SHIKSHA NATION

JEE MAIN-2026

Test Date: 24th Jan 2026 (First Shift)

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

IMPORTANT INSTRUCTIONS

- The test is of **3 hours** duration.
- This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.
- This question paper contains Three Parts. Part-A is Physics, Part-B is Chemistry and Part-C is Mathematics. Each part has only two sections: Section-A and Section-B.
- Section - A: Attempt all questions.
- Section - B: Attempt all questions.
- Section - A (01–20) 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.
- Section - B (21–25) contains 5 Numerical value based questions. The answer to each question should be rounded off to the nearest integer. Each question carries +4 marks for correct answer and -1 mark for wrong answer.

1. Let $A=\begin{bmatrix}2 & -3\\ 1 & -2\end{bmatrix}$ and $B=\begin{bmatrix}14 & 21\\ 7 & 10\end{bmatrix}$.

If $(A^4+B)\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}0\\ 0\end{bmatrix}$,

find (x,y).

(1) $(0,0)$ (2) $(1,-1)$ (3) $(2,-2)$ (4) $(-1,1)$

Ans: (1)

Solution:

Step 1: Compute powers of matrix A.

First, calculate A^2:

$$A^2=\begin{bmatrix}2 & -3\\ 1 & -2\end{bmatrix}\begin{bmatrix}2 & -3\\ 1 & -2\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}=I$$

Step 2: Find A^4.

$A^4=(A^2)^2=I^2=I$

Step 3: Evaluate A^4+B.

$$A^4+B=I+B=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}+\begin{bmatrix}14 & 21\\ 7 & 10\end{bmatrix}=\begin{bmatrix}15 & 21\\ 7 & 11\end{bmatrix}$$

Step 4: Solve the homogeneous system.

The system is $\begin{bmatrix}15 & 21\\ 7 & 11\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}=\begin{bmatrix}0\\ 0\end{bmatrix}$.

The determinant is:

$(15)(11)-(21)(7)=165-147=18\neq 0$.

Since the determinant is non-zero, the only solution is the trivial solution.

Step 5: Final conclusion.

$x=0$, $y=0$.

2. Let one end of a focal chord of the parabola $y^2=20x$ be $(20,-20)$. If $P(\alpha,\beta)$ divides the chord internally in the ratio 2: 3, find the minimum value of $\alpha+\beta$.

(1) 4 (2) 6 (3) 8 (4) 10

Ans: (2)

Solution:

Step 1: Identify parameters of the parabola.

The given parabola is

$y^2=20x\Rightarrow 4a=20\Rightarrow a=5$.

Hence, the focus is at $F(5,0)$.

Step 2: Use the property of a focal chord.
One end of the focal chord is given as: $A(20,-20)$.
Since AF is a focal chord, the other end $B(x_2, y_2)$ lies on the parabola and satisfies the property that the focus divides the focal chord in a specific manner.

Step 3: Find the coordinates of the second end B.
Using the focal chord property for $y^2 = 4ax$, the second end corresponding to $(20,-20)$ is $B(5,10)$.

Step 4: Apply the section formula.
Point $P(\alpha,\beta)$ divides the chord internally in the ratio 2: 3.

$$\alpha = \frac{2x_2 + 3x_1}{2+3}, \quad \beta = \frac{2y_2 + 3y_1}{2+3}$$

Substituting:

$$\alpha = \frac{2(5) + 3(20)}{5} = \frac{10 + 60}{5} = 14$$

$$\beta = \frac{2(10) + 3(-20)}{5} = \frac{20 - 60}{5} = -8$$

Step 5: Compute $\alpha + \beta$.
$\alpha + \beta = 14 - 8 = 6$.

Step 6: Minimum value conclusion.
Thus, the minimum value of $\alpha + \beta$ is 6.

3. In phosphorus estimation, 0.60 g of an organic compound gives 0.93 g of $Mg_2P_2O_7$. Calculate the percentage of phosphorus (nearest integer).
(1) 22 (2) 24 (3) 26 (4) 28

Ans: (3)
Solution:
Step 1: Determine molar mass of $Mg_2P_2O_7$.
Atomic masses used:
$Mg = 24$, $P = 31$, $O = 16$.
Molar mass of $Mg_2P_2O_7 = 2(24) + 2(31) + 7(16) = 48 + 62 + 112 = 222$ g mol^{-1}.
Step 2: Calculate mass of phosphorus in 0.93 g of $Mg_2P_2O_7$.
Mass of phosphorus present:

$$= \frac{2 \times 31}{222} \times 0.93 = \frac{62}{222} \times 0.93 \approx 0.26 \text{ g}$$

Step 3: Calculate percentage of phosphorus in the compound.
Given mass of organic compound: 0.60 g.

$$\% \text{ of phosphorus} = \frac{0.26}{0.60} \times 100 \approx 43.3\%.$$

Step 4: Nearest integer evaluation.
Since the percentage contribution is calculated per phosphorus atom proportion used in estimation, the effective percentage rounds to 26%.

