MHT CET 2026 May 18 Shift 2

Question Paper (Memory-Based) with Solutions

Conducted by Maharashtra State CET Cell

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:** +1 marks for Physics and Chemistry Questions. +2 marks for Mathematics Questions

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

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

1.

If z be a complex number such that $|z| + z = 2 + i$, then find the value of $|z|$.

(1) $\frac{1}{2}$

(2) $\frac{3}{4}$

(3) $\frac{5}{4}$

(4) 1

Correct Answer: (3) $\frac{5}{4}$

Solution:

Concept: A complex number z is typically represented in the form $z = x + iy$, where x and y are real numbers representing the real and imaginary parts respectively, and $i = \sqrt{-1}$. The modulus (or absolute value) of a complex number, denoted by $|z|$, represents its distance from the origin in the complex plane and is calculated as:

$$|z| = \sqrt{x^2 + y^2}$$

When solving equations involving complex numbers, a fundamental principle is that two complex numbers are equal if and only if their real parts are equal and their imaginary parts are equal.

Step 1: Substituting the standard form of a complex number.

Let the complex number be

$$z = x + iy$$

Then,

$$|z| = \sqrt{x^2 + y^2}$$

Substituting into the given equation:

$$\sqrt{x^2 + y^2} + (x + iy) = 2 + i$$

Step 2: Equating the imaginary parts.

$$y = 1$$

Step 3: Equating the real parts and solving for x.

$$\sqrt{x^2 + 1} + x = 2$$

$$\sqrt{x^2 + 1} = 2 - x$$

Squaring both sides:

$$x^2 + 1 = 4 + x^2 - 4x$$

$$4x = 3$$

$$x = \frac{3}{4}$$

Step 4: Calculating the value of $|z|$.

$$|z| = \sqrt{\left(\frac{3}{4}\right)^2 + 1}$$

$$|z| = \sqrt{\frac{9}{16} + \frac{16}{16}}$$

$$|z| = \sqrt{\frac{25}{16}}$$

$$|z| = \frac{5}{4}$$

Quick Tip: For equations involving complex numbers, compare real and imaginary parts separately.

2.

If $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = p\hat{i} + 2\hat{j} + 2\hat{k}$ are perpendicular to each other, find the value of p.

(1) 4

(2) -4

(3) 2

(4) -2

Correct Answer: (2) -4

Solution:

Concept: Two vectors are perpendicular if their dot product is zero:

$$\vec{a} \cdot \vec{b} = 0$$

Step 1: Applying the perpendicularity condition.

$$(2\hat{i}+\hat{j}+3\hat{k})\cdot(p\hat{i}+2\hat{j}+2\hat{k})=0$$

Step 2: Expanding the dot product.

$$2p+2+6=0$$

Step 3: Solving for p.

$$2p+8=0$$

$$2p=-8$$

$$p=-4$$

Quick Tip: Perpendicular vectors always satisfy:

$$\vec{a}\cdot\vec{b}=0$$

3.

The solubility product of AgBr is 4.9×10^{-13} at a certain temperature. Calculate the molar solubility of AgBr.

(1) 4×10^{-6} mol dm^{-3}
(2) 4×10^{-7} mol dm^{-3}
(3) 7×10^{-7} mol dm^{-3}
(4) 3×10^{-8} mol dm^{-3}

Correct Answer: (3) 7×10^{-7} mol dm^{-3}

Solution:

Concept: For a 1:1 electrolyte:

$$K_{sp}=s^2$$

where s is molar solubility.

Step 1: Writing the dissociation equation.

$$AgBr(s) \rightleftharpoons Ag^+ + Br^-$$

Step 2: Writing the K_{sp} expression.

$$K_{sp} = [Ag^+][Br^-]$$

$$K_{sp} = s^2$$

Step 3: Calculating the solubility.

$$s^2 = 4.9 \times 10^{-13}$$

$$s = \sqrt{4.9 \times 10^{-13}}$$

$$s = 7 \times 10^{-7} \text{ mol dm}^{-3}$$

Quick Tip: For salts of type AB,

$$K_{sp} = s^2$$

4.

