

Chemistry I

002

26/07/2024 08:30 AM – 11:30 AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2023-2024

SUBJECT: CHEMISTRY I

DURATION: 3 HOURS

Instructions to candidates:

- 1) Write your names and index number on the answer booklet as written on your registration form and **DO NOT** write your names and index number on additional answer sheets if provided.
- 2) **DO NOT** open this question paper until you are told to do so.
- 3) This paper consists of **THREE** sections: **A**, **B** and **C**.

Section A: Attempt **ALL** questions. **(55 marks)**

Section B: Attempt any **THREE** questions. **(30 marks)**

Section C: Attempt any **ONE** question. **(15 marks)**

- 4) **You do not need a periodic table.**
- 5) Silent-non programmable calculators may be used.
- 6) Use only a **blue** or **black** pen for answering and a **pencil** for drawing.

Section A: Attempt all questions (55 marks)

1) Fill in the blanks, in each of the following sentences, with the provided terms:

filtration, magnetic separation, homogeneous mixture, decantation.

- a) is a technique used for separating immiscible mixtures. **(1 mark)**
- b) is a composition of two or more substances, whose components distribute uniformly into each other. **(1 mark)**
- c) is a technique used for removing the solid particles from the liquid or gaseous fluid. **(1 mark)**
- d) A mixture of flour and iron nails can be separated with **(1 mark)**

2) Atoms are held together by chemical bonds.

- a) State any two (2) types of chemical bonds. **(2 marks)**
- b) Define the following terms: i) Cation **(1 mark)**
ii) Octet rule **(1 mark)**

3) Air is a mixture of gases. Match each gas component on the left with its percentage composition on the right. **(4 marks)**

Gas component	Composition (%)
a) Oxygen	1) 0.04
b) Nitrogen	2) 0.96
c) Carbon dioxide	3) 21
d) Argon, carbon dioxide, water vapour and trace gases	4) 78

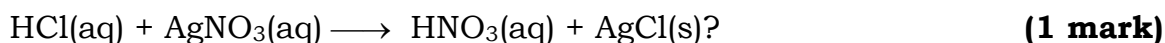
4) Choose a correct answer for each of the following questions.

- a) Which type of reaction is represented by the equation



- i) Precipitation iii) Decomposition
ii) Neutralisation iv) Combustion

- b) Which type of reaction is represented by the equation



- i) Combination iii) Combustion
ii) Precipitation iv) Neutralisation

c) A chemical reaction which proceeds with the evolution/release of heat energy is called: **(1 mark)**

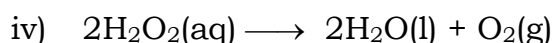
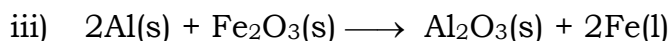
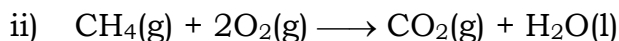
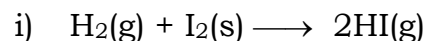
i) combination

iii) endothermic

ii) combustion

iv) exothermic

d) Which chemical equation among the following, shows a “single displacement” reaction? **(1 mark)**



5) For each of the following statements, answer True (**T**) or False (**F**).

a) Aluminium oxide (Al_2O_3) is a basic oxide. **(1 mark)**

b) Nitrogen dioxide (NO_2) is an acidic oxide. **(1 mark)**

c) A neutral oxide reacts with both acids or bases. **(1 mark)**

d) A solution of sulphur dioxide (SO_2) and water turns blue the red litmus paper. **(1 mark)**

6) Carboxylic acids constitute one of the functions of Organic Chemistry.

a) Give the general formula for carboxylic acids. **(1 mark)**

b) Write the formula of the acid made up of one (1) carbon atom. **(1 mark)**

c) Name the acid in (b) above. **(1 mark)**

d) State any one (1) use of carboxylic acid compounds. **(1 mark)**

7) Figure 1 shows the arrangement of particles in three substances of different states of matter designated as **X**, **Y** and **Z**.

