

Chemistry I

002

24/11/2017 08.30 AM - 11.30 AM



Rwanda Education Board

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2017

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 of paper 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. **(55marks)**
 - **Section B:** Attempt any **THREE** questions. **(30marks)**
 - **Section C:** Attempt **ONLY ONE** question. **(15marks)**
- 4) You are not allowed to use a Periodic Table.
- 5) Silent non-programmable calculator may be used.
- 6) Use only a **blue** or **black pen** for answering and a **pencil** for a drawing.

SECTION A: Attempt all questions. (55 marks)

- 1) The number of protons, neutrons and electrons in particles W, X, Y and Z are shown in the table below.

Particles	Number of protons	Number of neutrons	Number of electrons
W	6	6	6
X	9	10	10
Y	12	12	10
Z	19	20	19

- a) Which one of the particles is: **(3marks)**
(i) a cation?
(ii) an anion?
(iii) neutral?
- b) Write the electronic configuration of Z. **(1mark)**
- c) (i) State the valency of Z. **(1mark)**
(ii) Give a reason for your answer in 1c) (i) above. **(1mark)**

- 2) Sodium, aluminium and sulphur can combine with oxygen to form oxides. Copy and complete the following table to show the formula and class (amphoteric, acidic or basic) of the oxide of each of these elements.

(K: $z=19$, Al: $z=13$, S: $z=16$ O: $z=8$)

(6marks)

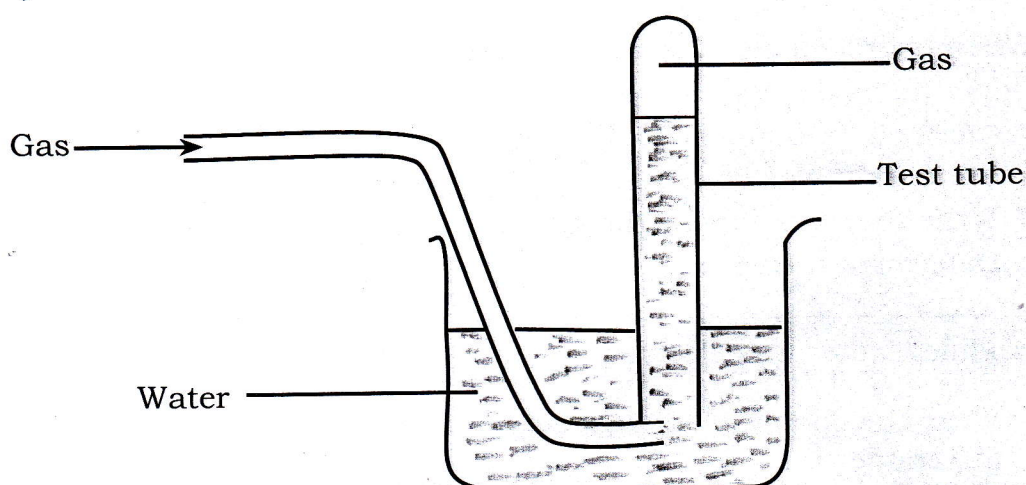
Element	Formula of oxide	Class of oxide
Potassium		
Aluminium		
Sulphur		

- 3) You are given a list of different gases: hydrogen chloride, hydrogen sulphide, sulphur dioxide and carbon dioxide. From the above list, identify the gas that has the following properties:

(3marks)

- a) turns blue litmus paper red,
b) forms white fumes with ammonia,
c) forms a white precipitate with aqueous silver nitrate.

- 4) State which of the following gases: NH_3 , O_2 , HCl and H_2 , can be collected by the method shown in the figure below and explain why the others cannot. **(3marks)**



- 5) Calculate the mass percentage of water of crystallization in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. (Atomic mass: $\text{Cu} = 64$; $\text{S} = 32$; $\text{O} = 16$; $\text{H} = 1$) **(3marks)**
- 6) An alkane X of formula mass 30 consists of 80% carbon by mass.
- Determine the empirical formula of X. **(2marks)**
 - Determine the molecular formula of X. **(1mark)**
 - Write a chemical equation for the complete combustion of X in oxygen. **(1mark)**
- 7) Ethene can react to form a solid whose molecular mass is more than 10,000.
- Name the reaction that occurs. **(1mark)**
 - Write the chemical equation of that reaction. **(1mark)**
 - (i) State what is observed when ethene reacts with bromine. **(1mark)**
(ii) Write the equation for the reaction in 7(c)(i) above. **(1mark)**
- 8) Explain why:
- Hard water requires a lot of soap to form a lather. **(1mark)**
 - Isotopes of an element show similar chemical reactions. **(1mark)**
 - When carbon dioxide is bubbled through lime water, the lime water turns milky and finally clears. **(1mark)**
- 9) Calculate the mass of nitric acid (HNO_3) required for preparing 200cm^3 of 2M HNO_3 solution. (Atomic mass: $\text{H} = 1$, $\text{N} = 14$, $\text{O} = 16$) **(2marks)**
- 10) Soap can be prepared by boiling vegetable oil with sodium hydroxide and adding a solution of sodium chloride to the reaction mixture.
- What name is given to the reaction leading to the formation of soap? **(0.5marks)**

