



2025- REVISION
ADVANCED LEVEL CHEMISTRY – MODEL PAPER - 11

01.

a) Consider the following chemical species.

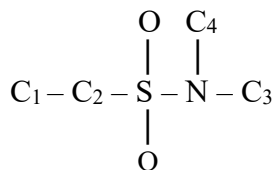


From the list,

- i) Identify the species which takes a shape similar to the shape of NF_3 molecule.
- ii) Identify the species which contains ionic bonds, covalent bonds and dative bonds.
- iii) Identify the species which has the highest number of lone pairs
- iv) Identify the species which has a bond angle of 180°
- v) Identify the species in which d orbitals in addition to s and p orbitals in the central atom participate for making chemical bonds.
- vi) Identify the species which exhibits both polar and, non-polar characters.

b) Many antibacterial drugs such as penicillin and tetracycline contain the compound group named.

"Sulphonamide". The molecular formula of a simple sulphonamide is $\text{C}_4\text{H}_{11}\text{SNO}_2$. It has the following skeleton.



- i) Draw the acceptable Lewis structure for this molecule.

ii) Draw resonance structures for this molecule. (excluding the structure drawn in part (i) above)

iii) Based on the Lewis structure drawn in (i) above, state the following regarding C₂, S, N, C₃, and C₄ atoms given in the table.

- I. VSEPR pairs around the atom
- II. Electron pair geometry around the atom
- III. Shape around the atom
- IV. Hybridization of the atom
- V. Bond angle

		C ₂	S	N	C ₃	C ₄
I.	VSEPR pairs					
II.	Electron pair geometry					
III.	Shape					
IV.	Hybridization					
V.	Bond angle					

iv) Identify the atomic / hybrid orbitals involved in the formation of the following a bonds in the Lewis structure drawn in part (i) above.

- I. C₁ – C₂ , C₁, C₂
- II. C₂ – S , C₂, S
- III. C₁ – C₂ , S, N
- IV. C₁ – C₂ , N, C₃
- V. C₁ – C₂ , C₃, C₄

v) In the Lewis structure drawn in part (1) above, arrange C₁, C₂, C₃ and C₄ atoms according to increasing of order of electronegativity. (Reasons are not required) [Numbering of atoms is as in part (iii)].

i) Basicity of following species ascends as $\text{CH}_3\text{NH}_2 < \text{NH}_3 < (\text{CH}_3)_3\text{NH} < (\text{CH}_3)_2\text{-NH}$

.....

.....

.....

$$\text{H}_2\text{C}=\text{C}(\text{H})\text{CH}_2\text{Br} \xrightarrow{\text{HBr}} \text{P} \xrightarrow{\text{Alcoholic KOH}} \text{Q} \xrightarrow[\text{Liq. NH}_3]{\text{NaNH}_2} \text{R} \xrightarrow{\text{CH}_3\text{CH}_2\text{Br}} \text{S}$$

--	--

--

--	--

--	--

- b. Classify each of the reactions in the above sequence as nucleophilic addition, electrophilic addition, nucleophilic substitution, electrophilic substitution, elimination, or acid base by writing the appropriate word.

.....

.....

- c. Write the mechanism of the first reaction indicated above.

(02) a) The experiments conducted to identify compound **A** are listed in the table below.

	Experiment	Observation
1	Addition of dil. H_2SO_4 to compound A	Clear solution (B) + colourless gas with a pungent smell (C)
2	Pass C gas through the reddish-brown coloured solution of D	Colourless solution which contains E and F . This is an acidic solution.
3	Addition of BaCl_2 to E solution	White precipitate (G)
4	Addition of AgNO_3 to F solution	Pale yellow precipitate (H)

Tests for **G** and **H** precipitates:

5	Addition of dil. HNO_3 to G precipitate	Precipitate was insoluble
6	Addition of conc. NH_4OH to H precipitate	Precipitate was dissolved

Tests for **B** solution

7	Addition of NH_4OH	White precipitate (I) was obtained, and this dissolves in conc. NH_4OH .
8	Heat precipitate I at a high temperature	Yellow coloured solid.

