VITEEE 2026 April 30 Shift 2

Question Paper with Solutions

Conducted by VIT Vellore

General Instructions

(i) Duration: The total duration of the examination is 2.5 hours (150 minutes).

(ii) Total Marks: The complete paper carries a maximum of 500 marks.

(iii) Structure: The paper has 4 Sections:

- **Part 1:** 35 Multiple Choice Questions (Physics).
- **Part 2:** 35 Multiple Choice Questions (Chemistry).
- **Part 3:** 40 Multiple Choice Questions (Mathematics/Biology).
- **Part 4:** 10 Multiple Choice Questions (Aptitude).
- **Part 5:** 5 Multiple Choice Questions (English)

(iv) Compulsory Questions: All 125 questions are compulsory.

(v) Each question has four options. Only **one** option is correct.

(vi) **Correct Answer:** +4 marks.

(vii) Incorrect Answer: −1 (Negative marking).

(viii) Unanswered/Marked for Review: 0 marks.

1. A bag contains 4 red and 6 black balls. A ball is drawn at random, its colour is noted and it is returned to the bag. Moreover, 2 additional balls of the colour drawn are put in the bag and then a ball is drawn at random. What is the probability that the second ball is red?

(A) $\frac{1}{3}$

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

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

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

Correct Answer: (B) $\frac{2}{5}$

Solution:

Concept:

This problem uses the **Law of Total Probability**. If an event can occur through multiple mutually exclusive cases, then the total probability is the sum of probabilities through each case.

$$P(A) = P(B_1)P(A|B_1) + P(B_2)P(A|B_2)$$

where B_1, B_2 are different possible outcomes of the first event.

Here,

- R_1: First ball drawn is red
- B_1: First ball drawn is black
- R_2: Second ball drawn is red

Thus,

$$P(R_2) = P(R_1)P(R_2|R_1) + P(B_1)P(R_2|B_1)$$

Step 1: Find the probability that the first ball is red or black.

Initially the bag contains:

$$4 \text{ red}, \quad 6 \text{ black}$$

Total balls $= 10$.

$$P(R_1) = \frac{4}{10}, \qquad P(B_1) = \frac{6}{10}$$

Step 2: Find the probability that the second ball is red if the first ball was red.

If the first ball drawn is red:

- The ball is returned.
- Two additional red balls are added.

New composition:

$$6 \text{ red}, \quad 6 \text{ black}$$

Total balls $= 12$.

$$P(R_2|R_1) = \frac{6}{12}$$

Step 3: Find the probability that the second ball is red if the first ball was black.

If the first ball drawn is black:

- The ball is returned.
- Two additional black balls are added.

New composition:

$$4 \text{ red}, \quad 8 \text{ black}$$

Total balls $= 12$.

$$P(R_2|B_1) = \frac{4}{12}$$

Step 4: Apply the law of total probability.

$$P(R_2) = P(R_1)P(R_2|R_1) + P(B_1)P(R_2|B_1)$$

$$P(R_2) = \left(\frac{4}{10} \times \frac{6}{12}\right) + \left(\frac{6}{10} \times \frac{4}{12}\right)$$

$$P(R_2) = \frac{24}{120} + \frac{24}{120}$$

$$P(R_2) = \frac{48}{120} = \frac{2}{5}$$

$$\boxed{P(R_2) = \frac{2}{5}}$$

Quick Tip: Whenever the result of the second experiment depends on the outcome of the first experiment, use the **Law of Total Probability**:

$$P(A) = \sum P(B_i)P(A|B_i)$$

Break the problem into cases based on the first event and then combine the probabilities.

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2. Find the integrating factor (I.F.) for the differential equation

$$\frac{dy}{dx} + y\sec x = \tan x.$$

(A) $\sec x - \tan x$

(B) $\sec x + \tan x$

(C) $\tan x$

(D) $\sec x$

Correct Answer: (B) $\sec x + \tan x$

Solution:

Concept:

A first-order linear differential equation has the form

$$\frac{dy}{dx} + Py = Q$$

The integrating factor (I.F.) is given by

$$I.F. = e^{\int P\,dx}$$

Multiplying the differential equation by the integrating factor converts the left side into the derivative of a product, making it easier to solve.

