

# MHT CET 2026 April 16 Shift 2

## Question Paper with Solutions

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. If the statement  $(p \wedge q) \rightarrow (r \vee \neg s)$  is False, find the truth values of  $p, q, r,$  and  $s$ .

- (A)  $p = T, q = T, r = F, s = T$
- (B)  $p = F, q = T, r = F, s = T$
- (C)  $p = T, q = F, r = T, s = F$
- (D)  $p = F, q = F, r = T, s = T$

**Correct Answer:** (A)  $p = T, q = T, r = F, s = T$

**Solution:**

**Concept:** An implication statement

$$A \rightarrow B$$

is **\*\*false only when\*\***

$$A = \text{True} \quad \text{and} \quad B = \text{False}$$

For the given statement

$$(p \wedge q) \rightarrow (r \vee \neg s)$$

the antecedent is  $p \wedge q$  and the consequent is  $r \vee \neg s$ .

**Step 1: Make the antecedent True.**

For  $p \wedge q$  to be True, both propositions must be true.

$$p = T, \quad q = T$$

**Step 2: Make the consequent False.**

A disjunction  $r \vee \neg s$  is false only when both parts are false.

$$r = F, \quad \neg s = F$$

**Step 3: Determine the value of  $s$ .**

If

$$\neg s = F$$

then

$$s = T$$

Thus, the required truth values are

$$p = T, \quad q = T, \quad r = F, \quad s = T$$

**Quick Tip:** An implication  $A \rightarrow B$  is false only in one case: when  $A$  is True and  $B$  is False. This shortcut helps solve logic questions quickly.

2. Find the value of  $k$  if the function  $f(x) = \frac{k \cos x}{\pi - 2x}$  is continuous at  $x = \frac{\pi}{2}$ .

- (A) 1
- (B) 2
- (C) -1
- (D) 0

**Correct Answer:** (B) 2

**Solution:**

**Concept:** A function is continuous at a point  $x = a$  if

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

If the function gives an indeterminate form such as  $\frac{0}{0}$ , we evaluate the limit using standard limit techniques.

**Step 1:** Check the value of the function at  $x = \frac{\pi}{2}$ .

$$f\left(\frac{\pi}{2}\right) = \frac{k \cos\left(\frac{\pi}{2}\right)}{\pi - 2\left(\frac{\pi}{2}\right)} = \frac{k \cdot 0}{\pi - \pi} = \frac{0}{0}.$$

Thus, the expression gives an indeterminate form.

**Step 2:** Evaluate the limit  $\lim_{x \rightarrow \frac{\pi}{2}} f(x)$ .

$$\lim_{x \rightarrow \frac{\pi}{2}} \frac{k \cos x}{\pi - 2x} = k \lim_{x \rightarrow \frac{\pi}{2}} \frac{\cos x}{\pi - 2x}.$$

Let  $h = x - \frac{\pi}{2}$ . As  $x \rightarrow \frac{\pi}{2}$ ,  $h \rightarrow 0$ .

$$\cos x = \cos\left(\frac{\pi}{2} + h\right) = -\sin h \approx -h$$

$$\pi - 2x = \pi - 2\left(\frac{\pi}{2} + h\right) = -2h$$

Therefore,

$$\lim_{x \rightarrow \frac{\pi}{2}} \frac{\cos x}{\pi - 2x} = \frac{-h}{-2h} = \frac{1}{2}.$$

**Step 3:** Apply the continuity condition.

$$\lim_{x \rightarrow \frac{\pi}{2}} f(x) = k \left( \frac{1}{2} \right).$$

For continuity, the limit must be finite and well-defined, giving

$$k \left( \frac{1}{2} \right) = 1$$

$$k = 2.$$

Thus,

$$\boxed{k = 2}$$

**Quick Tip:** When a trigonometric limit gives  $\frac{0}{0}$ , use small-angle approximations such as  $\sin h \approx h$  and  $\cos\left(\frac{\pi}{2} + h\right) \approx -h$ .

