Maharashtra Board Class 12 Chemistry Question Paper with Solutions(Memory Based)

General Instructions

1. The question paper consists of six sections — Section A to Section F.
2. Time allowed is **3 hours 15 minutes** and the maximum marks are **90**.
3. All questions are compulsory unless otherwise stated.
4. Section A contains Multiple Choice Questions (MCQs). Choose the correct answer from the given options.
5. Section B includes:
   - True/False questions
   - Fill in the blanks
   - Very short answer questions (one or two words)
6. Section C contains short answer type questions.
7. Section D contains long descriptive questions with internal choices.
8. Section E contains long answer questions. Attempt the required number as instructed.
9. Section F consists of Map Work. Mark and label the places correctly on the outline map of India.
10. Figures to the right indicate full marks for each question.
11. Write neatly and draw diagrams wherever necessary.
12. Write answers only in the space provided or as instructed.

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1. All _____ properties of solution are related with decreasing in vapour pressure.

Correct Answer: Colligative

Solution:
Concept:
When a non-volatile solute is added to a solvent, the vapour pressure of the solution decreases. This lowering of vapour pressure leads to several related properties known as colligative properties.

Colligative Properties:
Colligative properties are those properties of solutions that depend only on the number of solute particles present, not on their nature.

Examples of Colligative Properties:

- Lowering of vapour pressure

- Elevation of boiling point
- Depression of freezing point
- Osmotic pressure

All these properties arise due to the decrease in vapour pressure when solute is added.

Answer: Colligative

Quick Tip

Colligative properties depend on quantity of solute particles, not their chemical identity.

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2. Fuel cells produce electricity with an efficiency of about _____ percentage compared to thermal plants whose efficiency is about 40%.

Correct Answer: 70%

Solution:
Concept:
Fuel cells convert chemical energy directly into electrical energy through electrochemical reactions. Unlike thermal power plants, they do not rely on combustion, which increases their efficiency.

Explanation:

- Thermal power plants operate at about 40% efficiency due to energy losses as heat.
- Fuel cells can achieve efficiencies of about $60\% - 70\%$.
- When waste heat is utilized (combined heat and power systems), overall efficiency may exceed 80%.

Efficiency of fuel cells $\approx 70\%$

Quick Tip

Fuel cells are more efficient because they directly convert chemical energy into electrical energy without intermediate heat conversion.

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3. Zn, Cd and Hg generally are not considered as _____ elements.

Correct Answer: Transition

Solution:
Concept:
Transition elements are defined as elements that have partially filled d-orbitals in their atoms or in at least one of their common oxidation states.

Explanation:

- Zinc (Zn), Cadmium (Cd), and Mercury (Hg) belong to Group 12 of the periodic table.
- Their electronic configurations have completely filled d-subshells.

$$\text{Zn} : [Ar]\, 3d^{10}4s^2$$
$$\text{Cd} : [Kr]\, 4d^{10}5s^2$$
$$\text{Hg} : [Xe]\, 4f^{14}5d^{10}6s^2$$

Even in their common ions (e.g., Zn^{2+}), the d-orbitals remain fully filled.

Conclusion:
Since they do not have partially filled d-orbitals, Zn, Cd, and Hg are not considered true transition elements.

Answer: Transition elements

Quick Tip

Group 12 elements are called d-block elements but not true transition elements due to fully filled d-orbitals.

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4. In addition of bromine in CCl_4 to an alkene resulting in disappearance of reddish brown colour of bromine constitutes an important method for the detection of _____ in a molecule.

Correct Answer: Unsaturation (double bond)

Solution:
Concept:
Bromine test is a common qualitative test used in organic chemistry to detect unsaturation in hydrocarbons.

Explanation:

- Bromine in carbon tetrachloride (CCl_4) has a reddish-brown colour.
- When an alkene is added, bromine undergoes an addition reaction across the double bond.
- This reaction removes the colour of bromine solution.

Reaction:

$$R{-}CH = CH{-}R + Br_2 \rightarrow R{-}CHBr{-}CHBr{-}R$$

Conclusion:
Disappearance of bromine colour indicates the presence of a double bond or unsaturation in the molecule.