Step 1: Identify the standard linear form.

Given equation:

$$\frac{dy}{dx} + y\sec x = \tan x$$

Comparing with

$$\frac{dy}{dx} + Py = Q$$

we get

$$P = \sec x$$

Step 2: Apply the integrating factor formula.

$$I.F. = e^{\int P\,dx}$$

$$I.F. = e^{\int \sec x\,dx}$$

Step 3: Evaluate the integral of $\sec x$.

$$\int \sec x\,dx = \ln|\sec x + \tan x|$$

Thus,

$$I.F. = e^{\ln(\sec x + \tan x)}$$

$$I.F. = \sec x + \tan x$$

$$\boxed{\sec x + \tan x}$$

Quick Tip: For any linear differential equation of the form

$$\frac{dy}{dx} + Py = Q$$

the integrating factor is always

$$I.F. = e^{\int P\,dx}.$$

Memorize common integrals such as $\int \sec x\,dx = \ln|\sec x + \tan x|$ to solve quickly.

3. If ω is an imaginary cube root of unity, find the value of $(1+\omega-\omega^2)^7$.

(A) $128\omega^2$

(B) $-128\omega^2$

(C) 64ω

(D) $-64\omega^2$

Correct Answer: (B) $-128\omega^2$

Solution:

Concept:

For cube roots of unity,

$$1+\omega+\omega^2=0$$

and

$$\omega^3=1$$

These identities allow simplification of expressions involving powers of ω.

Step 1: Use the identity of cube roots of unity.

$$1+\omega+\omega^2=0$$

Rearranging,

$$1+\omega=-\omega^2$$

Step 2: Simplify the given expression.

$$1+\omega-\omega^2$$

Substitute $1+\omega=-\omega^2$:

$$1+\omega-\omega^2=-\omega^2-\omega^2$$

$$= -2\omega^2$$

Step 3: Raise to the power 7.

$$(1+\omega-\omega^2)^7 = (-2\omega^2)^7$$

$$= (-2)^7(\omega^2)^7$$

$$= -128\,\omega^{14}$$

Step 4: Reduce the power of ω.

Since

$$\omega^3 = 1$$

$$\omega^{14} = \omega^{12+2} = (\omega^3)^4\omega^2$$

$$= 1^4\omega^2 = \omega^2$$

Thus,

$$(1+\omega-\omega^2)^7 = -128\omega^2$$

$$\boxed{-128\omega^2}$$

Quick Tip: For cube roots of unity always remember:

$$1+\omega+\omega^2 = 0, \qquad \omega^3 = 1$$

Reduce higher powers using $\omega^3 = 1$ and simplify expressions quickly.

4. In an LCR series circuit, the resonance frequency is f. If the capacitance is made 4 times, what will be the new resonance frequency?

(A) $4f$

(B) $2f$

(C) $f/2$

(D) $f/4$

Correct Answer: (C) $f/2$

Solution:

Concept:

For an LCR series circuit, the resonance frequency is given by

$$f = \frac{1}{2\pi\sqrt{LC}}$$

where L is the inductance and C is the capacitance.

Thus, resonance frequency is inversely proportional to the square root of capacitance.

Step 1: Write the formula for resonance frequency.

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Step 2: Substitute the new capacitance.

Given that the capacitance becomes

$$C' = 4C$$

The new frequency becomes

$$f' = \frac{1}{2\pi\sqrt{L(4C)}}$$

Step 3: Simplify the expression.

$$f' = \frac{1}{2\pi\sqrt{4LC}}$$

$$f' = \frac{1}{2\pi \cdot 2\sqrt{LC}}$$

$$f' = \frac{1}{2}\left(\frac{1}{2\pi\sqrt{LC}}\right)$$

$$f' = \frac{f}{2}$$

$$\boxed{f' = \frac{f}{2}}$$

Quick Tip: In an LCR circuit,

$$f \propto \frac{1}{\sqrt{C}}$$

So if capacitance increases k times, the frequency becomes $\frac{1}{\sqrt{k}}$ times the original value.

