

MHT CET 2026 May 19 Shift 1

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. Which of the following compound is not in gaseous phase at 25°C?

- (1) ClF
- (2) BrF_3
- (3) IF_3
- (4) ClF_3

Correct Answer: (2) BrF_3

Solution:

Concept: Interhalogen compounds are compounds formed by the combination of two different halogen atoms. These compounds are generally represented by formulas such as XY , XY_3 , XY_5 , and XY_7 , where X is the larger and less electronegative halogen atom and Y is the smaller and more electronegative halogen atom.

The physical state of interhalogen compounds depends mainly on:

- Molecular mass
- Strength of intermolecular forces
- Molecular size and polarity
- Boiling point of the compound

Compounds having lower molecular mass and weaker intermolecular attractions generally exist as gases at room temperature, whereas compounds with larger molecular size and stronger intermolecular attractions tend to exist as liquids or solids.

Step 1: Analyzing the compound ClF .

ClF (Chlorine monofluoride) is a small interhalogen molecule formed between chlorine and fluorine atoms.

- It has relatively low molecular mass.
- Weak intermolecular van der Waals forces act between its molecules.
- Therefore, its boiling point is low.

As a result, ClF exists in gaseous state at 25°C .

Step 2: Analyzing the compound BrF_3 .

BrF_3 (Bromine trifluoride) contains a heavier central bromine atom and three fluorine atoms.

- Its molecular mass is considerably greater than ClF .
- The molecule is T-shaped and polar in nature.

- Stronger intermolecular attractions are present between molecules.
- Due to these stronger intermolecular forces, the boiling point becomes much higher.

Hence, at room temperature (25°C), BrF_3 exists as a liquid rather than a gas.

Step 3: Analyzing the compound IF_3 .

IF_3 (Iodine trifluoride) is another interhalogen compound.

- Although iodine is heavier, IF_3 is unstable under ordinary conditions.
- In many standard chemistry references and competitive examinations, it is treated among gaseous interhalogen compounds.

Therefore, it is not the correct option for the compound that is definitely non-gaseous at room temperature.

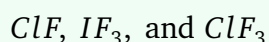
Step 4: Analyzing the compound ClF_3 .

ClF_3 (Chlorine trifluoride) is a volatile interhalogen compound.

- It has comparatively lower molecular mass than BrF_3 .
- It possesses relatively weaker intermolecular attractions.
- Therefore, it remains gaseous at room temperature.

Step 5: Final comparison and conclusion.

Among all the given compounds:



are considered gaseous at room temperature, whereas:



exists as a liquid because of its stronger intermolecular forces and higher boiling point.

Hence, the compound which is **not** in gaseous phase at 25°C is:



Quick Tip: For interhalogen compounds, increasing molecular size generally increases intermolecular attraction and boiling point. Heavier interhalogens are therefore more likely to exist as liquids or solids at room temperature.

2. A solution is prepared by dissolving 2 gram of non-volatile solute in 500 mL solution at 27°C. The osmotic pressure of the solution is 0.82 atm. The molar mass of the solute is:

- (1) 100 g mol⁻¹
- (2) 120 g mol⁻¹
- (3) 150 g mol⁻¹
- (4) 180 g mol⁻¹

Correct Answer: (1) 120 g mol⁻¹

Solution:

Concept: Osmotic pressure is a colligative property that depends on the number of solute particles present in the solution. For dilute solutions, osmotic pressure is given by the van't Hoff equation:

$$\pi = CRT$$

where:

- π = osmotic pressure
- C = molar concentration of solution
- R = universal gas constant
- T = absolute temperature

Since:

$$C = \frac{n}{V} = \frac{w}{MV}$$

the osmotic pressure equation becomes:

$$\pi = \frac{wRT}{MV}$$

where:

- w = mass of solute
- M = molar mass of solute
- V = volume of solution in liters

Step 1: Writing the given data.

From the question:

$$w = 2 \text{ g}$$

$$V = 500 \text{ mL} = 0.5 \text{ L}$$

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

$$\pi = 0.82 \text{ atm}$$

Gas constant:

$$R = 0.082 \text{ L atm mol}^{-1}\text{K}^{-1}$$

Step 2: Substituting values into osmotic pressure formula.

