MHT CET 2026 April 17 Shift 2

Question Paper with Solutions(Memory Based)

Conducted by CET Cell, Maharashtra

General Instructions

(i) **Duration:** The total duration of the examination is 3 hours (180 minutes).

(ii) **Total Marks:** The complete paper carries a maximum of 200 marks.

(iii) **Structure:** The paper has 3 Sections:

- **Section A:** 50 Multiple Choice Questions (Physics)
- **Section B:** 50 Multiple Choice Questions (Chemistry)
- **Section C:** 50 Multiple Choice Questions (Mathematics)

(iv) **Compulsory Questions:** All 150 questions are compulsory.

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

(vi) **Right Answer:** Physics (+1 marks), Chemistry (+1 marks) and Mathematics (+2 marks).

(vii) **Incorrect Answer:** (No Negative marking).

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

1. Find the area of the region bounded by the curve $y^2 = 4x$ and the line $x = 3$.

(A) $8\sqrt{3}$

(B) $6\sqrt{3}$

(C) $4\sqrt{3}$

(D) $12\sqrt{3}$

Correct Answer: (A) $8\sqrt{3}$

Solution:

Concept:

To find the area bounded between a parabola and a vertical line, it is convenient to express x in terms of y and integrate with respect to y.

Given curve:

$$y^2 = 4x \quad \Rightarrow \quad x = \frac{y^2}{4}$$

Area between curves:

$$A = \int (x_{right} - x_{left})\, dy$$

Step 1: Find the points of intersection.

The line $x = 3$ intersects the parabola when:

$$y^2 = 4(3) = 12$$

$$y = \pm 2\sqrt{3}$$

Thus the limits are:

$$-2\sqrt{3} \le y \le 2\sqrt{3}$$

Step 2: Set up the integral.

Right boundary:

$$x = 3$$

Left boundary:

$$x = \frac{y^2}{4}$$

$$A = \int_{-2\sqrt{3}}^{2\sqrt{3}} \left(3 - \frac{y^2}{4}\right) dy$$

Step 3: Evaluate the integral.

$$A = \int_{-2\sqrt{3}}^{2\sqrt{3}} 3\,dy - \int_{-2\sqrt{3}}^{2\sqrt{3}} \frac{y^2}{4} dy$$

First integral:

$$= 3(4\sqrt{3}) = 12\sqrt{3}$$

Second integral:

$$\int_{-2\sqrt{3}}^{2\sqrt{3}} \frac{y^2}{4} dy = \frac{1}{4}\left[\frac{y^3}{3}\right]_{-2\sqrt{3}}^{2\sqrt{3}}$$

$$(2\sqrt{3})^3 = 24\sqrt{3}$$

$$= \frac{1}{12}(48\sqrt{3}) = 4\sqrt{3}$$

Therefore,

$$A = 12\sqrt{3} - 4\sqrt{3} = 8\sqrt{3}$$

$$\boxed{A = 8\sqrt{3} \text{ sq. units}}$$

Quick Tip: For a parabola of the form $y^2 = 4ax$, expressing x in terms of y simplifies area calculations when bounded by vertical lines.

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2. If the vectors $2i - j + k$, $i + 2j - 3k$ and $3i + aj + 5k$ are coplanar, find the value of a.

(A) −2

(B) −4

(C) 2

(D) 4

Correct Answer: (B) −4

Solution:

Concept:

Three vectors are **coplanar** if their scalar triple product is zero.

$$\vec{A} \cdot (\vec{B} \times \vec{C}) = 0$$

Equivalently, the determinant formed by their components is zero.

