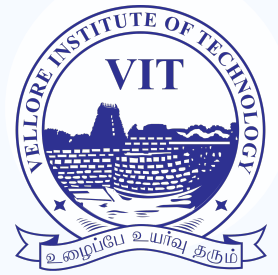


# VITEEE 2026 April 30 Shift 2

## 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 red, 6 black

Total balls = 10.

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

**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 red, 6 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 red, 8 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.

## 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.

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3. If  $\omega$  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)  $64\omega$
- (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  $\omega$ .

**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  $\omega$ .**

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:

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

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.

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

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

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

Given

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

**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.

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

- (A)  $0.1\text{ V}$
- (B)  $0.01\text{ V}$
- (C)  $0.02\text{ V}$
- (D)  $0.005\text{ V}$

**Correct Answer:** (B)  $0.01\text{ V}$  ( $10\text{ mV}$ )

**Solution:**

**Concept:**

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

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

where  $\beta$  = 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

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

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

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

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

**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.

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

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

$$V_{in} = 0.01 V$$

$$V_{in} = 0.01 V = 10 mV$$

**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

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

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:**

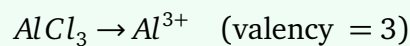
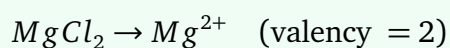
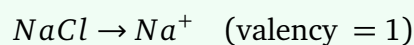
According to the **Hardy-Schulze rule**, the coagulating power of an electrolyte depends on the valency of the ion having charge opposite to that of the colloidal particles.

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

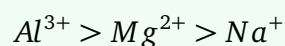
**Step 1: Identify the charge on the sol.**

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.**



**Step 3: Apply Hardy-Schulze rule.**



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



**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.*

**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:

- $\alpha$ -D-glucose
- $\beta$ -D-fructose

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

**Step 1: Identify the carbon atoms involved.**

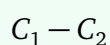
In sucrose:

- The  $C_1$  carbon of  $\alpha$ -D-glucose
- The  $C_2$  carbon of  $\beta$ -D-fructose

form the glycosidic linkage.

**Step 2: State the type of linkage.**

Thus, sucrose contains a

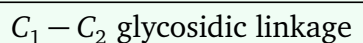


glycosidic bond between glucose and fructose.

**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**.



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

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



**Quick Tip:** In close packed structures:

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

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

where  $N$  is the number of close packed atoms.

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.

$$189 - 32 = 157$$

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.