Answer: Unsaturation

Quick Tip

Decolourisation of bromine in CCl_4 is a quick test for alkenes and alkynes (unsaturated compounds).

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5. Amines behave as _____ due to presence of an unshared pair of electron on Nitrogen atom.

Correct Answer: Bases

Solution:
Concept:
Amines are organic derivatives of ammonia (NH_3) in which one or more hydrogen atoms are replaced by alkyl or aryl groups. The nitrogen atom in amines contains a lone pair of electrons.

Explanation:

- Nitrogen atom in amines has an unshared (lone) pair of electrons.
- This lone pair can accept a proton (H^+).
- Hence, amines behave as Lewis bases or Brønsted bases.

Example Reaction:

$$RNH_2 + H^+ \rightarrow RNH_3^+$$

This shows proton acceptance, confirming basic nature.

Conclusion:
Due to the presence of a lone pair on nitrogen, amines exhibit basic properties.

Answer: Bases

Quick Tip

More availability of lone pair on nitrogen increases basic strength of amines.

6. Only _____ are obtained on hydrolysis of Protein.

Correct Answer: Amino acids

Solution:
Concept:
Proteins are complex biomolecules made up of long chains of amino acids linked by peptide bonds. When proteins are broken down chemically, these peptide bonds are cleaved.

Explanation:

- Hydrolysis involves breaking bonds using water (acidic, basic, or enzymatic conditions).
- During hydrolysis, peptide bonds in proteins are broken.
- This releases individual amino acid units.

Reaction Representation:

$$\text{Protein} + H_2O \xrightarrow{\text{Hydrolysis}} \text{Amino acids}$$

Conclusion:
Since proteins are polymers of amino acids, their complete hydrolysis yields amino acids.

$$\boxed{\text{Answer: Amino acids}}$$

Quick Tip

Proteins = polymers; Amino acids = monomers released after hydrolysis.

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7. Conductivity of a solution increases with dilution. (True/False)

Correct Answer: False

Solution:
Concept:
There are two types of conductivity in electrolytic solutions:

- Specific conductivity (κ)
- Molar conductivity (Λ_m)

Explanation:

- On dilution, the number of ions per unit volume decreases.
- Therefore, **specific conductivity decreases**.

- However, **molar conductivity increases** due to increased ion mobility and dissociation.

Since the statement says conductivity (generally referring to specific conductivity), it is incorrect.

$$\boxed{\text{False}}$$

Quick Tip

Dilution ↓ specific conductivity but ↑ molar conductivity.

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8. Value of magnetic moment of a divalent ion in aqueous solution having atomic number 25 will be 5.92 B.M. (True/False)

Correct Answer: True

Solution:
Concept:
Magnetic moment of transition metal ions depends on the number of unpaired electrons and is calculated using the spin-only formula:

$$\mu = \sqrt{n(n+2)} \text{ B.M.}$$

where n = number of unpaired electrons.

Step 1: Identify the Element
Atomic number 25 → Manganese (Mn)

$$\text{Mn} : [Ar]\, 3d^5 4s^2$$

Step 2: Divalent Ion Formation

$$\text{Mn}^{2+} : [Ar]\, 3d^5$$

All five d-electrons remain unpaired.

$$n = 5$$

Step 3: Calculate Magnetic Moment

$$\mu = \sqrt{5(5+2)} = \sqrt{35} = 5.92 \text{ B.M.}$$

Conclusion:
The given statement is correct.

$$\boxed{\text{True}}$$

Quick Tip

Maximum spin-only magnetic moment occurs for d^5 configuration due to five unpaired electrons.

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9. Bromo, iodo and polychloro derivatives of hydrocarbons are heavier than water. (True/False)

Correct Answer: True

Solution:
Concept:
The density of organic compounds depends on the atoms present in the molecule. Halogen atoms like chlorine, bromine, and iodine have higher atomic masses compared to hydrogen.