- b) Name one crop from which oil for making soap can be obtained. **(1mark)**
c) Why is sodium chloride added to the reaction mixture? **(1mark)**
d) State one advantage of using detergents instead of soap. **(1mark)**
- 11) When hydrogen gas was passed over x g of strongly heated copper (II) oxide until there was no further change, 4 g of a solid was formed. (Atomic mass: Cu = 64, O= 16)
- a) State what was observed. **(1mark)**
b) Write the equation for the reaction. **(1mark)**
c) Determine the value of X. **(2marks)**
- 12) Acidified water was electrolyzed using platinum electrodes.
- a) Write the chemical equation of reaction that took place at the:
(i) anode
(ii) cathode **(2marks)**
b) Name any other substance that can be used as electrodes in the electrolysis of acidified water. **(0.5mark)**
- 13) Describe the industrial preparation of nitric acid from ammonia (the diagram is not required). Your description should include equations for reactions that occur. **(6marks)**
- 14) The formation of methanol from hydrogen and carbon monoxide is represented by the equation:
 $2\text{H}_2(\text{g}) + \text{CO}(\text{g}) \leftrightarrow \text{CH}_3\text{OH}(\text{g})$; the released energy= 92kJ/mol.
Calculate the energy that is released, in kJ/mol, when 96g of methanol is formed. (Relative mass: C= 12, H= 1 and O= 16) **(2marks)**
- 15) Magnesium reacts with steam to give solid X and gas Y.
- a) Identify:
(i) solid X. **(0.5mark)**
(ii) gas Y. **(0.5mark)**
b) Describe how Y could be tested. **(1mark)**
c) Write the chemical equation for the reaction between X and hydrochloric acid. **(1mark)**

SECTION B: Attempt any three questions. (30 marks)

- 16) a) Substance X reacts with a solid chloride to produce hydrogen chloride.
- (i) Identify X. **(1mark)**
 - (ii) State the conditions for the reaction. **(1.5marks)**
 - (iii) Write the equation for the reaction. **(1mark)**
- b) (i) Name the substance that is formed when hydrogen chloride is dissolved in water. **(1mark)**
- (ii) Explain why an aqueous solution of hydrogen chloride is an electrolyte whereas the solution of the gas in organic compounds is a non-electrolyte (no equation is required). **(2marks)**
- c) An aqueous solution of hydrogen chloride was added drop-wise to 4.2 g of solid sodium hydrogen carbonate until there was no further change. A colourless gas was evolved.
- (i) Write the chemical equation(s) for the reaction between sodium hydrogen carbonate and hydrogen chloride. **(1mark)**
 - (ii) Calculate the volume of the gas, measured at s.t.p that was evolved. (1 mole of gas occupies a volume of 22400 cm³ at s.t.p, Na= 23, H= 1, C= 12, O= 16) **(2.5marks)**
- 17) a) Copper (II) carbonate was heated strongly until there was no further change.
- (i) State what was observed. **(1mark)**
 - (ii) Write the chemical equation for the reaction. **(1mark)**
- b) Excess dilute sulphuric acid was added to the residue in 17 (a) (ii) and the mixture warmed.
- (i) State what was observed. **(1mark)**
 - (ii) Write the chemical equation for the reaction. **(1mark)**
- c) To the product in 17(b) above was added dilute sodium hydroxide solution drop wise until in excess.
- (i) State what was observed. **(1mark)**
 - (ii) Write the chemical equation for the reaction. **(1mark)**

d) 25.0 cm^3 of 0.1 M hydrochloric acid required 10.0 cm^3 of sodium carbonate for complete neutralization.