Using:

$$\pi = \frac{wRT}{MV}$$

Substituting all values:

$$0.82 = \frac{2 \times 0.082 \times 300}{M \times 0.5}$$

Step 3: Simplifying the numerator.

$$2 \times 0.082 \times 300$$

$$= 49.2$$

Therefore:

$$0.82 = \frac{49.2}{0.5M}$$

Step 4: Solving for molar mass M .

Multiply both sides by $0.5M$:

$$0.82 \times 0.5M = 49.2$$

$$0.41M = 49.2$$

Now divide both sides by 0.41:

$$M = \frac{49.2}{0.41}$$

$$M = 120 \text{ g mol}^{-1}$$

Step 5: Identifying the correct option.

The molar mass of the non-volatile solute is:

$$120 \text{ g mol}^{-1}$$

Hence, the correct answer is:

$$(2) 120 \text{ g mol}^{-1}$$

Quick Tip: For osmotic pressure problems, always convert:

- Temperature into Kelvin
- Volume into liters

A commonly used formula is:

$$M = \frac{wRT}{\pi V}$$

which directly gives molar mass.

3. What is the oxidation state of sulfur in Marshall's acid, $H_2S_2O_8$?

- (1) +4
- (2) +5
- (3) +6
- (4) +7

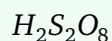
Correct Answer: (3) +6

Solution:

Concept: The oxidation state (oxidation number) of an element represents the apparent charge it would possess if all bonds were completely ionic. While calculating oxidation states in a compound, the following standard rules are commonly used:

- Hydrogen generally has oxidation state +1.
- Oxygen generally has oxidation state -2 .
- In peroxides and peroxide linkages ($-O-O-$), oxygen has oxidation state -1 .
- The algebraic sum of oxidation states of all atoms in a neutral compound is zero.

Marshall's acid is also called **peroxodisulfuric acid** and has the molecular formula:



It contains a peroxide linkage ($-O-O-$), which is extremely important while calculating oxidation state.

Step 1: Identifying the special peroxide oxygen atoms.

In $H_2S_2O_8$:

- Two oxygen atoms are present in peroxide linkage ($-O-O-$).
- These peroxide oxygen atoms each have oxidation state -1 .
- The remaining six oxygen atoms have normal oxidation state -2 .

Step 2: Assigning oxidation states to all atoms.

Let oxidation state of each sulfur atom be x .

Now calculate contribution from each atom:

$$\text{Hydrogen: } 2(+1) = +2$$

$$\text{Peroxide oxygen: } 2(-1) = -2$$

$$\text{Remaining oxygen: } 6(-2) = -12$$

$$\text{Sulfur: } 2x$$

Step 3: Forming the oxidation number equation.

Since the molecule is neutral:

$$2x + 2 - 2 - 12 = 0$$

Simplifying:

$$2x - 12 = 0$$

$$2x = 12$$

$$x = 6$$

Step 4: Final conclusion.

Therefore, the oxidation state of sulfur in Marshall's acid is:

+6

Hence, the correct option is:

(3) + 6

Quick Tip: Always check for peroxide linkage ($-O-O-$) in compounds like:

- H_2O_2
- $H_2S_2O_8$
- Na_2O_2

In peroxide linkage, oxygen has oxidation state -1 , not -2 .

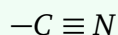
4. What is formed when an alkyl cyanide reacts with sodium in ether?

- (1) Primary amine
- (2) Secondary amine
- (3) Alkene
- (4) Alcohol

Correct Answer: (1) Primary amine

Solution:

Concept: Alkyl cyanides (also called nitriles) contain the functional group:

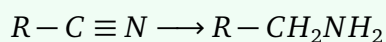


When nitriles undergo reduction, the cyanide group is converted into an amino group ($-NH_2$).

Reduction of nitriles can be carried out using reducing agents such as:

- Sodium in ether
- Lithium aluminium hydride ($LiAlH_4$)
- Hydrogen gas in presence of catalysts like Ni or Pt

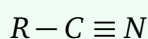
The reduction converts:



The product formed is a **primary amine**.

Step 1: Understanding the structure of alkyl cyanide.

An alkyl cyanide has the general formula:

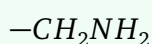


where:

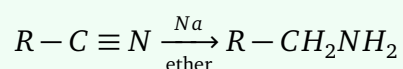
- R represents an alkyl group.
- $-C \equiv N$ is the nitrile functional group.