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5. A circular coil of radius R carries a current I. The magnetic field at its centre is B. At what distance from the centre on the axis of the coil will the magnetic field be $B/8$?

(A) R

(B) $2R$

(C) $\sqrt{3}R$

(D) $4R$

Correct Answer: (C) $\sqrt{3}R$

Solution:

Concept:

Magnetic field on the axis of a circular current loop at a distance x from the centre is

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

Magnetic field at the centre of the coil is

$$B_{centre} = \frac{\mu_0 I}{2R}$$

Step 1: Relate the field on axis to the field at the centre.

Given

$$B_{axis} = \frac{B_{centre}}{8}$$

Step 2: Substitute the expressions for magnetic fields.

$$\frac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}} = \frac{1}{8}\left(\frac{\mu_0 I}{2R}\right)$$

Canceling $\mu_0 I$ and simplifying,

$$\frac{R^2}{(R^2 + x^2)^{3/2}} = \frac{1}{8R}$$

Step 3: Solve for x.

$$(R^2 + x^2)^{3/2} = 8R^3$$

Taking cube root on both sides,

$$R^2 + x^2 = 4R^2$$

$$x^2 = 3R^2$$

$$x = \sqrt{3}R$$

$$\boxed{x = \sqrt{3}R}$$

Quick Tip: Magnetic field on the axis of a current loop decreases with distance according to

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

Always compare with the field at the centre to simplify calculations quickly.

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6. In a common emitter transistor amplifier, the audio signal voltage across the collector resistance of $2\,k\Omega$ is $2V$. If the current amplification factor (β) is 100 and the base resistance is $1\,k\Omega$, find the input signal voltage.

(A) $0.1\,V$

(B) $0.01\,V$

(C) $0.02\,V$

(D) $0.005\,V$

Correct Answer: (B) $0.01\,V$ $(10\,mV)$

Solution:

Concept:

In a common emitter amplifier, the voltage gain is given by

$$A_v = \beta \left(\frac{R_C}{R_B} \right)$$

where β = current amplification factor, R_C = collector resistance, R_B = base resistance.

Also,

$$A_v = \frac{\text{Output Voltage}}{\text{Input Voltage}}$$

Step 1: Calculate the voltage gain.

Given

$$\beta = 100, \quad R_C = 2k\Omega = 2000\Omega, \quad R_B = 1k\Omega = 1000\Omega$$

$$A_v = \beta \left(\frac{R_C}{R_B} \right)$$

$$A_v = 100 \times \frac{2000}{1000}$$

$$A_v = 100 \times 2 = 200$$

Step 2: Use the relation between input and output voltage.

$$A_v = \frac{V_{out}}{V_{in}}$$

Given output voltage

$$V_{out} = 2V$$

Step 3: Calculate the input signal voltage.

$$V_{in} = \frac{V_{out}}{A_v}$$

$$V_{in} = \frac{2}{200}$$

$$V_{in} = 0.01\,V$$

$$\boxed{V_{in} = 0.01\,V = 10\,mV}$$

Quick Tip: For a common emitter amplifier:

$$A_v = \beta\left(\frac{R_C}{R_B}\right)$$

Once the voltage gain is known, input voltage can be quickly found using

$$V_{in} = \frac{V_{out}}{A_v}.$$

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7. Which of the following electrolytes is most effective in the coagulation of a negative sol like

As_2S_3?

(A) $NaCl$

(B) $MgCl_2$

(C) $AlCl_3$

(D) KCl

Correct Answer: (C) $AlCl_3$

Solution:

Concept:

According to the **Hardy–Schulze rule**, the coagulating power of an electrolyte depends on the valency of the ion having charge opposite to that of the colloidal particles.

- For a **negative sol**, the **cation** is responsible for coagulation.
- Higher the valency of the cation, greater will be its coagulating power.

Step 1: Identify the charge on the sol.

The sol As_2S_3 is a **negatively charged sol**. Therefore, the coagulating ion must be a **cation**.