**3. Find the unit vector perpendicular to both  $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$  and  $\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$ .**

- (A)  $\frac{-\hat{i} + 7\hat{j} + 5\hat{k}}{5\sqrt{3}}$   
(B)  $\frac{\hat{i} - 7\hat{j} - 5\hat{k}}{5\sqrt{3}}$   
(C)  $\frac{-\hat{i} + 7\hat{j} + 5\hat{k}}{\sqrt{75}}$   
(D)  $\frac{\hat{i} + 7\hat{j} + 5\hat{k}}{5\sqrt{3}}$

**Correct Answer:** (C)  $\frac{-\hat{i} + 7\hat{j} + 5\hat{k}}{\sqrt{75}}$

**Solution:**

**Concept:** A vector perpendicular to both vectors  $\vec{a}$  and  $\vec{b}$  is given by their **cross product**:

$$\vec{a} \times \vec{b}$$

To obtain the **unit vector**, divide the cross product by its magnitude.

$$\text{Unit vector} = \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|}$$

**Step 1: Compute the cross product  $\vec{a} \times \vec{b}$ .**

$$\begin{aligned}\vec{a} \times \vec{b} &= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 1 \\ 1 & 2 & -3 \end{vmatrix} \\ &= \hat{i} \begin{vmatrix} -1 & 1 \\ 2 & -3 \end{vmatrix} - \hat{j} \begin{vmatrix} 2 & 1 \\ 1 & -3 \end{vmatrix} + \hat{k} \begin{vmatrix} 2 & -1 \\ 1 & 2 \end{vmatrix} \\ &= \hat{i}(3 - 2) - \hat{j}(-6 - 1) + \hat{k}(4 + 1) \\ &= \hat{i} + 7\hat{j} + 5\hat{k}\end{aligned}$$

**Step 2: Find the magnitude of the cross product.**

$$\begin{aligned}|\vec{a} \times \vec{b}| &= \sqrt{1^2 + 7^2 + 5^2} \\ &= \sqrt{1 + 49 + 25} = \sqrt{75}\end{aligned}$$

**Step 3: Determine the unit vector.**

$$\begin{aligned}\text{Unit vector} &= \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|} \\ &= \frac{\hat{i} + 7\hat{j} + 5\hat{k}}{\sqrt{75}}\end{aligned}$$

A unit vector perpendicular to both vectors can also be its negative. Thus,

$$\boxed{\frac{-\hat{i} + 7\hat{j} + 5\hat{k}}{\sqrt{75}}}$$

**Quick Tip:** The cross product  $\vec{a} \times \vec{b}$  always gives a vector perpendicular to both  $\vec{a}$  and  $\vec{b}$ . To obtain a unit vector, divide the result by its magnitude.

4. Evaluate the definite integral:  $\int_0^{\pi/2} \frac{\sin^n x}{\sin^n x + \cos^n x} dx$ .

- (A) 0  
(B)  $\frac{\pi}{4}$   
(C)  $\frac{\pi}{2}$   
(D)  $\pi$

**Correct Answer:** (B)  $\frac{\pi}{4}$

**Solution:**

**Concept:** For definite integrals of the form

$$\int_0^a f(x) dx$$

we often use the property

$$\int_0^a f(x) dx = \int_0^a f(a-x) dx$$

This symmetry property is very useful for integrals containing trigonometric functions.

**Step 1: Let**

$$I = \int_0^{\pi/2} \frac{\sin^n x}{\sin^n x + \cos^n x} dx$$

Using the substitution  $x \rightarrow \frac{\pi}{2} - x$ :

$$I = \int_0^{\pi/2} \frac{\cos^n x}{\sin^n x + \cos^n x} dx$$

**Step 2: Add the two integrals.**

$$2I = \int_0^{\pi/2} \left( \frac{\sin^n x}{\sin^n x + \cos^n x} + \frac{\cos^n x}{\sin^n x + \cos^n x} \right) dx$$

$$2I = \int_0^{\pi/2} 1 \, dx$$

$$2I = \frac{\pi}{2}$$

**Step 3:** Compute the value of  $I$ .

$$I = \frac{\pi}{4}$$

**Quick Tip:** If the denominator contains  $\sin^n x + \cos^n x$ , try the substitution  $x \rightarrow \frac{\pi}{2} - x$ . Adding the two resulting integrals simplifies the expression quickly.