Step 2: Reduction of nitrile group.

During reduction, the carbon-nitrogen triple bond gains hydrogen atoms and gets converted into:



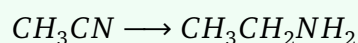
Thus:



Step 3: Identifying the product formed.

The group $-NH_2$ attached to one carbon atom represents a **primary amine**.

For example:



Ethyl cyanide gives ethylamine after reduction.

Step 4: Evaluating the options.

- Primary amine: Correct, nitriles reduce to primary amines.
- Secondary amine: Incorrect, no second alkyl group is attached to nitrogen.
- Alkene: Incorrect, reduction does not form double bonds here.
- Alcohol: Incorrect, nitriles do not reduce into alcohols under these conditions.

Step 5: Final conclusion.

Therefore, alkyl cyanides on reduction with sodium in ether form:

Primary amine

Hence, the correct option is:

(1) Primary amine

Quick Tip: Remember the important conversion:



Thus:

- Nitrile \rightarrow Primary amine
- Number of carbon atoms increases by one compared to alkyl halide used in cyanide preparation.

5. Which of the following is not amphoteric in nature?

- (1) NH_3
- (2) HCl
- (3) H_2O
- (4) Cr_2O_3

Correct Answer: (2) HCl

Solution:

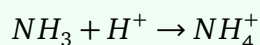
Concept: An amphoteric substance is one that can behave both as an acid and as a base depending upon the reacting species. According to the Brønsted-Lowry concept:

- Acids donate protons (H^+)
- Bases accept protons (H^+)

A substance capable of both donating and accepting protons is called amphoteric or amphiprotic. Some metal oxides also show amphoteric behavior because they react with both acids and bases.

Step 1: Checking the nature of NH_3 .

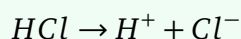
Ammonia (NH_3) mainly acts as a base because it accepts a proton:



Under certain conditions, it can also donate a proton very weakly. Hence, it can exhibit amphoteric behavior in advanced acid-base chemistry.

Step 2: Checking the nature of HCl .

Hydrochloric acid is a strong acid:

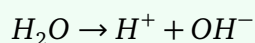


It donates protons very easily but does not accept protons. Therefore, it behaves only as an acid and is not amphoteric.

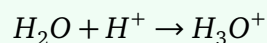
Step 3: Checking the nature of H_2O .

Water is a classic amphoteric substance.

- It can donate a proton:



- It can also accept a proton:



Therefore, water is amphoteric.

Step 4: Checking the nature of Cr_2O_3 .

Chromium oxide reacts with both acids and bases.

- With acids, it behaves as a base.
- With bases, it behaves as an acid.

Hence, Cr_2O_3 is amphoteric.

Step 5: Final conclusion.

Among the given compounds, HCl behaves only as an acid and does not show amphoteric nature.

Therefore, the correct answer is:

(2) HCl

Quick Tip: Common amphoteric substances include:

- H_2O
- Al_2O_3
- ZnO
- Cr_2O_3

Strong acids like HCl and HNO_3 are not amphoteric because they can only donate protons.

6. The rate of reaction $A \rightarrow P$ is $1.25 \times 10^{-2} \text{ mol dm}^{-3} \text{ s}^{-1}$ when $[A] = 0.5 \text{ M}$. Calculate the rate constant if the reaction is second order in A.

- (1) 0.05
- (2) 0.04
- (3) 0.03
- (5) 0.01

Correct Answer: (1) 0.05

Solution:

Concept: The rate law for a reaction relates the rate of reaction to the concentration of reactants. For a reaction that is second order with respect to reactant A:

$$\text{Rate} = k[A]^2$$

where:

- k = rate constant
- $[A]$ = concentration of reactant
- Rate = rate of reaction

To find the rate constant, we rearrange the equation:

$$k = \frac{\text{Rate}}{[A]^2}$$

Step 1: Writing the given data.

Given:

$$\text{Rate} = 1.25 \times 10^{-2} \text{ mol dm}^{-3}\text{s}^{-1}$$

$$[A] = 0.5 \text{ M}$$

Reaction order with respect to A = 2

Step 2: Writing the rate law equation.

