

ICSE 2025 EXAMINATION

Sample Question Paper - 4

Chemistry

Time Allowed: 2 hours

Maximum Marks: 80

General Instructions:

- Answers to this Paper must be written on the paper provided separately.
- You will not be allowed to write during the first 15 minutes.
- This time is to be spent reading the question paper.
- The time given at the head of this Paper is the time allowed for writing the answers.
- **Section A** is compulsory. Attempt any four questions from **Section B**.
- The intended marks for questions or parts of questions are given in brackets [].

Section A

1. **Question 1 Choose one correct answer to the questions from the given options:** [15]
- (a) Amongst the following, select the element with highest ionisation enthalpy. [1]
- | | |
|--------------|--------------|
| a) Beryllium | b) Potassium |
| c) Sodium | d) Magnesium |
- (b) An element in period-3 whose electron affinity is zero _____. [1]
- | | |
|------------|-----------|
| a) Neon | b) Argon |
| c) Sulphur | d) Sodium |
- (c) Compound X consists of molecules. The type of bonding in X will be [1]
- | | |
|------------------|-------------|
| a) electrovalent | b) ionic |
| c) molecular | d) covalent |
- (d) Which of the following metals can displace hydrogen from the aqueous solution of NaOH? [1]
- | | |
|-------|-------|
| a) Hg | b) Al |
| c) Cu | d) Ag |
- (e) Identify the metallic oxide which is amphoteric in nature: [1]
- | | |
|----------------------|------------------|
| a) Copper (II) oxide | b) Zinc oxide |
| c) Barium oxide | d) Calcium oxide |
- (f) The metal oxide which can react with acid as well as alkali is: [1]
- | | |
|---------------------|--------------------|
| a) Silver oxide | b) Calcium oxide |
| c) Copper(II) oxide | d) Aluminium oxide |
- (g) The empirical formula of the compound is CH. Its molecular weight is 78. The molecular formula of [1]

a) C₄H₄b) C₃H₃
c) C₂H₂d) C₆H₆

2. **Question 2** **[25]**
- (a) Ammonia is manufactured by Haber's process. **[5]**
- i. Under what conditions do the reactants combine to form ammonia? Give a balanced equation for the reaction.
- ii. In what ratio by volume, are the above gases used?
- iii. What is the function of:
- a. Finely divided iron,

2. **Question 2** [25]

- (a) Ammonia is manufactured by Haber's process.
- Under what conditions do the reactants combine to form ammonia? Give a balanced equation for the reaction.
 - In what ratio by volume, are the above gases used?
 - What is the function of:
 - Finely divided iron,

b. Molybdenum in the above process?

iv. Mention two possible ways by which ammonia produced is removed from unchanged gases.

(b) Match the following:

[5]

Column A	Column B
(a) Acid salt	(i) Sodium potassium carbonate
(b) Mixed salt	(ii) Alum
(c) Complex salt	(iii) Sodium hydrogen carbonate
(d) Double salt	(iv) Sodium zincate

(c) Complete the following by choosing the correct answers from the bracket:

- i. In Period 3, the most metallic element is _____. (sodium/magnesium/aluminium) [1]
- ii. The hydroxides which can act as weak bases as well as weak acids are _____ (neutral, acidic, amphoteric) in nature. [1]
- iii. _____ is defined as the amount of substance which contains same number of units as the number of atoms in 12 g of carbon-12. [1]
- iv. We can expect that pure water _____ normally conduct electricity. [1]
- v. Hot, concentrated nitric acid reacts with sulphur to form _____. (sulphur dioxide/sulphuric acid) [1]

(d) Identify the following:

- i. The covalent compounds of carbon and hydrogen. [1]
- ii. The gas evolved when hydrochloric acid is added to manganese(IV) oxide. [1]
- iii. The particle that move when electric current is passed through metal wire. [1]
- iv. Ice like crystals formed on cooling an organic acid sufficiently. [1]
- v. _____ have maximum electron affinity in their respective periods. (halogens/inert gases) [1]