- Identify the chemical species from **A** to **I**.
- Write the balanced equations for the following reactions.



b) 250 cm^3 of solution was prepared by mixing K_2SO_4 , KNO_3 , and KNO_2 in water. 25 cm^3 of the above solution was allowed to oxidize with excess KOH and Al powder. The resulted gas was passed through 50 cm^3 of a 0.1 mol dm^{-3} H_2SO_4 solution. 30 cm^3 of 0.2 mol dm^{-3} NaOH solution was required to neutralize the remaining H_2SO_4 solution. In another experiment required 30 cm^3 of initial solution to decolorize 25 cm^3 of acidic KMnO_4 solution. (Concentration of the KMnO_4 solution = 4.74 g dm^{-3} and $\text{K} = 39$, $\text{Mn} = 55$, $\text{N} = 14$, $\text{O} = 16$)

- Write the balanced equations for all the chemical reactions occur at the above experiment.
- Determine the mass of KNO_3 and KNO_2 in initial sample.

(03) a) **M** is a 3d element in the periodic table that has only one unpaired electron. However, **M** can react with 50% dilute HNO_3 to produce the colorless gas **G** and the coloured solution **L**. **M** cannot react with dilute HCl .

- i. Identify **M** giving reasons.
- ii. Write two industrial uses of **M**.
- iii. Write an experiment to identify **G** gas.
- iv. Write the balanced equation for the reaction between **M** and 50% diluted HNO_3 .
- v. A coloured solution **Q** is produced when excess conc. HCl is added to solution **L**, while a colorful **R** solution is produced when conc. NH_3 is added. Write the IUPAC names, shapes and the colours of **L**, **Q**, and **R** species.

b) **X**, **Y** and **Z** are aqueous solutions of three 3d metal salts. To each of the above solutions, a little amount of aqueous NaOH solution was added.

X – White precipitate was obtained. This precipitate was insoluble in both excess NaOH and in excess NH_3 solution. When kept in air it turned to black-brown coloured precipitate gradually.

Y – Green coloured precipitate was obtained. This precipitate was insoluble in excess NaOH . This dissolved in excess NH_3 solution.

Z – Yellowish brown precipitate was obtained. It is insoluble in both excess NaOH and NH_3 solutions.

- i. Identify **X**, **Y** and **Z** using the above observations.
- ii. Write balanced chemical equations to explain the reactions taking place above.
- iii. If you are provided a solid mixture of **X** and **Y** salts, write a method to calculate their respective mass percentages.

c) A 250 cm³ aqueous solution was prepared by dissolving 2.39 g of a solid mixture containing only NH₄Cl and (NH₄)₂SO₄. 25.0 cm³ of the above solution was transferred to a beaker, and 50 cm³ of 0.2 mol dm⁻³ NaOH was added to it. This solution was boiled until all the NH₃ was removed. Then the resulted solution was titrated with a 0.3 mol dm⁻³ HCl solution. 20.00 cm³ of HCl was required to obtain the end point. (N = 14, H = 1, S = 32, Cl = 35.5, O = 16)

- Write the balanced equations for all the chemical reactions.
- Calculate the mole percentage of NH₄Cl in the initial mixture.

d) The following procedure was used to determine the molar mass of an unknown gas **B**. First the mass of a rigid container of volume **V** containing dry air was measured as m_1 . The dry air was removed and was filled with gas B, mass measured was m_2 . All the gases were kept at the same temperature **T** and pressure **P**. Density of dry air is d . Prove that the molar mass (**M**) of the gas **B** is given by $M = \left[\frac{m_2 - (m_1 - dV)}{PV} \right] RT$

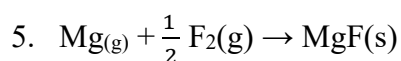
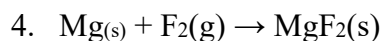
e. The mixtures A and B are identical in colour and colour intensity.

Mixture A	5 cm ³ of tube-well water	5 cm ³ of distilled water	5 cm ³ of 0.001 mol dm ⁻³ salicylic acid
Mixture B	1.5 cm ³ of 0.002 mol dm ⁻³ Fe ³⁺ ion solution	8.5 cm ³ of distilled water	5 cm ³ of 0.001 mol dm ⁻³ salicylic acid

- Calculate the concentration of Fe³⁺ in the tube-well water sample and give it in mg dm⁻³ (Fe = 56)
- What is the colour of the complex formed between Fe³⁺ ions and salicylic acid?
- What is the stoichiometric ratio between Fe³⁺ ions and salicylate ions in the above-mentioned complex?
- State an appropriate method for the removal of Fe²⁺ and Fe³⁺ ions in water.