Step 1: Write vectors in component form.

$$\vec{A} = (2, -1, 1)$$

$$\vec{B} = (1, 2, -3)$$

$$\vec{C} = (3, a, 5)$$

Step 2: Form the determinant condition.

$$\begin{vmatrix} 2 & -1 & 1 \\ 1 & 2 & -3 \\ 3 & a & 5 \end{vmatrix} = 0$$

Step 3: Expand the determinant.

$$= 2\begin{vmatrix} 2 & -3 \\ a & 5 \end{vmatrix} - (-1)\begin{vmatrix} 1 & -3 \\ 3 & 5 \end{vmatrix} + 1\begin{vmatrix} 1 & 2 \\ 3 & a \end{vmatrix}$$

$$= 2(10 + 3a) + (5 + 9) + (a - 6)$$

$$= 20 + 6a + 14 + a - 6$$

$$= 28 + 7a$$

Since vectors are coplanar:

$$28 + 7a = 0$$

$$a = -4$$

$$\boxed{a = -4}$$

Quick Tip: Three vectors are coplanar if the **determinant of their components is zero**. This represents the scalar triple product condition.

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3. Find the general solution of the differential equation $\frac{dy}{dx} + y\cot x = \csc x$.

(A) $y \sin x = x + c$

(B) $y \cos x = x + c$

(C) $y \sin x = c - x$

(D) $y \cos x = c + x$

Correct Answer: (A) $y \sin x = x + c$

Solution:

Concept:

The given differential equation is a **linear differential equation** of the form

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

where $P = \cot x$ and $Q = \csc x$.

The integrating factor (I.F.) is:

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

Step 1: Find the integrating factor.

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

$$= e^{\ln(\sin x)}$$

$$= \sin x$$

Step 2: Multiply the equation by the integrating factor.

$$\sin x \frac{dy}{dx} + y \sin x \cot x = \sin x \csc x$$

Since

$$\sin x \cot x = \cos x$$

the equation becomes

$$\sin x \frac{dy}{dx} + y \cos x = 1$$

Step 3: Recognize the derivative form.

$$\frac{d}{dx}(y \sin x) = 1$$

Step 4: Integrate both sides.

$$y \sin x = \int 1 \, dx$$

$$y \sin x = x + c$$

Thus, the general solution is

$$\boxed{y \sin x = x + c}$$

Quick Tip: For linear differential equations $\frac{dy}{dx} + Py = Q$, first compute the integrating factor $e^{\int P dx}$. Multiplying the equation by it converts the left side into an exact derivative.

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4. The probability of a shooter hitting a target is $\frac{3}{4}$. Find the probability of hitting the target exactly 4 times in 5 shots.

(A) $\frac{405}{1024}$

(B) $\frac{243}{1024}$

(C) $\frac{405}{512}$

(D) $\frac{81}{256}$

Correct Answer: (A) $\frac{405}{1024}$

Solution:

Concept:

This problem follows the **Binomial Distribution**.

If probability of success $= p$ and probability of failure $= q$, then probability of exactly r successes in n trials is:

$$P(X = r) = \binom{n}{r} p^r q^{n-r}$$

Step 1: Identify the parameters.

$$n = 5, \quad r = 4$$

$$p = \frac{3}{4}, \quad q = 1 - p = \frac{1}{4}$$

Step 2: Apply the binomial probability formula.

$$P(X = 4) = \binom{5}{4}\left(\frac{3}{4}\right)^4\left(\frac{1}{4}\right)$$

Step 3: Simplify the expression.

$$\binom{5}{4} = 5$$

$$P(X = 4) = 5 \times \frac{81}{256} \times \frac{1}{4}$$

$$= 5 \times \frac{81}{1024}$$

$$= \frac{405}{1024}$$

Thus,

$$\boxed{\frac{405}{1024}}$$

Quick Tip: For "exactly r" successes in repeated independent trials, always apply the binomial formula $\binom{n}{r}p^r q^{n-r}$.

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5. Find the value of k if the function $f(x) = \frac{k\sin x}{x}$ for $x \neq 0$ and $f(0) = 3$ is continuous at $x = 0$.

(A) 1

(B) 2

(C) 3

(D) 4

Correct Answer: (C) 3

Solution:

Concept:

A function is continuous at $x = a$ if

$$\lim_{x \to a} f(x) = f(a)$$

Thus for continuity at $x = 0$,

$$\lim_{x \to 0} f(x) = f(0)$$

We also use the standard limit

$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$

Step 1: Find the limit of the function as $x \to 0$.

$$\lim_{x \to 0} \frac{k\sin x}{x}$$

$$= k \lim_{x \to 0} \frac{\sin x}{x}$$

$$= k(1)$$

$$= k$$

Step 2: Apply the continuity condition.