Explanation:

- Hydrocarbons contain mainly carbon and hydrogen, so they are usually lighter than water.
- When halogens (Cl, Br, I) replace hydrogen atoms, molecular mass increases significantly.
- Bromo and iodo compounds especially have high densities due to heavy halogen atoms.
- Polychloro derivatives (e.g., chloroform, carbon tetrachloride) are also denser than water.

Examples:

- Chloroform ($CHCl_3$) – denser than water
- Carbon tetrachloride (CCl_4) – sinks in water
- Bromoform ($CHBr_3$) – very dense liquid

Conclusion:
Hence, the statement is correct.

$$\boxed{\text{True}}$$

Quick Tip

Heavier halogens increase density — more halogens, heavier the compound.

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10. Contrary to electrophilic addition reactions observed in alkenes, the aldehydes and ketones undergo nucleophilic addition reactions. (True/False)

Correct Answer: True

Solution:
Concept:
Different functional groups undergo different types of reactions depending on electron distribution and bond polarity.

Explanation:

- Alkenes contain a carbon–carbon double bond ($C = C$) rich in electron density.
- Therefore, they attract electrophiles and undergo electrophilic addition reactions.

Aldehydes and Ketones:

- They contain a polar carbonyl group ($C = O$).
- Oxygen is more electronegative, making the carbonyl carbon partially positive.
- This electrophilic carbon is attacked by nucleophiles.
- Hence, aldehydes and ketones undergo nucleophilic addition reactions.

Example:

$$RCHO + HCN \rightarrow RCH(OH)CN$$

(HCN adds via nucleophilic addition)

Conclusion:
The given statement is correct.

$$\boxed{\text{True}}$$

Quick Tip

Alkenes → electrophilic addition; Carbonyl compounds → nucleophilic addition.

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11. Lower aliphatic amines are soluble in water while higher amines are essentially insoluble in water. (True/False)

Correct Answer: True

Solution:
Concept:
Solubility of organic compounds in water depends on their ability to form hydrogen bonds and the size of the hydrophobic hydrocarbon chain.

Explanation:

- Amines contain a nitrogen atom with a lone pair of electrons.

- This allows formation of hydrogen bonds with water molecules.
- Lower aliphatic amines (e.g., methylamine, ethylamine) have small alkyl groups, so hydrogen bonding dominates → high solubility.

Higher Amines:

- As the alkyl chain length increases, the non-polar hydrocarbon portion increases.
- Hydrophobic effect reduces interaction with water.
- Thus, higher amines become less soluble or insoluble.

Conclusion:
The statement is correct.

$$\boxed{\text{True}}$$

Quick Tip

Increasing carbon chain length decreases solubility in water due to higher hydrophobic character.

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12. The most common sugar used in our homes is called as glucose. (True/False)

Correct Answer: False

Solution:
Concept:
Different sugars are used in daily life, and their chemical identities vary.

Explanation:

- The sugar commonly used in homes is table sugar.
- Table sugar is chemically known as sucrose ($C_{12}H_{22}O_{11}$).
- It is a disaccharide made of glucose and fructose units.

About Glucose:

- Glucose is a monosaccharide ($C_6H_{12}O_6$).
- It is found in fruits, honey, and blood sugar.
- It is not the common household sugar.

Conclusion:
Since household sugar is sucrose and not glucose, the statement is incorrect.

$$\boxed{\text{False}}$$

Quick Tip

Table sugar = sucrose; blood sugar = glucose.

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13. Match the correct pair:

Column A	**Column B**
(i) Glycogen	(a) Picric acid
(ii) Sodium benzoate	(b) Secondary valency 6
(iii) 2,4,6-trinitrophenol	(c) Food preservative
(iv) $K_4[Fe(CN)_6]$	(d) Half order
(v) Rate = $K[A]^{3/2}[B]^{-1}$	(e) Animal starch

Correct Matching: (i)–(e), (ii)–(c), (iii)–(a), (iv)–(b), (v)–(d)

Solution:
Explanation of Each Pair:

1. **Glycogen → Animal starch (e)** Glycogen is a polysaccharide that stores energy in animals, hence called animal starch.
2. **Sodium benzoate → Food preservative (c)** Widely used to preserve food and beverages due to antimicrobial properties.
3. **2,4,6-trinitrophenol → Picric acid (a)** The chemical name of picric acid is 2,4,6-trinitrophenol.
4. $K_4[Fe(CN)_6]$ → **Secondary valency 6 (b)** In coordination compounds, iron has coordination number (secondary valency) 6.
5. **Rate =** $K[A]^{3/2}[B]^{-1}$ → **Half order (d)** Fractional powers indicate fractional order reactions; here overall order is fractional (includes half-order behavior).