Since the reaction is second order:

$$\text{Rate} = k[A]^2$$

Substituting the given values:

$$1.25 \times 10^{-2} = k(0.5)^2$$

Step 3: Calculating $(0.5)^2$.

$$(0.5)^2 = 0.25$$

Thus:

$$1.25 \times 10^{-2} = k(0.25)$$

Step 4: Finding the value of rate constant k .

$$k = \frac{1.25 \times 10^{-2}}{0.25}$$

$$k = 5 \times 10^{-2}$$

$$k = 0.05$$

Step 5: Final conclusion.

Therefore, the value of the rate constant is:

0.05

Hence, the correct answer is:

(1) 0.05

Quick Tip: For reaction orders:

- First order:

$$\text{Rate} = k[A]$$

- Second order:

$$\text{Rate} = k[A]^2$$

- Third order:

$$\text{Rate} = k[A]^3$$

Always substitute concentration carefully before solving for k .

7. Identify the unit of rate constant for a first-order reaction.

(1) $\text{mol dm}^{-3}\text{s}^{-1}$

(2) s^{-1}

(3) $\text{mol}^{-1}\text{dm}^3\text{s}^{-1}$

(4) mol dm⁻³

Correct Answer: (2) s⁻¹

Solution:

Concept: The unit of the rate constant depends upon the order of the reaction. The general rate law is:

$$\text{Rate} = k[A]^n$$

where:

- k = rate constant
- $[A]$ = concentration of reactant
- n = order of reaction

For a first-order reaction:

$$\text{Rate} = k[A]$$

The rate of reaction has units:

$$\text{mol dm}^{-3}\text{s}^{-1}$$

and concentration has units:

$$\text{mol dm}^{-3}$$

Step 1: Writing the rate law for first-order reaction.

For first order:

$$\text{Rate} = k[A]$$

Rearranging:

$$k = \frac{\text{Rate}}{[A]}$$

Step 2: Substituting the units.

$$k = \frac{\text{mol dm}^{-3}\text{s}^{-1}}{\text{mol dm}^{-3}}$$

Step 3: Cancelling the common concentration units.

$$k = \text{s}^{-1}$$

Thus, the unit of rate constant for a first-order reaction is inverse second.

Step 4: Evaluating the options.

- $\text{mol dm}^{-3}\text{s}^{-1}$: Unit of reaction rate, not rate constant.
- s^{-1} : Correct unit for first-order rate constant.
- $\text{mol}^{-1}\text{dm}^3\text{s}^{-1}$: Unit of second-order rate constant.
- mol dm^{-3} : Unit of concentration only.

Step 5: Final conclusion.

Therefore, the correct unit is:

$$\boxed{\text{s}^{-1}}$$

Hence, the correct option is:

$$\boxed{(2) \text{s}^{-1}}$$

Quick Tip: Remember the common units of rate constants:

- Zero order:

$$\text{mol dm}^{-3}\text{s}^{-1}$$

- First order:

$$\text{s}^{-1}$$

- Second order:

$$\text{mol}^{-1}\text{dm}^3\text{s}^{-1}$$

The unit changes with reaction order.

8. The magnetic moment of Cr^{3+} ion is 3.87 BM. The number of unpaired electrons present is:

- (1) 1
- (2) 2
- (3) 3
- (4) 4

Correct Answer: (3) 3

Solution:

Concept: The magnetic moment of transition metal ions can be calculated using the spin-only formula:

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

where:

- μ = magnetic moment in Bohr Magnetron (BM)
- n = number of unpaired electrons

This formula is commonly used for transition metal ions where orbital contribution is negligible.

Step 1: Writing the given magnetic moment.

Given:

$$\mu = 3.87 \text{ BM}$$

Using the formula:

$$\mu = \sqrt{n(n+2)}$$

Substitute the value of magnetic moment:

$$3.87 = \sqrt{n(n+2)}$$

Step 2: Squaring both sides.

$$(3.87)^2 = n(n+2)$$

$$14.97 \approx n(n+2)$$

Step 3: Testing possible integer values of n .

Check the options:

For $n = 1$:

$$1(1+2) = 3$$

$$\sqrt{3} = 1.73 \text{ BM}$$

Incorrect.

For $n = 2$:

$$2(2+2) = 8$$

$$\sqrt{8} = 2.83 \text{ BM}$$

Incorrect.

For $n = 3$:

$$3(3 + 2) = 15$$

$$\sqrt{15} = 3.87 \text{ BM}$$

This matches the given magnetic moment.