Given:

$$f(0) = 3$$

For continuity,

$$\lim_{x \to 0} f(x) = f(0)$$

$$k = 3$$

Therefore,

$$\boxed{k = 3}$$

Quick Tip: Whenever expressions involve $\frac{\sin x}{x}$ near $x = 0$, remember the important limit:

$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$

This identity is frequently used in continuity and limit problems.

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6. A stone is dropped from a height of $20\,\text{m}$; calculate its velocity just before it hits the ground ($g = 10\,\mathbf{m/s^2}$).

(A) $10\,\text{m/s}$

(B) $15\,\text{m/s}$

(C) $20\,\text{m/s}$

(D) 25 m/s

Correct Answer: (C) 20 m/s

Solution:

Concept:

For motion under gravity with constant acceleration, we use the kinematic equation:

$$v^2 = u^2 + 2gh$$

where

- u = initial velocity
- v = final velocity
- g = acceleration due to gravity
- h = height fallen

Step 1: Identify the given quantities.

Since the stone is dropped:

$$u = 0$$

$$g = 10\,\text{m/s}^2$$

$$h = 20\,\text{m}$$

Step 2: Substitute into the kinematic equation.

$$v^2 = 0 + 2(10)(20)$$

$$v^2 = 400$$

Step 3: Find the velocity.

$$v = \sqrt{400}$$

$$v = 20\,\text{m/s}$$

Thus the velocity just before hitting the ground is

$$\boxed{20\,\text{m/s}}$$

Quick Tip: When an object is dropped freely, the initial velocity $u = 0$. Use the equation $v^2 = 2gh$ to quickly find the final velocity.

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7. Calculate the de Broglie wavelength of an electron accelerated through a potential difference of $100\,\text{V}$.

(A) $0.1227\,\text{Å}$

(B) $1.227\,\text{Å}$

(C) $12.27\,\text{Å}$

(D) $2.27\,\text{Å}$

Correct Answer: (B) $1.227\,\text{Å}$

Solution:

Concept:

The de Broglie wavelength of an electron accelerated through a potential difference V is given by:

$$\lambda = \frac{12.27}{\sqrt{V}}\,\text{Å}$$

where V is in volts.

Step 1: Substitute the potential difference.

$$V = 100\,\text{V}$$

$$\lambda = \frac{12.27}{\sqrt{100}}$$

Step 2: Simplify the expression.

$$\sqrt{100} = 10$$

$$\lambda = \frac{12.27}{10}$$

$$\lambda = 1.227\,\text{Å}$$

Thus the de Broglie wavelength is

$$\boxed{1.227\,\text{Å}}$$

Quick Tip: For electrons accelerated through a potential V, remember the shortcut formula:

$$\lambda(\text{Å}) = \frac{12.27}{\sqrt{V}}$$

This avoids lengthy substitutions of physical constants.

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8. What is the ratio of the surface area of two soap bubbles if their radii are in the ratio $2:3$?

(A) $2:3$

(B) $4:9$

(C) $3:2$

(D) $9:4$

Correct Answer: (B) $4:9$

Solution:

Concept:

The surface area of a sphere (or soap bubble) is given by

$$A = 4\pi r^2$$

Thus, surface area is proportional to the square of the radius.

$$A \propto r^2$$

Step 1: Write the ratio of radii.

$$r_1 : r_2 = 2 : 3$$

Step 2: Find the ratio of surface areas.

Since $A \propto r^2$,

$$A_1 : A_2 = r_1^2 : r_2^2$$

$$= 2^2 : 3^2$$

$$= 4 : 9$$

Thus,

$$\boxed{4 : 9}$$

Quick Tip: Surface area of a sphere varies as the square of the radius. So if $r_1 : r_2 = a : b$, then $A_1 : A_2 = a^2 : b^2$.