- (e)
- i. A gaseous hydrocarbon contains 82.76% of carbon. Given that its vapour density is 29, find its molecular formula. [C = 12, H = 1]. [2]
 - ii. Draw the electron dot structure of: [3]
 - i. Nitrogen molecule [N = 7]
 - ii. Sodium chloride [Na = 11, Cl = 17]
 - iii. Ammonium ion [N = 7, H = 1]

Section B

Attempt any 4 questions

3. Question 3

[10]

(a) Sulphur trioxide $\xrightarrow{A}$ Sulphuric acid

[2]

In manufacturing of sulphuric acid by contact process. Sulphur trioxide is not converted to sulphuric acid by reacting it with water. Instead a two step procedure is used. Write the equations for the two steps involved in A.

(b) Write the products and balance the equation.

- i. Lead sulphate from lead carbonate. [1]
- ii. Copper carbonate. [1]

(c) **Arrange the following as per the instruction given in the brackets:**

- i. Cs, Na, Li, K, Rb (increasing order of metallic character) [1]
- ii. Li, F, N [increasing order of electronegativity] [1]
- iii. He, Ar, Ne (Increasing order of the number of shells) [1]

(d) **Fill in the blanks by selecting the appropriate word from the given choice:**

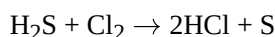
- i. One carbon atom in a hydrocarbon contain the root word as _____. [1]
- ii. -COOH group represents an _____. [1]
- iii. 1 mole = _____ L at STP if substance is a gas. [1]

4. **Question 4** [10]

(a) What are the terms defined in (i) and (ii) below? [2]

- i. A bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair.
- ii. A bond formed by a shared paired of electrons with both electrons coming from the same atom.

(b) If 112 cm^3 of hydrogen sulphide is mixed with 120 cm^3 of chlorine at STP what mass of sulphur is formed? [2]



(c) For each of the substance listed below, describe the role played in the extraction of aluminium: [3]

- i. Cryolite
- ii. Sodium hydroxide
- iii. Graphite

(d) **Explain the following:**

- i. Aluminium is more abundant than gold in the earth's crust, yet it is gold and not aluminium that has been known to man since ancient times. [1]
- ii. Farmers spread slaked lime on the fields. [1]
- iii. Direct current should be used during electroplating. [1]

5. **Question 5** [10]

(a) i. Gas used as illuminating country houses. Identify the gas. [1]

ii. Complete the chemical equation: $\text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COOH} \xrightarrow[\Delta]{\text{Conc. H}_2\text{SO}_4}$ [1]

(b) Compare the compounds carbon tetrachloride and sodium chloride with regard to solubility in water and electrical conductivity. [2]

(c) **Give balanced chemical equation for the following:**

- i. Action of concentrated sulphuric acid on carbon [1]
- ii. Action of dilute sulphuric acid on sodium hydroxide [1]
- iii. Lead nitrate is heated in a dry test tube [1]

(d) **State one relevant observation for each of the following reactions:**

- i. Barium chloride solution is slowly added to sodium sulphate solution. [1]
- ii. Sodium hydroxide solution is added to ferric chloride solution at first a little and then in excess. [1]
- iii. In the electrolyte during the electrolysis of copper sulphate solutions with inert electrodes. [1]

6. **Question 6** [10]

- (a) An element has atomic number 11. Where would you expect this element in the periodic table and why? [2]
- (b) a. What do you understand by Avogadro's number? [2]
b. Write the symbol which is used to denote it.
- (c) Which of the following represents the correct IUPAC name for the compounds concerned? [3]
i. 2,2-dimethylpentane or 2-dimethylpentane
ii. 2,4,7-trimethyloctane or 2,5,7-trimethyl octane
iii. 2-chloro-4-methylpentane or 4-chloro-2-methylpentane
- (d) Distinguish between the following pairs of compounds using a reagent as a chemical test: [3]
i. Calcium nitrate and Zinc nitrate solution.
ii. Ammonium sulphate crystals and Sodium sulphate crystals.
iii. Magnesium chloride and Magnesium nitrate solution.