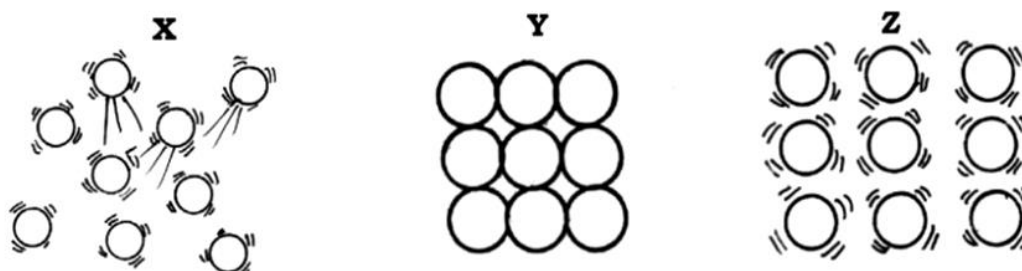


Figure 1

- a) The state of matter for substance **Y** is: **(1 mark)**
- | | |
|----------|-------------|
| i) solid | iii) liquid |
| ii) gas | iv) plasma |
- b) The phase transition of conversion of substance **Y** into **Z** is: **(1 mark)**
- | | |
|------------------|---------------------|
| i) deposition | iii) solidification |
| ii) condensation | iv) melting |
- c) Explain how the inter-particle forces in substance **X** differ from the inter-particle forces in substance **Y**. **(2 marks)**

- a) Copy and complete appropriately the *Table 1* below with the terms: *good*, *poor*, *soft* and *hard*. **(4 marks)**

Table 1

- b) Both diamond and graphite are insoluble in water because, **(1 mark)**
- i) there are many attractions which occur between water molecules and carbon atoms.
 - ii) there are strong attractions which occur between water molecules and carbon atoms.
 - iii) there are no possible attractions which occur between water molecules and carbon atoms.
 - iv) there are possible attractions which occur between water molecules and carbon atoms.

9) Solutions **K**, **L**, **M** and **N** have the pH values shown in the *Table 2* below.

Solution	K	L	M	N
pH	2	5.3	7	13

Table 2

Identify the solution which:

- a) is more likely to be rainwater. **(1 mark)**
- b) is more likely to be of sodium chloride solution, NaCl(aq). **(1 mark)**
- c) is more likely to be concentrated sodium hydroxide, NaOH_(aq). **(1 mark)**
- d) is more likely to be concentrated sulphuric acid, H₂SO_{4(aq)}. **(1 mark)**

10) Choose the correct answer for each of the following questions.

A student would like to prepare potassium nitrate (KNO₃) by reaction between potassium hydroxide solution and nitric acid solution.

a) The correct balanced chemical equation for this reaction is: **(1 mark)**

- i) $\text{KOH(aq)} + \text{HNO}_3\text{(aq)} \longrightarrow \text{KNO}_3\text{(aq)} + \text{H}_2\text{O(l)}$
- ii) $\text{K(OH)}_2\text{(aq)} + \text{HNO}_3\text{(aq)} \longrightarrow \text{KNO}_3\text{(aq)} + 2\text{H}_2\text{O(l)}$
- iii) $2\text{KOH(aq)} + \text{HNO}_3\text{(aq)} \longrightarrow \text{K}_2\text{NO}_3\text{(aq)} + \text{H}_2\text{O(l)}$
- iv) $2\text{KOH(aq)} + \text{HNO}_3\text{(aq)} \longrightarrow 2\text{KNO}_3\text{(aq)} + \text{H}_2\text{O(l)}$

b) The type of this reaction is: **(1 mark)**

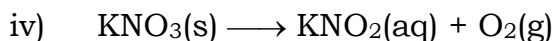
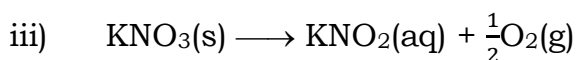
- i) precipitation
- iii) neutralisation
- ii) combination
- iv) combustion

c) The solution of potassium nitrate, KNO₃(aq), has a pH = 7. Therefore, KNO₃ is:

(1 mark)

- i) a basic salt.
- ii) a double salt.
- iii) an acidic salt.
- iv) a neutral salt.

d) The correct equation for the thermal decomposition of potassium nitrate, $\text{KNO}_3(\text{s})$ is: **(1 mark)**



11) When manufacturing sulphuric acid (H_2SO_4), sulphur dioxide (SO_2) can be obtained if sulphur or a metal sulphide is burnt in air.

a) State the two (2) crystalline forms (allotropes) of sulphur. **(2 marks)**

b) Write a balanced chemical equation showing the formation of sulphur dioxide when sulphur is burnt in air. **(1 mark)**

c) Determine the mass of sulphur dioxide produced when 4g of sulphur are burnt in air. Assume that there is no loss of mass. **(2 marks)**

(Atomic mass: S = 32, O = 16).

12) A gaseous hydrocarbon **W** contains 80% carbon by mass and has a molar mass of 30g/mol.

a) Define the term “*hydrocarbon*”. **(1 mark)**

b) Find out the empirical formula of **W**. **(3 marks)**

13) In titration technique, there are different stages.

a) What is meant by the *endpoint* in acid base titration? **(1 mark)**

b) Differentiate between *dissolution* and *dilution*. **(2 marks)**

c) Calculate the molarity of a solution prepared by use of 0.2074 g of calcium hydroxide, $\text{Ca}(\text{OH})_2$, in 40 mL of solution. **(2 marks)**

(Atomic mass: Ca = 40, O = 16, H = 1)

Section B: Attempt any three (3) questions (30 marks)

14) The following section is part of a modern Periodic Table. Observe it and answer the questions that follow. The numbers provided in upper left are the atomic numbers.

1							18
1	2	13	14	15	16	17	2
3 Q	4	5	6	7 Y	8	9 R	10 P
11 W	12	13 X	14	15	16	17 Z	18
19	20	31	32	33	34	35	36

- State the name of the elements of the group where element **W** belongs. **(1 mark)**
- How many total electrons does element **R** contain? **(1 mark)**
- Write the electron configuration of **Y**. **(1 mark)**
- How many electrons does **Z** contain in the outermost energy level? **(1 mark)**
- Write the formula of the compound formed between atoms of **X** and **Z** elements. **(2 marks)**
- Which of the above elements is the most reactive metal? Why? **(2 marks)**
- Which of the above elements is the least reactive non-metal? Give a reason for your answer. **(2 marks)**

15) Figure 2 shows a diagram which is used in covering an iron key with copper.

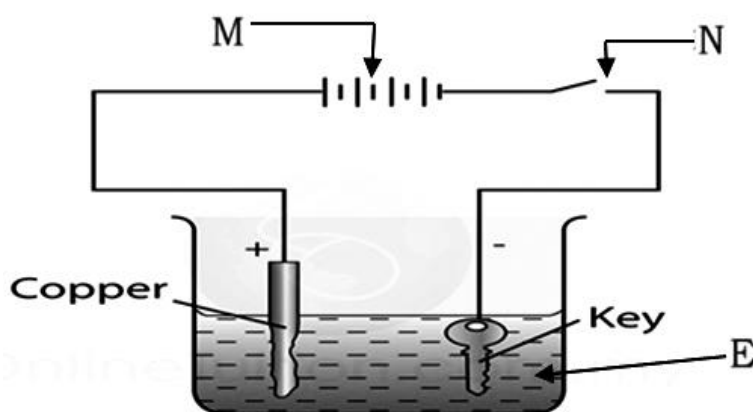


Figure 2

- Name the process being carried out. **(1 mark)**
- Name the structure **N**. **(1 mark)**
- Give the name or chemical formula of the electrolyte **E**. **(1 mark)**

- d) What is the role of the structure **M**? (1 mark)
- e) Identify the: i) anode (1 mark)
 ii) cathode (1 mark)
- f) Give the products formed at anode and cathode. (2 marks)
- g) Differentiate between the reactions that take place at anode and cathode. (2 marks)

16) Study the diagram shown in *Figure 3* below and answer the questions that follow.