For $n = 4$:

$$4(4 + 2) = 24$$

$$\sqrt{24} = 4.90 \text{ BM}$$

Incorrect.

Step 4: Final conclusion.

Thus, the number of unpaired electrons present in Cr^{3+} ion is:

3

Hence, the correct option is:

(3) 3

Quick Tip: Important spin-only magnetic moments:

- 1 unpaired electron → 1.73 BM
- 2 unpaired electrons → 2.83 BM
- 3 unpaired electrons → 3.87 BM
- 4 unpaired electrons → 4.90 BM
- 5 unpaired electrons → 5.92 BM

These values are frequently used directly in competitive exams.

9. Oil of wintergreen is chemically known as:

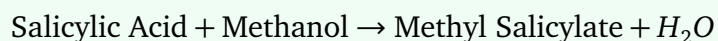
- (1) Methyl acetate
- (2) Methyl salicylate
- (3) Ethyl salicylate
- (4) Salicylic acid

Correct Answer: (2) Methyl salicylate

Solution:

Concept: Oil of wintergreen is a naturally occurring aromatic compound obtained from plants such as wintergreen and sweet birch. It belongs to the class of esters and possesses a characteristic pleasant smell. Chemically, it is known as **methyl salicylate**.

Methyl salicylate is formed by esterification of salicylic acid with methanol.



Step 1: Understanding the structure of methyl salicylate.

Methyl salicylate is an ester containing:

- A benzene ring
- An ester group ($-\text{COOCH}_3$)

- A hydroxyl group ($-OH$)

Its IUPAC name is:

Methyl 2-hydroxybenzoate

Step 2: Identifying the common name.

The compound methyl salicylate is commonly known as:

Oil of wintergreen

It is widely used in:

- Pain relief balms
- Liniments
- Flavoring agents
- Perfumes

Step 3: Evaluating the given options.

- Methyl acetate: Simple ester with fruity smell, not oil of wintergreen.
- Methyl salicylate: Correct chemical name of oil of wintergreen.
- Ethyl salicylate: Different ester compound.
- Salicylic acid: Parent acid used to prepare methyl salicylate.

Step 4: Final conclusion.

Therefore, oil of wintergreen is chemically known as:

Methyl salicylate

Hence, the correct option is:

(2) Methyl salicylate

Quick Tip: Remember some important common names:

- Oil of wintergreen → Methyl salicylate
- Vinegar → Acetic acid
- Wood spirit → Methanol
- Grain alcohol → Ethanol

Common names are frequently asked in organic chemistry questions.

10. Which of the following does not belong to Group 16 elements?

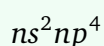
- (1) Oxygen
- (2) Sulfur
- (3) Selenium
- (4) Chlorine

Correct Answer: (4) Chlorine

Solution:

Concept: In the modern periodic table, elements are arranged into groups based on similarities in their electronic configuration and chemical properties.

Group 16 elements are collectively known as the **Chalcogens**. These elements have six electrons in their outermost shell and generally show the valence shell electronic configuration:



The common members of Group 16 are:

O, S, Se, Te, Po

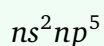
Step 1: Identifying the position of each element in the periodic table.

- Oxygen (O) belongs to Group 16.
- Sulfur (S) belongs to Group 16.
- Selenium (Se) belongs to Group 16.
- Chlorine (Cl) belongs to Group 17.

Step 2: Understanding why chlorine is different.

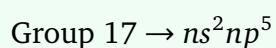
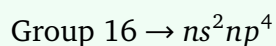
Chlorine belongs to the **Halogen family** which is Group 17 of the periodic table.

Its valence shell configuration is:



Thus, chlorine contains seven valence electrons instead of six.

Step 3: Comparing the groups.



Therefore, chlorine does not belong to Group 16.

Step 4: Final conclusion.

Hence, the element which does not belong to Group 16 is:

Chlorine

Therefore, the correct option is:

(4) Chlorine

Quick Tip: Important group names in the periodic table:

- Group 1 → Alkali metals
- Group 2 → Alkaline earth metals
- Group 16 → Chalcogens
- Group 17 → Halogens
- Group 18 → Noble gases

Remember:

O, S, Se, Te → Group 16

F, Cl, Br, I → Group 17