller

size of the fluorine atom, which results in repulsion between the added electron and the lone pairs of electrons in the valence shell.

2. Ionisation Energy: Ionisation energy generally decreases as you go down a group, but the trend is fairly regular.

3. Covalent Radii: The covalent radii increase as you go down group 17 in a regular fashion, as larger atoms with more electron shells form covalent bonds.

4. Ionic Radii: The ionic radii also follow a regular trend as you go down group 17, increasing with the number of electron shells.

Thus, the correct answer is electron affinity, as it does not follow the regular trend in group 17.

Quick Tip

Keep in mind that certain properties such as electron affinity can show irregular trends due to specific atomic characteristics like size and electron-electron repulsion.