7. **Question 7** [10]

- (a) How many covalent bonds and coordinate bonds are present in [2]
i. Hydronium ion
ii. Ammonium ion
- (b) A gas cylinder contains 12×10^{24} molecules of oxygen gas. If Avogadro's number is 6×10^{23} ; [2]
molecules. Calculate.
i. The mass of oxygen present in the cylinder.
ii. The volume of oxygen at STP present in the cylinder.
- (c) With reference, to the electrolysis of acidulated water, answer the following: [3]
i. Explain why distilled water is a non-electrolyte.
ii. What is the electrolytic cell called?
iii. State what you would observe at the:
a. Anode
b. Cathode
- (d) Draw the structural formula for each of the following: [3]
i. 2, 3 - dimethyl butane
ii. diethyl ether
iii. propanoic acid

8. **Question 8** [10]

- (a) Draw an electron dot diagram to show the formation of each of the following compounds: [2]
i. Methane
ii. Magnesium chloride
[H = 1, C = 6, Mg = 12, Cl = 17]
- (b) The vapour density of a gas is 8. What would be the volume occupied by 24.0 g of the gas at STP? [2]
- (c) Write balanced chemical equations, for the preparation of the given salts (i) to (iii) by using the [3]
methods A to C respectively:
A. Neutralization, B. Precipitation, C. Titration
i. Copper sulphate

ii. Zinc carbonate

iii. Ammonium sulphate

- (d) i. When moist chlorine reacts with hydrogen sulphide two products are formed:
- a. A gas which fumes in moist air
 - b. A yellow solid Name these products
- ii. What type of reaction is taking place when chlorine acts as a bleaching agent?

[3]

Solution

Section A

1. Question 1 Choose one correct answer to the questions from the given options:

- (i) **(a)** Beryllium

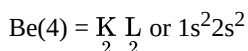
Explanation: {

i. Ionisation enthalpy $\propto$ effective nuclear charge and $\propto \frac{1}{\text{atomic size}}$

ii. Atomic size decreases in period and increases in group.

iii. Elements with fully-filled/half filled outermost sub-shell configuration are more stable.

Hence, ionisation enthalpy of beryllium (Be) is highest, as it has full-filled outermost electronic configuration



- (ii) **(b)** Argon

Explanation: {

Argon

- (iii) **(d)** covalent

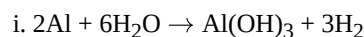
Explanation: {

Compound X consists of molecules not ions. So, the type of bonding in compound X will be covalent.

- (iv) **(b)** Al

Explanation: {

Aluminium (Al) metal when react with NaOH, it gives H(g) as follows.



- (v) **(b)** Zinc oxide

Explanation: {

Zinc oxide

- (vi) **(d)** Aluminium oxide

Explanation: {

Aluminium oxide because it is amphoteric in nature.

- (vii) **(d)** C_6H_6

Explanation: {

[Molecular weight = 78, $n = \frac{78}{13} = 6$ Molecular formula = $(\text{CH})_6$]

- (viii) **(a)** 40

Explanation: {

40

- (ix) **(b)** Three moles of oxide ions

Explanation: {

One mole of electrons(e) are discharged by 1 Faraday charge.

One mole of Al ion = $\text{Al}^{3+} \rightarrow$ requires 3 moles of e^-

$\therefore$ 2 mol of $\text{Al}^{3+} \rightarrow$ requires 6 moles of e^-

Similarly, 5 mole of $\text{OH}^- \rightarrow$ requires 5 moles of e^-

3 moles of oxide ions i.e. $\text{O}^{2-} \rightarrow$ requires 6 moles of e^-

6 moles of hydrogen ions i.e. $\text{H}^+ \rightarrow$ requires 6 moles of e^- .

Hence, hydroxide ions require least moles (numbers) of electrons.

- (x) **(a)** adsorption

Explanation: {

The adsorption phenomenon is involved in the froth floatation process.