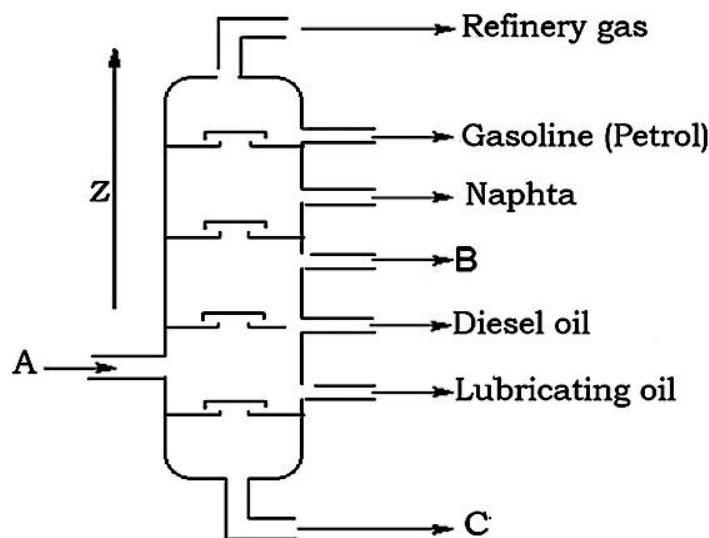


Figure 3

- a) Name the diagram presented in *Figure 3* above. (1 mark)
- b) State the names for components **A**, **B** and **C**. (3 marks)
- c) What is the condition needed on component **A** for the process to function? (1 mark)
- d) Which component among the above ones is more likely to be used in roads construction? (1 mark)
- e) Which component boils and condenses at lower temperature between *lubricating oil* and *naphtha*? (1 mark)
- f) Which component boils and condenses first between *gasoline* and *diesel oil*? (1 mark)
- g) On the line pointing upward, the letter **Z** stands for temperature in the column. Does the temperature increase or decrease upward in the column? Give a reason. (2 marks)

17) Water covers about 70% of the earth's surface.

- a) State any two (2) major sources of water? **(2 marks)**
- b) Give any two (2) characteristics of pure water. **(2 marks)**
- c) Explain why distilled water is not preferable for drinking. **(1 mark)**
- d) A student arrived in a laboratory and found a colourless liquid suspected to be water. Suggest a suitable chemical reagent and the expected observable changes that could help to confirm whether the liquid was water. **(2 marks)**
- e) Select a term corresponding to the problem which can be caused by deforestation (cutting down trees). **(1 mark)**
 - i) a) Acidic rain b) weak wind c) Precipitation d) Infiltration
 - ii) Justify your answer in i) above. **(2 marks)**

18) You are provided with the following substances known as electrolytes and non-electrolytes:

-Sugar (sucrose) ($C_{12}H_{22}O_{11}$)	- Ammonia (NH_3)
-Sodium chloride ($NaCl$)	- Sulphuric acid (H_2SO_4)
-Ethanoic acid (CH_3COOH)	- Ethanol (CH_3CH_2OH)

- a) Define the term *electrolyte*. **(1 mark)**
- b) Differentiate between weak electrolyte and strong electrolyte. **(2 marks)**
- c) Select two examples of substances which are strong electrolytes from the list provided above. **(2 marks)**
- d) Identify one example of a substance which is a non-electrolyte from the list provided above. **(1 mark)**
- e) The *Figure 4* shows two beakers **S** and **T**, which contain two different solutions: sucrose solution ($C_{12}H_{22}O_{11(aq)}$) and sodium chloride solution ($NaCl_{(aq)}$). The bulb glows for the solution in **T** but does not glow for the solution in **S**.