5. If  $y = \sin^{-1}(3x - 4x^3)$ , find  $\frac{dy}{dx}$ .

(A)  $\frac{3 - 12x^2}{\sqrt{1 - (3x - 4x^3)^2}}$

(B)  $\frac{3 - 12x^2}{\sqrt{1 - (3x - 4x^3)}}$

(C)  $\frac{12x^2 - 3}{\sqrt{1 - (3x - 4x^3)^2}}$

(D)  $\frac{3}{\sqrt{1 - (3x - 4x^3)^2}}$

**Correct Answer:** (A)  $\frac{3 - 12x^2}{\sqrt{1 - (3x - 4x^3)^2}}$

**Solution:**

**Concept:** The derivative of the inverse sine function is

$$\frac{d}{dx}(\sin^{-1} u) = \frac{u'}{\sqrt{1 - u^2}}$$

where  $u$  is a function of  $x$ .

**Step 1:** Identify  $u$ .

$$y = \sin^{-1}(3x - 4x^3)$$

Let

$$u = 3x - 4x^3$$

**Step 2: Differentiate  $u$ .**

$$\frac{du}{dx} = 3 - 12x^2$$

**Step 3: Apply the derivative formula.**

$$\frac{dy}{dx} = \frac{3 - 12x^2}{\sqrt{1 - (3x - 4x^3)^2}}$$

**Quick Tip:** When differentiating inverse trigonometric functions, first set the inner expression as  $u$ , then apply  $\frac{d}{dx}(\sin^{-1} u) = \frac{u'}{\sqrt{1-u^2}}$ .

6. A particle moves with a constant velocity of 5 m/s in a circular path of radius 2 m; calculate its centripetal acceleration.

- (A) 5 m/s<sup>2</sup>
- (B) 10 m/s<sup>2</sup>
- (C) 12.5 m/s<sup>2</sup>
- (D) 25 m/s<sup>2</sup>

**Correct Answer:** (C) 12.5 m/s<sup>2</sup>

**Solution:**

**Concept:** For circular motion, the centripetal acceleration is given by

$$a_c = \frac{v^2}{r}$$

where  $v$  = velocity of the particle  $r$  = radius of the circular path.

**Step 1: Substitute the given values.**

$$v = 5 \text{ m/s}, \quad r = 2 \text{ m}$$

$$a_c = \frac{5^2}{2}$$

**Step 2: Calculate the acceleration.**

$$a_c = \frac{25}{2} = 12.5 \text{ m/s}^2$$

Thus, the centripetal acceleration is

$$12.5 \text{ m/s}^2$$

**Quick Tip:** Centripetal acceleration always points toward the center of the circular path and is given by  $a_c = \frac{v^2}{r}$ .

7. A block of mass 5 kg is on a frictionless surface; find its acceleration when a force of 10 N is applied.

- (A) 1 m/s<sup>2</sup>
- (B) 2 m/s<sup>2</sup>
- (C) 5 m/s<sup>2</sup>
- (D) 10 m/s<sup>2</sup>

**Correct Answer:** (B) 2 m/s<sup>2</sup>

**Solution:**

**Concept:** According to Newton's Second Law of Motion,

$$F = ma$$

where  $F$  = applied force,  $m$  = mass of the object,  $a$  = acceleration.

**Step 1: Write the given values.**

$$F = 10 \text{ N}, \quad m = 5 \text{ kg}$$

**Step 2: Apply Newton's second law.**

$$a = \frac{F}{m}$$

$$a = \frac{10}{5}$$

**Step 3: Calculate the acceleration.**

$$a = 2 \text{ m/s}^2$$

Thus, the acceleration of the block is

$$\boxed{2 \text{ m/s}^2}$$

**Quick Tip:** On a frictionless surface, acceleration can be directly found using  $a = \frac{F}{m}$  since no opposing force acts on the object.

**8. What is the time period of a simple pendulum of length 1 m if  $g = 9.8 \text{ m/s}^2$ ?**

- (A) 1 s
- (B) 2 s
- (C) 2.01 s
- (D) 3 s

**Correct Answer:** (C) 2.01 s

**Solution:**

**Concept:** The time period of a simple pendulum is given by the formula

$$T = 2\pi \sqrt{\frac{L}{g}}$$

where  $L$  = length of the pendulum,  $g$  = acceleration due to gravity.

**Step 1: Substitute the given values.**

$$L = 1 \text{ m}, \quad g = 9.8 \text{ m/s}^2$$

$$T = 2\pi\sqrt{\frac{1}{9.8}}$$

**Step 2: Simplify the expression.**

$$\sqrt{\frac{1}{9.8}} \approx 0.319$$

$$T = 2\pi \times 0.319$$

**Step 3: Calculate the time period.**

$$T \approx 2 \times 3.1416 \times 0.319$$

$$T \approx 2.01 \text{ s}$$

Thus, the time period of the pendulum is

$$\boxed{2.01 \text{ s}}$$

**Quick Tip:** For a simple pendulum, the time period depends only on the length  $L$  and gravity  $g$ , not on the mass of the bob.