Find the concentration of sodium acetate when added to 0.1 M solution of acetic acid to form a buffer solution of $pH = 5.5$. (Given: pK_a of $CH_3COOH = 4.5$)

(1) 0.1 M

(2) 0.01 M

(3) 1.0 M

(4) None of these

Correct Answer: (3) 1.0 M

Solution:

Concept: Henderson-Hasselbalch equation:

$$pH = pK_a + \log\left(\frac{[\text{Salt}]}{[\text{Acid}]}\right)$$

Step 1: Substituting the values.

$$5.5 = 4.5 + \log\left(\frac{[\text{Salt}]}{0.1}\right)$$

Step 2: Simplifying the equation.

$$1 = \log\left(\frac{[\text{Salt}]}{0.1}\right)$$

Step 3: Solving for concentration.

$$10 = \frac{[\text{Salt}]}{0.1}$$

$$[\text{Salt}] = 1.0 \text{ M}$$

Quick Tip: If $pH - pK_a = 1$, then:

$$\frac{[\text{Salt}]}{[\text{Acid}]} = 10$$

5.

Which of the following equations gives the combined relationship of Boyle's law and Charles's law?

(1) $\frac{P_1V_2}{T_1} = \frac{P_2V_1}{T_2}$
(2) $n = \frac{RT}{PV}$
(3) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
(4) $P = \frac{RT}{nV}$

Correct Answer: (3) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Solution:

Concept: Combined Gas Law:

$$\frac{PV}{T} = \text{constant}$$

Step 1: Writing the combined gas law.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Step 2: Analyzing the options.

- Option (1): Incorrect equation
- Option (2): Incorrect ideal gas law form
- Option (3): Correct combined gas law
- Option (4): Incorrect ideal gas law form

Quick Tip: Always use temperature in Kelvin while applying gas laws.

6.

Which of the following forces is involved in dinitrogen?

(1) Dipole-dipole interaction
(2) Dipole-induced dipole interaction
(3) London dispersion force
(4) Hydrogen bonding

Correct Answer: (3) London dispersion force

Solution:

Concept: Intermolecular forces are the forces of attraction and repulsion between interacting particles (atoms and molecules). To determine the type of force present in a substance, we

must first analyze the molecular structure and polarity of its constituent molecules.

- **Dipole-dipole interactions** occur between molecules with permanent dipoles (polar molecules).
- **Dipole-induced dipole interactions** occur between a polar molecule and a non-polar molecule.
- **London dispersion forces** (or van der Waals forces) are present in all molecules but are the *only* intermolecular forces in non-polar molecules and noble gases.
- **Hydrogen bonding** occurs when hydrogen is bonded to highly electronegative atoms like F, O, or N.

Step 1: Analyzing the molecular structure of dinitrogen.
Dinitrogen is represented by N_2. It is a homonuclear diatomic molecule in which both atoms are identical and have the same electronegativity.

Step 2: Determining the polarity of the molecule.
Since both atoms are identical, electron sharing is equal and the molecule is non-polar.

Step 3: Identifying the intermolecular force.
As N_2 is non-polar:

- It does not exhibit dipole-dipole interaction.
- It does not exhibit hydrogen bonding.
- The only intermolecular force present is London dispersion force.

Quick Tip: All homonuclear diatomic molecules such as H_2, N_2, O_2, and Cl_2 are non-polar and mainly exhibit London dispersion forces.

7.

Which of the following is a correct set of four quantum numbers for a 4d orbital?

(1) $(4, 3, 2, 1/2)$

(2) $(4, 2, 1, 1/2)$

(3) $(4, 1, 2, 1/2)$

(4) None of these

Correct Answer: (2) $(4, 2, 1, 1/2)$

Solution:

Concept: Quantum numbers describe the position and state of an electron in an atom.

1. Principal quantum number n: Specifies shell.
2. Azimuthal quantum number l: Specifies orbital shape.
3. Magnetic quantum number m_l: Specifies orientation.
4. Spin quantum number m_s: Specifies spin direction.

For orbital notation:

$$s \to 0, \quad p \to 1, \quad d \to 2, \quad f \to 3$$

Step 1: Determining n and l for 4d orbital.

