

# 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:

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

**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,

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

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

**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.

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:

$$28 + 7a = 0$$

$$a = -4$$

$$a = -4$$

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

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

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

**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.

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,

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

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

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

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

Thus for continuity at  $x = 0$ ,

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

We also use the standard limit

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

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

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

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

$$= k(1)$$

$$= k$$

**Step 2: Apply the continuity condition.**

Given:

$$f(0) = 3$$

For continuity,

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

$$k = 3$$

Therefore,

$$\boxed{k = 3}$$

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

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

This identity is frequently used in continuity and limit problems.

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

- (A) 10 m/s
- (B) 15 m/s
- (C) 20 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

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

**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.

7. Calculate the de Broglie wavelength of an electron accelerated through a potential difference of 100 V.

- (A) 0.1227 Å
- (B) 1.227 Å
- (C) 12.27 Å
- (D) 2.27 Å

**Correct Answer:** (B) 1.227 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.

$$\sqrt{100} = 10$$

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

$$\lambda = 1.227 \text{ \AA}$$

Thus the de Broglie wavelength is

$$\boxed{1.227 \text{ \AA}}$$

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

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

This avoids lengthy substitutions of physical constants.

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

$$A_1 : A_2 = a^2 : b^2.$$

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

- (A) 0.5 H
- (B) 1 H
- (C) 2 H
- (D) 3 H

**Correct Answer:** (B) 1 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.**

$$\begin{aligned} \frac{dI}{dt} &= \frac{I_1 - I_2}{\Delta t} \\ &= \frac{5 - 2}{0.1} \\ &= \frac{3}{0.1} = 30 \text{ A/s} \end{aligned}$$

**Step 3: Substitute into the formula.**

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

$$30 = L(30)$$

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

Thus,

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

**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.

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

- (A)  $0.0125 \text{ J}$
- (B)  $0.025 \text{ J}$
- (C)  $0.125 \text{ J}$
- (D)  $0.25 \text{ J}$

**Correct Answer:** (A)  $0.0125 \text{ J}$

**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.

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

**Step 2:** Substitute the values into the formula.

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

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

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

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.

**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:

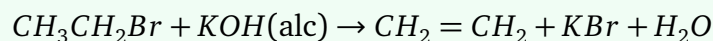
Alkyl halides react with **alcoholic KOH** mainly through the **elimination reaction (E2 mechanism)**.

In this reaction:

- A hydrogen atom is removed from the  $\beta$ -carbon
- The halogen atom leaves from the  $\alpha$ -carbon
- A **double bond** is formed

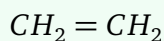
Thus an **alkene** is produced.

**Step 1: Write the reaction.**



**Step 2: Identify the product.**

The elimination of HBr from ethyl bromide forms



which is **Ethene (Ethylene)**.

Ethene

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

13. What is the hybridization of the central atom in  $\text{SF}_6$  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.**

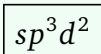
$$SN = 6$$

**Step 3: Determine the hybridization.**

For steric number 6:

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

Thus,



**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 ( $R = 0.0821 \text{ L atm mol}^{-1}\text{K}^{-1}$ ).

- (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

- $\pi$  = osmotic pressure
- $C$  = molar concentration
- $R$  = gas constant
- $T$  = temperature in Kelvin

**Step 1:** Convert the temperature to Kelvin.

$$T = 27^\circ\text{C} + 273$$

$$T = 300\text{K}$$

**Step 2:** Substitute the values in the formula.

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

**Step 3:** Calculate the osmotic pressure.

$$\pi = 2.463$$

$$\pi \approx 2.46\text{ atm}$$

Thus,

$$2.46 \text{ atm}$$

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

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

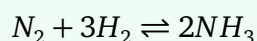
- (A) Nickel
- (B) Platinum
- (C) Finely divided Iron (Fe) with Molybdenum (Mo) as a promoter
- (D) Vanadium pentoxide

**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.



This reaction occurs under:

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

**Step 1: Identify the catalyst used.**

The reaction is catalyzed by

Finely divided Iron (Fe)

**Step 2: Role of the promoter.**

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

Molybdenum (Mo)

is added.

**Step 3: Final identification.**

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

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.**