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9. If the current in a coil changes from $5\,\text{A}$ to $2\,\text{A}$ in $0.1\,\text{s}$ and an average emf of $30\,\text{V}$ is induced, find the self-inductance.

(A) $0.5\,\text{H}$

(B) $1\,\text{H}$

(C) $2\,\text{H}$

(D) $3\,\text{H}$

Correct Answer: (B) $1\,\text{H}$

Solution:

Concept:

The induced emf in a coil due to self-inductance is given by

$$E = L\frac{dI}{dt}$$

where

- E = induced emf
- L = self-inductance
- $\frac{dI}{dt}$ = rate of change of current

Step 1: Identify the given quantities.

$$E = 30\,\text{V}$$

$$I_1 = 5\,\text{A}, \quad I_2 = 2\,\text{A}$$

$$\Delta t = 0.1\,\text{s}$$

Step 2: Find the rate of change of current.

$$\frac{dI}{dt} = \frac{I_1 - I_2}{\Delta t}$$

$$= \frac{5-2}{0.1}$$

$$= \frac{3}{0.1} = 30\,\text{A/s}$$

Step 3: Substitute into the formula.

$$E = L\frac{dI}{dt}$$

$$30 = L(30)$$

$$L = 1\,\text{H}$$

Thus,

$$\boxed{L = 1\,\text{H}}$$

Quick Tip: For self-inductance problems remember the relation:

$$E = L\frac{\Delta I}{\Delta t}$$

A larger rate of change of current produces a larger induced emf.

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10. Find the energy stored in a capacitor of $10\,\mu F$ charged to a potential of $50\,V$.

(A) $0.0125\,J$

(B) $0.025\,J$

(C) $0.125\,J$

(D) $0.25\,J$

Correct Answer: (A) $0.0125\,J$

Solution:

Concept:

The energy stored in a capacitor is given by

$$U = \frac{1}{2}CV^2$$

where

- C = capacitance
- V = potential difference
- U = stored energy

Step 1: Convert the capacitance into SI units.

$$C = 10\,\mu F = 10 \times 10^{-6}\,F$$

Step 2: Substitute the values into the formula.

$$U = \frac{1}{2} C V^2$$

$$U = \frac{1}{2} \times (10 \times 10^{-6}) \times (50)^2$$

Step 3: Simplify the expression.

$$(50)^2 = 2500$$

$$U = \frac{1}{2} \times 10 \times 10^{-6} \times 2500$$

$$U = 12500 \times 10^{-6}$$

$$U = 0.0125\, J$$

Thus the energy stored is

$$\boxed{0.0125\, J}$$

Quick Tip: Always convert microfarads to farads before calculation: $1\,\mu F = 10^{-6}\,F$.
Then apply the formula $U = \frac{1}{2} C V^2$.

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11. Calculate the number of atoms per unit cell in a Face-Centered Cubic (FCC) crystal structure.

(A) 2

(B) 4

(C) 6

(D) 8

Correct Answer: (B) 4

Solution:

Concept:

In a **Face-Centered Cubic (FCC)** crystal structure:

- Atoms are present at the **8 corners**
- Atoms are also present at the **6 faces**

Each corner atom is shared by **8 unit cells** and each face-centered atom is shared by **2 unit cells**.

Step 1: Contribution of corner atoms.

$$8 \times \frac{1}{8} = 1$$

Step 2: Contribution of face-centered atoms.

$$6 \times \frac{1}{2} = 3$$

Step 3: Total number of atoms in the unit cell.

$$1 + 3 = 4$$

Thus,

$$\boxed{4}$$

Quick Tip: Remember common crystal structures:
SC = 1, BCC = 2, FCC = 4 atoms per unit cell.

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12. Identify the major product formed when Ethyl Bromide reacts with alcoholic KOH.

(A) Ethanol

(B) Ethene (Ethylene)

(C) Diethyl ether

(D) Acetaldehyde

Correct Answer: (B) Ethene (Ethylene)

Solution:

Concept:

Alkyl halides react with **alcoholic KOH** mainly through the **elimination reaction (E2 mechanism)**.