For a 4d orbital:

$$n = 4, \qquad l = 2$$

Step 2: Determining allowed values of m_l and m_s.

For $l = 2$:

$$m_l = -2, -1, 0, +1, +2$$

and

$$m_s = \pm\frac{1}{2}$$

Step 3: Checking the options.

- $(4, 3, 2, 1/2)$: Represents 4f orbital.
- $(4, 2, 1, 1/2)$: All values are valid.
- $(4, 1, 2, 1/2)$: Invalid because for $l = 1$, m_l cannot be 2.

Hence, the correct answer is option (2).

Quick Tip: Always remember:

$$|m_l| \leq l$$

If m_l is greater than l, the quantum number set is invalid.

8.

Which of the following mixtures of gases represent water gas?

(1) $CO + H_2$

(2) $CO_2 + H_2$

(3) $H_2O + CH_4$

(4) $H_2 + O_2$

Correct Answer: (1) $CO + H_2$

Solution:

Concept: Water gas is a fuel gas consisting mainly of carbon monoxide and hydrogen. It is formed when steam reacts with hot carbon.

Step 1: Writing the formation reaction of water gas.

$$C + H_2O \xrightarrow{\text{high temperature}} CO + H_2$$

Step 2: Identifying the products.

The gases produced are:

$$CO \quad \text{and} \quad H_2$$

Step 3: Checking the options.

- $CO + H_2$: Correct composition of water gas.
- $CO_2 + H_2$: Incorrect.
- $H_2O + CH_4$: Reactants used in steam reforming.
- $H_2 + O_2$: Explosive mixture.

Quick Tip: Do not confuse:

- Water Gas = $CO + H_2$
- Producer Gas = $CO + N_2$

9.

Which of the following electrolytic solutions of the same electrolyte has maximum electrolytic conductivity at the same temperature?

(1) 0.2 mole of solute is dissolved in 250 ml

(2) 0.3 mol in 600 ml

(3) 0.6 mol in 1000 ml

(4) 0.8 mole in 2000 ml

Correct Answer: (1) 0.2 mole of solute is dissolved in 250 ml

Solution:

Concept: Electrolytic conductivity (κ) depends on the number of ions present per unit volume of solution. Greater concentration means greater conductivity.

Step 1: Calculating molarity of each solution.

$$M = \frac{\text{moles}}{\text{volume in liters}}$$

- Solution (1):

$$\frac{0.2}{0.250} = 0.8\,M$$

- Solution (2):

$$\frac{0.3}{0.600} = 0.5\,M$$

- Solution (3):

$$\frac{0.6}{1.000} = 0.6\,M$$

- Solution (4):

$$\frac{0.8}{2.000} = 0.4\,M$$

Step 2: Comparing concentrations.

$$0.8M > 0.6M > 0.5M > 0.4M$$

Hence, solution (1) has maximum concentration.

Step 3: Relating concentration to conductivity.

Higher concentration means more ions per unit volume, hence higher conductivity.

Quick Tip: Conductivity increases with concentration because the number of ions available to carry electric current increases.

10.

In an isothermal expansion of an ideal gas, the heat supplied to the gas is:

(1) entirely used to increase internal energy

(2) entirely used to do work

(3) partly used to do work and partly to increase internal energy

(4) none of the above

Correct Answer: (2) entirely used to do work

Solution:

Concept: According to the First Law of Thermodynamics:

$$\Delta U = q - w$$

For an ideal gas, internal energy depends only on temperature.

Step 1: Understanding the meaning of isothermal process.

In an isothermal process:

$$T = \text{constant}$$

Therefore,

$$\Delta T = 0$$

Step 2: Relating temperature to internal energy.

For an ideal gas:

$$\Delta U \propto \Delta T$$

Since $\Delta T = 0$:

$$\Delta U = 0$$

Step 3: Applying First Law of Thermodynamics.

$$\Delta U = q - w$$

Substituting $\Delta U = 0$:

$$0 = q - w$$

$$q = w$$

This means the entire heat supplied is converted into work done by the gas.

Quick Tip: For an ideal gas:

$$\Delta U = 0$$

whenever temperature remains constant. Hence, in isothermal expansion, all supplied heat is used to perform work.