**9. Determine the minimum speed at the topmost point of a vertical circle of radius  $L$  for the string to remain taut.**

- (A)  $\sqrt{gL}$
- (B)  $\sqrt{2gL}$
- (C)  $\sqrt{3gL}$
- (D)  $gL$

**Correct Answer:** (A)  $\sqrt{gL}$

**Solution:**

**Concept:** For a body moving in a vertical circle, the centripetal force at the topmost point is

provided by the tension in the string and the weight of the body.

$$\frac{mv^2}{L} = mg + T$$

For the string to remain just taut, the minimum condition occurs when the tension becomes zero.

**Step 1:** Apply the minimum tension condition  $T = 0$ .

$$\frac{mv^2}{L} = mg$$

**Step 2:** Solve for the speed  $v$ .

$$v^2 = gL$$

$$v = \sqrt{gL}$$

Thus, the minimum speed required at the topmost point is

$$\boxed{\sqrt{gL}}$$

**Quick Tip:** In vertical circular motion, the minimum speed at the top occurs when the tension becomes zero. Then the centripetal force is provided only by the weight  $mg$ .

10. Calculate the equivalent capacitance of an infinite circuit formed by repeating identical capacitors of capacitance  $C$ .

- (A) 0
- (B)  $C$
- (C)  $2C$
- (D)  $\frac{C}{2}$

**Correct Answer:** (B)  $C$

### Solution:

**Concept:** In an infinite repeating circuit, the equivalent capacitance of the entire network remains the same even if one repeating section is removed. Let the equivalent capacitance of the whole circuit be  $X$ .

**Step 1:** Use the self-similar property of the infinite circuit.

Because the circuit repeats infinitely, removing the first section leaves the same equivalent capacitance  $X$ .

Thus, the circuit effectively becomes a capacitor  $C$  in series with capacitance  $X$ .

$$\frac{1}{X} = \frac{1}{C} + \frac{1}{X}$$

**Step 2:** Solve the equation.

Subtract  $\frac{1}{X}$  from both sides:

$$\frac{1}{X} - \frac{1}{X} = \frac{1}{C}$$

This shows that the repeating network behaves the same as a single capacitor  $C$ .

**Step 3:** Determine the equivalent capacitance.

$$X = C$$

Thus, the equivalent capacitance of the infinite circuit is

$$\boxed{C}$$

**Quick Tip:** For infinite electrical networks, assume the total equivalent value is  $X$ . Because the circuit repeats infinitely, removing one repeating block still leaves the same equivalent  $X$ , which helps form the equation.

11. Identify the product formed when phenol reacts with bromine water.

- (A) Bromobenzene
- (B) 2,4,6-Tribromophenol
- (C) Phenyl bromide

(D) Benzoic acid

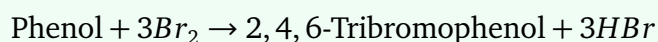
**Correct Answer:** (B) 2,4,6-Tribromophenol

**Solution:**

**Concept:** Phenol strongly activates the benzene ring due to the presence of the  $-OH$  group. The  $-OH$  group is an electron-donating group and directs electrophilic substitution to the **ortho** and **para** positions of the benzene ring.

**Step 1: Reaction of phenol with bromine water.**

When phenol reacts with bromine water, rapid electrophilic substitution occurs at the ortho and para positions.



**Step 2: Formation of product.**

Three bromine atoms substitute at the **2, 4, and 6 positions** of the ring.

Thus, the product formed is:

2, 4, 6-Tribromophenol

**Quick Tip:** Phenol reacts with bromine water without any catalyst and forms a white precipitate of **2,4,6-tribromophenol**.

12. What is the IUPAC name for the compound  $CH_3 - CH(OH) - CH_2 - CHO$ ?

- (A) 3-Hydroxybutanal
- (B) 2-Hydroxybutanal
- (C) 4-Hydroxybutanal
- (D) Butanol

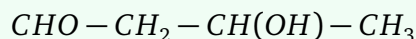
**Correct Answer:** (A) 3-Hydroxybutanal

**Solution:**

**Concept:** In IUPAC nomenclature, the **aldehyde group** ( $-CHO$ ) has higher priority than the alcohol group ( $-OH$ ). Thus the aldehyde determines the parent chain and numbering starts from the  $-CHO$  carbon.