(xi) (d) muriatic acid

Explanation: {
muriatic acid

(xii) (d) Ammonia

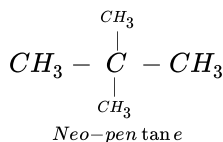
Explanation: {
Ammonia

(xiii) (b) C₃H₇OH

Explanation: {
C₃H₇OH

(xiv) (d) Neopentane

Explanation: {
Neo-pentane will give only one monochloro derivative on halogenation.



(xv) (c) (CH₃)₂CH-COOH

Explanation: {
$$\begin{array}{c} \text{CH}_3 - \text{C} \text{H} - \text{COOH} \\ | \\ \text{CH}_3 \\ \text{Iso-Butyric acid} \end{array}$$

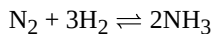
2. Question 2

(i) i. Temperature - 450 - 500°C

Pressure - 200-900 atm.

Catalyst - finely divided iron

Promoter - Molybdenum



ii. In the ratio 1:3 by volume

iii. a. Catalyst

b. Promoter

iv. a. By liquefaction

b. By dissolving in water.

(ii) (a) - (iii), (b) - (i), (c) - (iv), (d) - (ii)

(iii) Complete the following by choosing the correct answers from the bracket:

i. 1. Sodium

ii. 1. amphoteric

iii. 1. Mole

iv. 1. will not

v. 1. Sulphuric acid

(iv) Identify the following:

i. 1. Hydrocarbons

ii. 1. Chlorine

iii. 1. Electron

iv. 1. Glacial acetic acid

v. 1. halogens

(v) i.

Element	Percentage	Atomic Weight	Molecules	Ratio	Simple ratio
C	82.76	12	6.89	2	1
H	17.24	1	17.3	5	2.5

Molecular Mass of C_2H_2

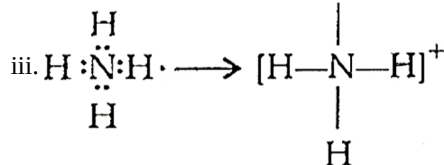
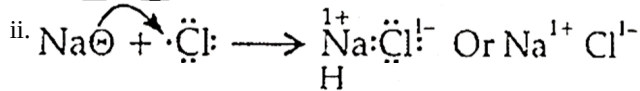
$$12 \times 2 + 1 \times 6 = 24 + 6 = 30; \text{ Vapour density} = 29$$

$$\text{Mass} = 2 \times \text{VD}$$

$$= 2 \times 29 = 58 \text{ gm.}$$

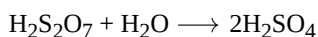
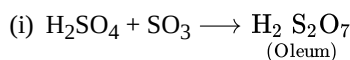
$$n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}} = \frac{58}{30} = 1.8 = 2$$

$$\text{Molecular formula} = 2 \times C_2H_5 = C_4H_{10}$$

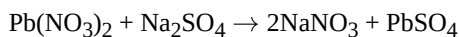
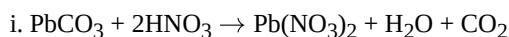


Section B

3. Question 3



(ii) Write the products and balance the equation.



ii. Any soluble salt of copper reacted with sodium, potassium or ammonium carbonate solution.



(iii) Arrange the following as per the instruction given in the brackets:

i. $Li < Na < K < Rb < Cs$ (increasing order)

ii. Increasing order of electronegativity $Li < N < F$

iii. $He < Ne < Ar$

(iv) Fill in the blanks by selecting the appropriate word from the given choice:

i. 1. meth

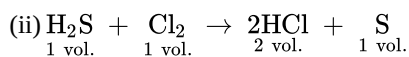
ii. 1. Carboxylic acid

iii. 1. 22.4

4. Question 4

(i) i. Covalent bond

ii. Coordinate bond



1 vol. of H_2S requires 1 vol. of Cl_2

$$112 \text{ cm}^3 \text{ of } H_2S \text{ requires } \frac{1 \times 112}{1} = 112 \text{ cm}^3 \text{ of } Cl_2.$$

$$1 \text{ mole of any gas at STP} = 22400 \text{ cm}^3$$

22400 cm^3 of H_2S gives 1 atom of sulphur

$$22400 \text{ cm}^3 \text{ of } H_2S \text{ gives} = 32 \text{ g of S}$$

$$112 \text{ cm}^3 \text{ of } H_2S \text{ gives} = \frac{32 \times 112}{22400} = 0.16 \text{ g of S.}$$