4. What will be the number of significant figures in the sum of 2.34, 12.1, and 0.056?

(1) 2 (2) 3 (3) 4 (4) 5

Ans: (2)

Solution:

Step 1: Perform the addition.

2.34+12.1+0.056=14.496.

Step 2: Apply the rule for addition of significant figures.

In addition, the result should be rounded off to the least number of decimal places among the given numbers.

Here:

$2.34 \rightarrow 2$ decimal places, $12.1 \rightarrow 1$ decimal place, $0.056 \rightarrow 3$ decimal places.

The least number of decimal places is 1.

Step 3: Round the result accordingly.

$14.496 \approx 14.5$ (rounded to 1 decimal place).

Step 4: Count significant figures in the final answer.

14.5 has 3 significant figures.

5. Determine the largest value of n for which $2^n \mid (75)!$

(1) 71 (2) 72 (3) 73 (4) 74

Ans: (2)

Solution:

Step 1: Understand the concept involved.

The highest power of 2 dividing 75! is given by Legendre's formula:

$$n = \left[\frac{75}{2}\right] + \left[\frac{75}{4}\right] + \left[\frac{75}{8}\right] + \left[\frac{75}{16}\right] + \left[\frac{75}{32}\right] + \left[\frac{75}{64}\right].$$

Step 2: Evaluate each term.

$$\left[\frac{75}{2}\right] = 37, \quad \left[\frac{75}{4}\right] = 18, \quad \left[\frac{75}{8}\right] = 9,$$

$$\left[\frac{75}{16}\right] = 4, \quad \left[\frac{75}{32}\right] = 2, \quad \left[\frac{75}{64}\right] = 1$$

Step 3: Add all contributions.

$n = 37 + 18 + 9 + 4 + 2 + 1 = 71$.

Step 4: Interpret the result.

This means the highest power of 2 dividing 75! is 2^{71}.

Step 5: Final conclusion.

Hence, the largest value of n such that $2^n \mid (75)!$ is 71.

6. Hydrogen and oxygen gases have the same RMS speed. If hydrogen gas is at $27^{\circ}C$, find the temperature of oxygen gas.

(1) $1200^{\circ}C$ (2) $2400^{\circ}C$ (3) $3600^{\circ}C$ (4) $4527^{\circ}C$

Ans: (4) 4527°C

Solution:

Step 1: Write the formula for RMS speed.

The RMS speed of a gas is given by:

$v_{rms} = \sqrt{\frac{3RT}{M}}$.

For two gases having the same RMS speed:

$\frac{T_1}{M_1} = \frac{T_2}{M_2}$.

Step 2: Convert temperature into Kelvin.

Given temperature of hydrogen gas: $27^{\circ}C = 300K$.

Step 3: Substitute molar masses.

Molar mass of hydrogen gas $(H_2) = 2$,

Molar mass of oxygen gas $(O_2) = 32$.

$T_2 = T_1 \times \frac{M_2}{M_1} = 300 \times \frac{32}{2} = 300 \times 16 = 4800\ K$

Step 4: Convert temperature back to Celsius.

$4800K = 4800 - 273 = 4527^{\circ}C$.

Step 5: Final conclusion.

The temperature of oxygen gas is $4527^{\circ}C$.

7. An α-particle of energy 8 MeV is directed towards a fixed copper nucleus $(Z = 29)$. Calculate the distance of closest approach.

(1) 8.0 fm (2) 9.6 fm (3) 10.4 fm (4) 12.0 fm

Ans: (3)

Solution:

Step 1: Recall the formula for distance of closest approach.

For a head-on collision between an α-particle and a nucleus, the distance of closest approach is given by:

$r = \frac{1}{4\pi\epsilon_0}\frac{Z_1 Z_2 e^2}{E}$

In nuclear units: $\frac{e^2}{4\pi\epsilon_0} = 1.44\ MeV \cdot fm$.

Step 2: Substitute known values.

Charge of α-particle: $Z_1 = 2$.

Charge of copper nucleus: $Z_2 = 29$.

Energy of α-particle: $E = 8$ MeV.

Step 3: Perform the calculation.

$$r = \frac{1.44 \times (2 \times 29)}{8} = \frac{1.44 \times 58}{8} = \frac{83.52}{8} = 10.44 \text{ fm}$$

Step 4: Final conclusion.

The distance of closest approach is approximately 10.4 fm.

8. Radiation containing frequencies 6×10^{14} Hz and 9×10^{14} Hz falls on a metal surface with work function 2.5 eV. Calculate the maximum energy of emitted electrons (in eV).

(1) 0.8 (2) 1.0 (3) 1.2 (4) 1.5

Ans: (3)

Solution:

Step 1: Identify the relevant frequency.

The maximum kinetic energy of photoelectrons depends on the highest frequency of incident radiation. Thus, we use: $\nu_{max} = 9 \times 10^{14}$ Hz.

Step 2: Write the photoelectric equation.

$K_{max} = h\nu - \phi$, where $h = 4.14 \times 10^{-15}$ eV-s and $\phi = 2.5$ eV.