MCQ

- 1) The chemical formula of ferric phosphate is,
1. $\text{Fe}(\text{PO}_4)_3$ 2. FePO_4 3. $\text{Fe}(\text{PO}_3)_2$ 4. $\text{Fe}_2(\text{PO}_4)_3$ 5. $\text{Fe}_3(\text{PO}_4)_2$
- 2) The confusion that existed among chemists at the very early stages of the study of Chemistry, regarding the concept of atomic structure was dispelled by,
1. Dalton 2. Avogadro 3. Cannizzaro 4. Moseley 5. Rutherford
- 3) Chromate ions are converted to dichromate ions by the reaction with ethanoic acid. In this reaction,
1. The chromate ions undergo oxidation
2. The chromate ions undergo reduction.
3. The chromate ions undergo both oxidation and reduction
4. The ethanoic acid undergoes oxidation.
5. None of the above occurs.
- 4) Which one of the following will give a precipitate readily with aqueous silver ethanoate?
1. $\text{ClCH}_2\text{CH}_2\text{Cl}$ 2. $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$ 3. $\text{CH}_2=\text{CHBr}$ 4. CH_3CCl_3 5. $\text{Br}_2\text{C}=\text{CBr}_2$
- 5) The chemical formula of rutile is,
1. $\text{Fe}_2\text{O}_3 \cdot \text{TiO}_2$ 2. $\text{FeO} \cdot \text{TiO}_2$ 3. TiO_3 4. TiO_2 5. TiO_4
- 6) Which one of the following could be used to distinguish chemically between AgBr and AgI ?
1. Dilute HNO_3 2. Concentrated HNO_3 3. Dilute HCl
4. Concentrated Cl_3CCOOH 5. Dilute H_2SO_4
- 7) Which one of the following changes is most closely connected with the standard enthalpy of formation of magnesium fluoride?
1. $\text{Mg}_{(\text{s})} + \text{F}_{2(\text{g})} \rightarrow \text{MgF}_{2(\text{s})}$
2. $\text{Mg}^{2+}_{(\text{g})} + 2\text{F}^{-}_{(\text{g})} \rightarrow \text{MgF}_{2(\text{s})}$
3. $\text{Mg}_{(\text{s})} + \frac{1}{2}\text{F}_{2(\text{g})} \rightarrow \text{MgF}_{(\text{s})}$



8) How much of oxygen gas at s.t.p. is expected to be liberated by the passage of 1 Faraday of electricity through an aqueous solution of sulphuric acid?

1. 22.4 dm³ 2. 11.2 dm³ 3. 5.6 dm³ 4. 88.8 dm³ 5. 44.8 dm³

9) When 1 mole of an organic compound, X was subjected to acidic KMnO₄ under oxidative conditions, 2 moles of ketone and 1 mole of dicarboxylic acid were obtained. The compound, X

1. can be $(\text{CH}_3)_2\text{C} = \text{CHCH}_2\text{CH}_2\text{CH} = \text{CHCOOH}$

2. can be $\text{C}_6\text{H}_5\text{CH} = \text{CHCH} = \text{C}(\text{CH}_3)_2$

3. can be $\text{CH}_3\text{CH} = \text{CHCH} = \text{CHCH}_3$

4. can be $(\text{CH}_3)_2\text{C} = \text{CHCH}_2\text{CH}_2\text{CH} = \overset{\text{CH}_3}{\underset{|}{\text{C}}}\text{C}_6\text{H}_5$

5. cannot be any of the above.

10) Which one of the following statements concerning ionization energies is true?

1. The first ionization energy of Al is greater than the first ionization energy of Mg
2. The first ionization energy of Si is smaller than the first ionization energy of S.
3. The fourth ionization energy of B is smaller than the fourth ionization energy of Al
4. The first ionization energy of Cl is greater than the first ionization energy of Ne.
5. All of the above statements are false.