(iii) i. Cryolite acts as a solvent for the electrolytic mixture as it lowers the fusion temperature from 2050°C to 950°C and enhances conductivity it act as a solvent.

ii. Sodium hydroxide is used to remove insoluble impurities from the ore. When bauxite ore is treated with sodium hydroxide, it dissolves and forms sodium aluminate leaving behind insoluble impurities called red mud. (consists of

ferric oxide, sand etc.)

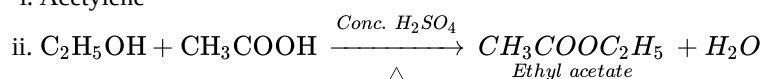
- iii. Graphite lining is used as an cathode and graphite rods are used as anode in the extraction of aluminium because it has a very high melting point and is a good conductor of electricity.

(iv) Explain the following:

- This is due to the fact that aluminium never occurs in the free state in nature. It is always chemically combined with other elements. This is because of its high reactivity. The ores of aluminium are also very stable and cannot be reduced by coke. On the other hand, gold is a noble metal. It is available in the free state or native form because of its unreactive nature.
- Slaked lime is calcium hydroxide, Ca(OH)_2 . It is alkaline in nature. It is added to the soil so as to neutralise the effect of acid rain.
- During electroplating, direct current is used because, if an alternating current is used then, due to alternate discharge and ionisation at the cathode, the coating obtained on the articles will not be smooth.

5. Question 5

- (i) i. Acetylene



- (ii)

	CCl₄ Carbon tetrachloride	NaCl Sodium chloride
Solubility in water	Insoluble in water	Soluble in water
Electrical conductivity	Bad conductor of electricity	Good conductor of electricity in molten or aqueous state

(iii) Give balanced chemical equation for the following:

- $\text{C} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CO}_2 + 2\text{SO}_2 + 2\text{H}_2\text{O}$
- $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$
- $2\text{Pb(NO}_3)_2 \xrightarrow{\Delta} 2\text{PbO} + 4\text{NO}_2 \uparrow + \text{O}_2 \uparrow$

(iv) State one relevant observation for each of the following reactions:

- When barium chloride solution white precipitate of is slowly added to sodium sulphate solution, then white precipitate of barium sulphate is formed.
 $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$
- A reddish brown ppt. of ferric hydroxide is formed which remains insoluble in excess of sodium hydroxide.
- The colour of the electrolyte fades i.e., from blue it changes to colourless.

6. Question 6

- (i) The electronic configuration of the element is 2, 8, 1.

- As the element has three electronic shells, it belongs to the 3rd period.
- As the element has one valence electron, it belongs to -1 group.
Thus, the element is expected to be in -1 group of the 3rd period.

- (ii) a. It is defined as the number of atoms present in 12 g of C-12 isotope i.e., 6.022×10^{23} atoms.

It is defined as the number of elementary units i.e., atoms, ions or molecules present in one mole of a substance.

- b. It is denoted by N_A .

- (iii) i. IUPAC name - 2,2-dimethyl pentane (because for the two alkyl groups on the same carbon, its locant is repeated twice)
- ii. IUPAC name - 2,4, 7-trimethyloctane (because 2,4 , 7-locant set is lower than 2, 5, 7).
- iii. IUPAC name - 2-chloro-4-methylpentane (alphabetical order of substituents)

- (iv) i. By ammonium hydroxide

Calcium nitrate	Zinc nitrate
When ammonium hydroxide is added in excess no precipitate of calcium hydroxide occurs.	When ammonium hydroxide is added in excess white gelatinous precipitate of zinc hydroxide is formed which is soluble in excess NH_4OH .

ii. By sodium hydroxide

Ammonium sulphate crystals	Sodium sulphate crystals
When sodium hydroxide is added white gelatinous precipitate of zinc hydroxide is formed.	Sodium sulphate does not react with sodium hydroxide.

iii. By silver nitrate

Magnesium chloride	Magnesium nitrate
On adding silver nitrate solution white precipitate of silver chloride is formed.	On adding silver nitrate no reaction occurs.