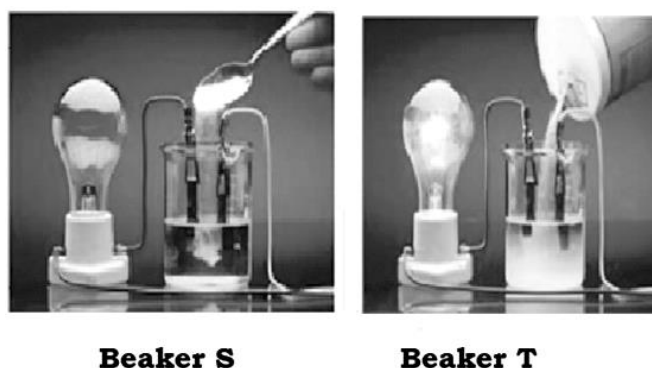
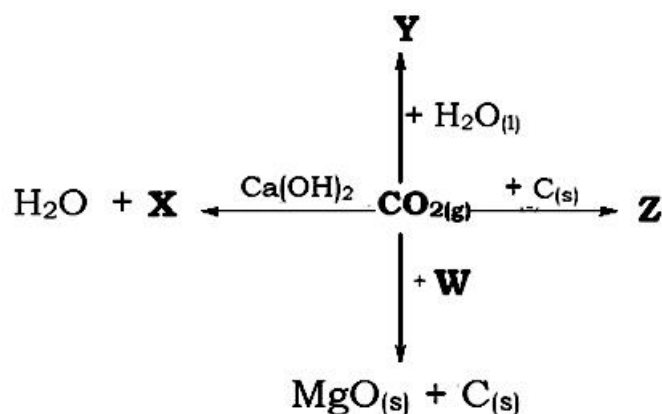


Figure 4

- i) Which beaker contains sucrose solution and which contains sodium chloride solution? **(2 marks)**
- ii) Justify your answer in i) above. **(2 marks)**

Section C: Attempt any one (1) question. (15 marks)

19) Study carefully the following reaction scheme of carbon dioxide (CO_2).



- a) Write the chemical formulae of atoms or compounds **X**, **Z** and **W**. **(3 marks)**
- b) Name the atoms or compounds **X**, **Z** and **W**. **(3 marks)**
- c) State any two (2) physical properties of carbon dioxide. **(2 marks)**
- d) Write a balanced chemical equation showing how **Y** is formed. **(2 marks)**
- e) Suggest any two (2) uses of carbon dioxide. **(2 marks)**
- f) State one environmental problem that is caused by excess increase of carbon dioxide in atmosphere. **(1 mark)**
- g) Propose any two (2) measures that can be taken to minimize the excess increase of carbon dioxide in the atmosphere and which can help to fight the problem you stated in f) above. **(2 marks)**
- 20) Salts are prepared through different methods. Some salts are soluble while others are not.
- a) Define the term *solubility*. **(1 mark)**
- b) Solubilities of three common salts in water at 20°C and 30°C are given in *Table 3* below.

	Solute	Solubility	
		at 20°C	at 30°C
A)	NaCl	35	37
B)	NaNO ₃	88	95
C)	CuSO ₄	21	25

Table 3

- i) Name salts **A** and **B**. **(3 marks)**
- ii) Which one among the three salts is more soluble? **(1 mark)**
- iii) Deduce from the table above, two (2) factors that affect the solubility of salts. **(2 marks)**
- c) The solubility of copper sulphate is 25 at 30°C. A student needs to make a saturated solution of 50 grams of solute.
- Given that, $\text{Solubility} = \frac{\text{Weight of solute (in grams)}}{\text{Weight of solvent (in grams)}} \times 100$
- Determine the amount of solvent (water) that will be required. **(3 marks)**
- d) One of the methods used in preparing salts is the use of reaction between acids and metal oxides. You are required to prepare a salt of copper sulphate (CuSO₄). Formulate a short procedure you will follow to get crystals of copper sulphate.
- i) Give the acid and metal oxide required. **(2 marks)**
- ii) Write the chemical equation involved. **(2 marks)**
- iii) Predict other two (2) actions needed for concentrating the product and get crystals of copper sulphate. **(1 mark)**

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