In this reaction:

- A hydrogen atom is removed from the β-carbon
- The halogen atom leaves from the α-carbon
- A **double bond** is formed

Thus an **alkene** is produced.

Step 1: Write the reaction.

$$CH_3CH_2Br + KOH(\text{alc}) \rightarrow CH_2 = CH_2 + KBr + H_2O$$

Step 2: Identify the product.

The elimination of HBr from ethyl bromide forms

$$CH_2 = CH_2$$

which is **Ethene (Ethylene)**.

$$\boxed{\text{Ethene}}$$

Quick Tip: **Alcoholic KOH** favors **elimination (E2)** producing alkenes, while **aqueous KOH** favors substitution producing alcohols.

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13. What is the hybridization of the central atom in SF_6 molecule?

(A) sp^3

(B) sp^2

(C) sp^3d

(D) sp^3d^2

Correct Answer: (D) sp^3d^2

Solution:

Concept:

Hybridization depends on the **steric number**:

$$\text{Steric number} = \text{Number of sigma bonds} + \text{lone pairs}$$

The steric number determines the hybridization.

Step 1: Determine the bonding in SF_6.

Sulfur forms **six sigma bonds** with six fluorine atoms.

$$\text{Number of sigma bonds} = 6$$

$$\text{Lone pairs on S} = 0$$

Step 2: Find the steric number.

$$SN = 6$$

Step 3: Determine the hybridization.

For steric number 6:

$$\text{Hybridization} = sp^3d^2$$

Thus,

$$\boxed{sp^3d^2}$$

Quick Tip: Steric number vs hybridization:

$2 \rightarrow sp$

$3 \rightarrow sp^2$

$4 \rightarrow sp^3$

$5 \rightarrow sp^3d$

$6 \rightarrow sp^3d^2$

14. Find the osmotic pressure of a $0.1\,M$ glucose solution at $27°C$ ($R = 0.0821\,L\,atm\,mol^{-1}K^{-1}$).

(A) $1.23\,atm$

(B) $2.46\,atm$

(C) $3.46\,atm$

(D) $4.10\,atm$

Correct Answer: (B) $2.46\,atm$

Solution:

Concept:

The osmotic pressure of a dilute solution is given by the van't Hoff equation:

$$\pi = CRT$$

where

- π = osmotic pressure
- C = molar concentration
- R = gas constant
- T = temperature in Kelvin

Step 1: Convert the temperature to Kelvin.

$$T = 27°C + 273$$

$$T = 300\,K$$

Step 2: Substitute the values in the formula.

$$\pi = (0.1)(0.0821)(300)$$

Step 3: Calculate the osmotic pressure.

$$\pi = 2.463$$

$$\pi \approx 2.46\,atm$$

Thus,

$$\boxed{2.46\,atm}$$

Quick Tip: Always convert temperature to Kelvin before using the osmotic pressure formula $\pi = CRT$.

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15. Name the catalyst used in the manufacture of ammonia by Haber's process.

(A) Nickel

(B) Platinum

(C) Finely divided Iron (Fe) with Molybdenum (Mo) as a promoter

(D) Vanadium pentoxide

Correct Answer: (C) Finely divided Iron (Fe) with Molybdenum (Mo) as a promoter

Solution:

Concept:

The **Haber process** is used for the industrial synthesis of ammonia from nitrogen and hydrogen.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

This reaction occurs under:

- High pressure ($\sim 200\,atm$)
- Moderate temperature ($\sim 450^\circ C$)
- Suitable catalyst

Step 1: Identify the catalyst used.

The reaction is catalyzed by

$$\text{Finely divided Iron (Fe)}$$

Step 2: Role of the promoter.

To increase the efficiency of the catalyst, a promoter such as

$$\text{Molybdenum (Mo)}$$

is added.

Step 3: Final identification.

Thus the catalyst system used in Haber's process is:

$$\boxed{\text{Finely divided Iron with Molybdenum as promoter}}$$

Quick Tip: Remember the industrial conditions of Haber process:

High pressure, moderate temperature, and **Iron catalyst with molybdenum promoter**.