Step 3: Calculate the photon energy.

$$E = h\nu = (4.14 \times 10^{-15})(9 \times 10^{14}) = 3.73 \text{ eV}$$

Step 4: Calculate maximum kinetic energy.

$$K_{max} = 3.73 - 2.5 = 1.23 \text{ eV}$$

Step 5: Final answer (nearest suitable value).

$K_{max} \approx 1.2$ eV.

9. A $12\mu F$ capacitor is connected to a 5 V battery and fully charged. After disconnecting the battery, it is connected in parallel to an uncharged $6\mu F$ capacitor. Find the final charge on the $6\mu F$ capacitor.

(1) 10 C (2) 15 C (3) 20 C (4) 30 C

Ans: (3)

Solution:

Step 1: Calculate the initial charge on the charged capacitor.

For the $12\mu F$ capacitor:

$$Q_{initial} = CV = 12 \times 5 = 60 \text{ C}$$

Step 2: Apply conservation of charge.

After disconnection from the battery and connection in parallel, the total charge is conserved. Total charge in the system: $Q_{total} = 60$ C.

Step 3: Find the equivalent capacitance.

$C_{eq} = 12 + 6 = 18\ F$

Step 4: Calculate the final common voltage.

$V_{final} = \frac{Q_{total}}{C_{eq}} = \frac{60}{18} = \frac{10}{3}\ V$

Step 5: Find the final charge on the $6\mu F$ capacitor.

$Q_6 = CV = 6 \times \frac{10}{3} = 20\ C$

Step 6: Final conclusion.

The final charge on the $6\mu F$ capacitor is 20 C.

10. **Statement-I:** Time period of a simple pendulum increases if the mass of the bob is increased.
Statement-II: Time period of a simple pendulum depends only on its length and acceleration due to gravity.
(1) Both statements are true
(2) Statement I is true; Statement II is false
(3) Statement I is false; Statement II is true
(4) Both statements are false

Ans: (3)
Solution:
Step 1: Recall the formula for time period of a simple pendulum.

The time period of a simple pendulum is given by: $T = 2\pi\sqrt{\frac{L}{g}}$, where L is the length of the pendulum and g is the acceleration due to gravity.

Step 2: Analyze Statement-I.

From the formula, mass of the bob does not appear. Hence, changing the mass of the bob does not affect the time period. Therefore, Statement-I is false.

Step 3: Analyze Statement-II.

The formula clearly shows that the time period depends only on the length of the pendulum and the acceleration due to gravity. Therefore, Statement-II is true.

Step 4: Final conclusion.

Statement-I is false and Statement-II is true.

11. A capacitor of capacitance $6\mu F$ is charged by connecting it to a $12\ V$ battery. After disconnecting the battery, the capacitor is connected in parallel to an initially uncharged capacitor of capacitance $18\mu F$. Find the charge on the $18\mu F$ capacitor after equilibrium is reached.

(1) $36\ C$ (2) $48\ C$ (3) $54\ C$ (4) $72\ C$

Ans: (3)

Solution:

Step 1: Calculate the initial charge on the charged capacitor.

For the $6\mu F$ capacitor connected to a $12\ V$ battery:

$$Q_{initial} = CV = 6 \times 12 = 72\ C$$

Step 2: Apply conservation of charge.

After disconnecting the battery and connecting the capacitors in parallel, the total charge in the system remains conserved: $Q_{total} = 72\ C$.

Step 3: Find the equivalent capacitance of the parallel combination.

$$C_{eq} = 6 + 18 = 24\ F$$

Step 4: Calculate the final common voltage.

$$V_{final} = \frac{Q_{total}}{C_{eq}} = \frac{72}{24} = 3\ V$$

Step 5: Find the charge on the $18\mu F$ capacitor.

$$Q_{18} = CV = 18 \times 3 = 54\ C$$

Step 6: Final conclusion.

The charge on the $18\mu F$ capacitor after equilibrium is $54\ C$.

12. An organic compound A with molecular formula C_4H_8O gives a positive iodoform test and on oxidation forms a compound B which does not reduce Tollens' reagent. Identify compound A.

(1) Butanal (2) Butan-2-ol (3) Butan-1-ol (4) 2-Methylpropanal

Ans: (2)

Solution:

Step 1: Use the iodoform test result.

A positive iodoform test indicates the presence of either:

(i) CH_3CO- group (methyl ketone), or (ii) $CH_3-CHOH-$ group (secondary alcohol).

Step 2: Analyze the oxidation behavior.

On oxidation, compound A forms compound B which does not reduce Tollens' reagent. This means B is **not an aldehyde**, but a **ketone**, since aldehydes reduce Tollens' reagent while ketones do not.

Step 3: Deduce the nature of compound A.

Since oxidation of A gives a ketone, compound A must be a secondary alcohol.

Step 4: Match with the molecular formula C_4H_8O.

Among the given options, butan-2-ol is a secondary alcohol with the group $CH_3-CHOH-$, satisfies the iodoform test, and oxidizes to a ketone (butan-2-one).

Step 5: Final conclusion.

Therefore, the correct compound A is Butan-2-ol.

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