7. Question 7

- (i) i. Hydronium ion contains two covalent bonds and one co-ordinate bond.
 ii. Ammonium ion has three covalent bonds and one co-ordinate bond.

- (ii) i. 1 mole oxygen molecule = 6.022×10^{23} molecules.

$$X \text{ mole of oxygen} = 12 \times 10^{24}$$

$$\text{No. of molecules} = \frac{12 \times 10^{24}}{6 \times 10^{23}} = 20 \text{ molecules}$$

$$1 \text{ molecule} \rightarrow 32 \text{ gm}$$

$$20 \text{ molecules} \rightarrow 32 \times 20 = 640 \text{ g}$$

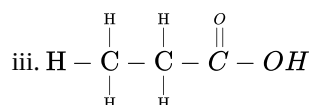
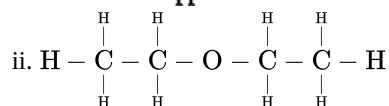
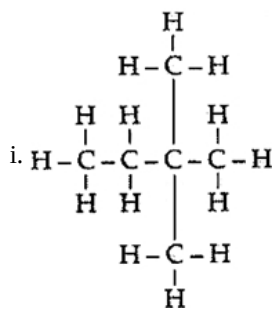
ii. 22.4 l - 1 molecule

$$x \text{ l} - 20 \text{ molecule}$$

$$x - 22.4 \times 20 \rightarrow 448 \text{ l of O}_2$$

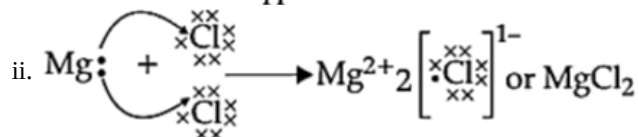
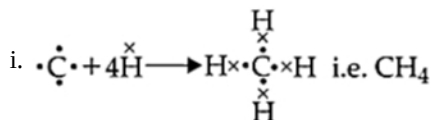
- (iii) i. Distilled water is a covalent compound. In the absence of ions it does not conduct electricity.
 ii. Hoffman's voltmeter.
 iii. O₂ is liberated at anode and H₂ is liberated at cathode.

(iv)



8. Question 8

(i)



(ii) Given, Vapour density = 8

$$\text{Molecular weight} = 2 \times \text{VD}$$

$$= 2 \times 8 = 16$$

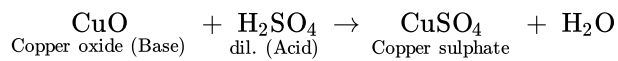
$$\text{No. of moles in 24.0g of gas} = \frac{\text{wt.}}{\text{mol.wt.}} = \frac{24}{16}$$

$$= 1.5 \text{ moles}$$

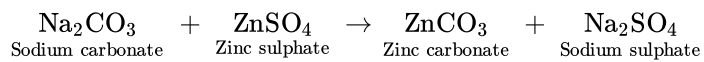
At STP 1 mole of a gas occupies 22.4 l

1.5 moles of the gas will occupy = $\frac{1.5 \times 22.4}{1} = 33.61$

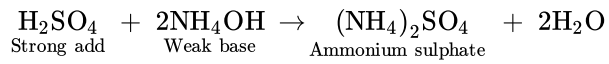
(iii) i. Copper sulphate - by neutralization:



ii. Zinc carbonate - by precipitation



iii. Ammonium sulphate - by titration



(iv) i. a. Hydrochloric acid gas

b. Sulphur

ii. Oxidation