Step 2: Compare the valency of cations in the given electrolytes.

$$NaCl \rightarrow Na^+ \quad (\text{valency } = 1)$$

$$MgCl_2 \rightarrow Mg^{2+} \quad (\text{valency } = 2)$$

$$AlCl_3 \rightarrow Al^{3+} \quad (\text{valency } = 3)$$

Step 3: Apply Hardy–Schulze rule.

$$Al^{3+} > Mg^{2+} > Na^+$$

Thus, Al^{3+} has the highest coagulating power.

$$\boxed{AlCl_3}$$

Quick Tip: For coagulation of colloids, remember the Hardy–Schulze rule: *The ion with charge opposite to the colloidal particles and having the highest valency causes maximum coagulation.*

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8. Which linkage joins the monosaccharide units in sucrose?

(A) $C_1 - C_4$ glycosidic linkage

(B) $C_1 - C_2$ glycosidic linkage

(C) $C_1 - C_6$ glycosidic linkage

(D) $C_2 - C_4$ glycosidic linkage

Correct Answer: (B) $C_1 - C_2$ glycosidic linkage

Solution:

Concept:

Sucrose is a disaccharide composed of two monosaccharide units:

- α-D-glucose
- β-D-fructose

These two units are connected through a **glycosidic bond**.

Step 1: Identify the carbon atoms involved.

In sucrose:

- The C_1 carbon of α-D-glucose
- The C_2 carbon of β-D-fructose

form the glycosidic linkage.

Step 2: State the type of linkage.

Thus, sucrose contains a

$$C_1 - C_2$$

glycosidic bond between glucose and fructose.

Step 3: Explain why sucrose is non-reducing.

Both reducing groups of glucose and fructose are involved in bond formation, so no free aldehyde or ketone group remains.

Hence, sucrose is a **non-reducing sugar**.

$$\boxed{C_1 - C_2 \text{ glycosidic linkage}}$$

Quick Tip: Sucrose consists of α-D-glucose and β-D-fructose joined by a $C_1 - C_2$ glycosidic bond. Since both anomeric carbons participate in bonding, sucrose is a **non-reducing sugar**.

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9. A compound is formed by two elements X and Y. Atoms of Y make ccp and those of element X occupy all the octahedral voids. What is the formula of the compound?

(A) XY_2

(B) X_2Y

(C) XY

(D) X_2Y_3

Correct Answer: (C) XY

Solution:

Concept:

In a **cubic close packed (ccp)** or **face-centered cubic (fcc)** arrangement:

- If the number of close packed atoms is N,
- The number of **octahedral voids** present is also N.

Thus,

$$\text{Number of octahedral voids} = \text{Number of atoms in ccp}$$

Step 1: Assume the number of atoms of Y.

Let the number of atoms of Y forming the ccp structure be

$$N$$

Step 2: Determine the number of octahedral voids.

In a ccp structure,

$$\text{Number of octahedral voids} = N$$

Step 3: Determine the number of atoms of X.

Since element X occupies **all octahedral voids**,

$$\text{Number of atoms of } X = N$$

Step 4: Find the ratio of X and Y.

$$X : Y = N : N = 1 : 1$$

Therefore, the formula of the compound is

$$\boxed{XY}$$

Quick Tip: In close packed structures:

$$\text{Octahedral voids} = N$$

$$\text{Tetrahedral voids} = 2N$$

where N is the number of close packed atoms.

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10. Complete the series: 285, 253, 221, 189, ?

(A) 165

(B) 157

(C) 169

(D) 145

Correct Answer: (B) 157

Solution:

Concept:
A number series often follows a specific pattern such as a constant difference, constant ratio, or another arithmetic rule. Here we check the difference between consecutive terms.

Step 1: Find the difference between consecutive terms.

$$285 - 253 = 32$$

$$253 - 221 = 32$$

$$221 - 189 = 32$$

Thus, the difference between each term is constant.

Step 2: Identify the pattern.
Since each term decreases by 32, the series follows an **arithmetic progression** with common difference

$$d = -32$$

Step 3: Find the next term.

$$189 - 32 = 157$$

$$\boxed{157}$$

Quick Tip: In number series questions, first check simple patterns such as constant difference, constant ratio, or alternating operations before looking for more complex rules.