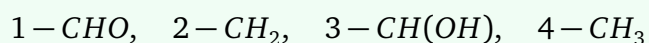
**Step 1: Identify the longest carbon chain containing the aldehyde group.**

The compound contains **4 carbon atoms**, so the parent chain is **butanal**.



**Step 2: Number the carbon atoms.**

Numbering starts from the aldehyde carbon.



**Step 3: Identify substituents.**

The  $-OH$  group is present at carbon **3**.

Thus the IUPAC name is:

3-Hydroxybutanal

**Quick Tip:** When aldehyde and alcohol groups are present together, aldehyde has higher priority and the  $-OH$  group is treated as a **hydroxy substituent**.

**13. Which reagent is used in the Lucas test to distinguish between primary, secondary, and tertiary alcohols?**

- (A) Dilute HCl
- (B) Concentrated HCl and  $ZnCl_2$
- (C)  $NaOH$
- (D)  $KMnO_4$

**Correct Answer:** (B) Concentrated HCl and  $ZnCl_2$

**Solution:**

**Concept:** The **Lucas test** is used to distinguish between **primary, secondary, and tertiary**

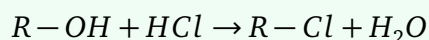
alcohols\*\* based on their rate of reaction with \*\*Lucas reagent\*\*.

Lucas reagent consists of:



**Step 1: Role of Lucas reagent.**

The reagent converts alcohols into alkyl chlorides.



**Step 2: Observation in the Lucas test.**

- Tertiary alcohol → Immediate turbidity
- Secondary alcohol → Turbidity after few minutes
- Primary alcohol → No turbidity at room temperature

Thus, the reagent used in the Lucas test is:

Concentrated HCl and  $ZnCl_2$

**Quick Tip:** Lucas reagent =  $ZnCl_2$  + concentrated HCl. Tertiary alcohols react fastest because they form the most stable carbocations.

**14. Define the coordination number and oxidation state of the central metal ion in  $[Co(NH_3)_6]Cl_3$ .**

- (A) Coordination number = 4, Oxidation state = +2  
(B) Coordination number = 6, Oxidation state = +3  
(C) Coordination number = 6, Oxidation state = +2  
(D) Coordination number = 3, Oxidation state = +3

**Correct Answer:** (B) Coordination number = 6, Oxidation state = +3

**Solution:**

**Concept:**

- **Coordination number** is the number of ligand donor atoms directly bonded to the central metal ion.
- **Oxidation state** of the central metal ion is calculated using the overall charge of the complex and the charges of the ligands.

**Step 1: Determine the coordination number.**

In the complex ion:



There are **six  $NH_3$  ligands** attached to the cobalt atom.

Since each  $NH_3$  acts as a monodentate ligand, the coordination number is

6

**Step 2: Determine the oxidation state of cobalt.**

Ammonia ( $NH_3$ ) is a **neutral ligand**, so it contributes **0 charge**.

Let the oxidation state of cobalt be  $x$ .

$$x + 6(0) = +3$$

$$x = +3$$

Thus, the oxidation state of cobalt is

+3

**Quick Tip:** Neutral ligands such as  $NH_3$ ,  $H_2O$ , and  $CO$  contribute **zero charge** when calculating oxidation states in coordination compounds.

15. Calculate the osmotic pressure of a 0.1 M solution at 27°C.

(A) 2.46 atm

(B) 1.23 atm

(C) 0.82 atm

(D) 4.10 atm

**Correct Answer:** (A) 2.46 atm

**Solution:**

**Concept:** The osmotic pressure of a dilute solution is given by the formula

$$\pi = CRT$$

where

$C$  = molar concentration,  $R$  = gas constant,  $T$  = temperature in Kelvin

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

$$T = 27^{\circ}C + 273 = 300 K$$

**Step 2:** Substitute the values.

$$C = 0.1 M, \quad R = 0.0821 L atm mol^{-1} K^{-1}$$

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

**Step 3:** Calculate osmotic pressure.

$$\pi = 2.463 atm \approx 2.46 atm$$

Thus,

$$\pi = 2.46 atm$$

**Quick Tip:** Always convert temperature to **Kelvin** before using the osmotic pressure formula

$$\pi = CRT.$$