Final Matching:

$$\boxed{(i)-(e),\ (ii)-(c),\ (iii)-(a),\ (iv)-(b),\ (v)-(d)}$$

Quick Tip

Remember: Glycogen = animal starch, Sodium benzoate = preservative, Picric acid = trinitrophenol.

14. Write the chemical name of Vitamin B_2.

Correct Answer: Riboflavin

Solution:
Concept:
Vitamins are essential organic compounds required in small amounts for normal body metabolism. Each vitamin has a common name and a chemical name.

Vitamin B_2:

- Chemical name: **Riboflavin**
- Water-soluble vitamin
- Belongs to the Vitamin B-complex group

Functions:

- Helps in energy production
- Important for skin and eye health
- Plays a role in cellular respiration

Sources:

- Milk and dairy products
- Eggs
- Green vegetables
- Whole grains

$$\boxed{\text{Vitamin } B_2 = \text{Riboflavin}}$$

Quick Tip

Vitamin B_1 = Thiamine, B_2 = Riboflavin, B_3 = Niacin.

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15. Write chemical formula of Iron (III) hexacyanidoferrate (II).

Correct Answer: $Fe_4[Fe(CN)_6]_3$

Solution:
Concept:
Coordination compounds consist of a central metal ion surrounded by ligands. The name indicates oxidation states of metals and nature of ligands.

Given Name Breakdown:

- Iron (III) $\rightarrow Fe^{3+}$
- Hexacyanidoferrate (II) $\rightarrow [Fe(CN)_6]^{4-}$

Charge Balance:
To form a neutral compound:

LCM of charges = 12

- 4 ions of $Fe^{3+} \rightarrow +12$
- 3 ions of $[Fe(CN)_6]^{4-} \rightarrow -12$

Final Formula:

$$Fe_4[Fe(CN)_6]_3$$

This compound is commonly known as **Prussian blue**.

$$\boxed{Fe_4[Fe(CN)_6]_3}$$

Quick Tip

Balance charges between metal ions and complex ions to write formulas of coordination compounds.

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16. Write unit of rate constant for second order reaction.

Correct Answer: $L\,mol^{-1}\,s^{-1}$ (or $M^{-1}s^{-1}$)

Solution:
Concept:
The unit of rate constant depends on the order of the reaction. Rate law:

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

Units of rate are:

$$mol\,L^{-1}s^{-1}$$

Second Order Reaction:
For a second order reaction:

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

Unit Calculation:

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

Substitute units:

$$k = \frac{mol\, L^{-1} s^{-1}}{(mol\, L^{-1})^2}$$

$$= L\, mol^{-1} s^{-1}$$

Alternative Form:

$$M^{-1} s^{-1}$$

(where $M = mol\, L^{-1}$)

$$\boxed{L\, mol^{-1}\, s^{-1}}$$

Quick Tip

Order ↑ → Power of concentration in denominator ↑ → More complex unit of k.

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17. Substances have zero resistivity or infinite conductivity known as _____.

Correct Answer: Superconductors

Solution:
Concept:
Electrical resistivity measures how strongly a material opposes the flow of electric current. Some materials exhibit special behavior at very low temperatures.

Explanation:

- Certain materials, when cooled below a critical temperature, lose all electrical resistance.
- Their resistivity becomes zero and conductivity becomes infinite.
- This phenomenon is called superconductivity.

Definition:
Materials that exhibit zero resistivity and infinite conductivity are called **superconductors**.

Examples:

- Mercury (below 4.2 K)
- Lead
- Niobium alloys

Answer: Superconductors

Quick Tip

Superconductivity occurs below a critical temperature where electrical resistance drops to zero.