(i) Write the chemical equation for the reaction which took place between sodium carbonate and hydrochloric acid. **(1mark)**

(ii) Calculate the concentration of sodium carbonate in mol/dm^3 . **(3marks)**

18) 5.34 g of a salt of formula M_2SO_4 (where M is a metal) were dissolved in water. The sulphate ion was precipitated by adding excess barium chloride solution and 4.66 g of barium sulphate (BaSO_4) were obtained.

(Atomic mass: S = 32, O = 16, Ba = 137;

Avogadro constant = $6.023 \times 10^{23} \text{ mol}^{-1}$)

a) Write the ionic equation of the reaction that leads to the formation of the precipitate. **(1mark)**

b) How many moles of sulphate ions were precipitated as barium sulphate? **(1.5marks)**

c) How many moles of M_2SO_4 were in the solution? **(1.5marks)**

d) What is the formula mass of M_2SO_4 ? **(2.5marks)**

e) What is the relative atomic mass of M? **(2.5marks)**

f) What is the mass of 6.023×10^{21} atoms of M? **(1mark)**

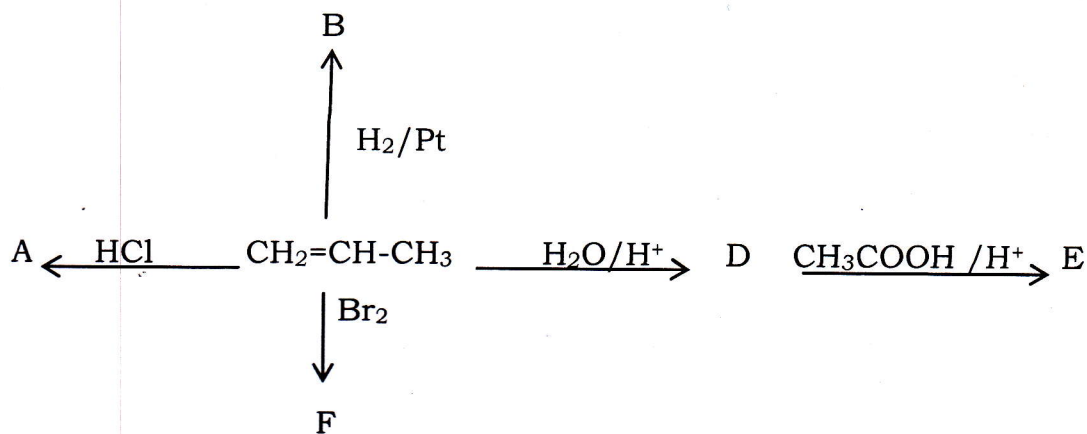
19) a) (i) State two properties which show that air is a mixture. **(1mark)**

(ii) Name two gases, other than oxygen, that are constituents of air and give their approximate percentages in air. **(2marks)**

b) Describe an experiment to determine the percentage of oxygen in air. (Show how the percentage can be calculated from the results). **(6marks)**

c) Write the chemical equation of the reaction that takes place in the silica tube. **(1mark)**

20) a) Write the molecular formula of A, B, D, E and F: **(5marks)**



b) Name the reactants $\text{CH}_2=\text{CH}-\text{CH}_3$ and CH_3COOH and the products A, B and F. **(5marks)**

SECTION C: Attempt only one question. (15 marks)

21) a) What is meant by "rate of chemical reaction"? **(1mark)**

b) Explain how the following factors affect the rate of a chemical reaction:

(i) Temperature. **(1mark)**

(ii) Surface of the reactants. **(1mark)**

c) The table below shows the volume of hydrogen gas collected at various time intervals when magnesium was reacted with 2 M hydrochloric acid.

Time (seconds)	0	1	2	3	4	5	6	7
Volume of H_2 collected (cm^3)	0	25	45	60	70	75	77	77

(i) Write the chemical equation of the reaction. **(1mark)**

(ii) Plot a graph of volume of hydrogen versus time. **(6marks)**

(iii) Determine the rate of reaction at 3 seconds (take the tangent at 3 seconds and find the slope, $s = \frac{\Delta y}{\Delta x} = \text{rate}$). **(2marks)**

(iv) Determine the volume of hydrogen evolved at 3.5 seconds. **(2marks)**

(v) When did the reaction end? **(1mark)**

- 22) a) (i) Draw a labelled diagram to show how a sample of oxygen gas can be prepared in the laboratory from hydrogen peroxide. **(5marks)**
- (ii) Write the chemical equation for the reaction that takes place in 22)a)(i) above. **(1mark)**
- b) State and explain what happens when each of the following substances are lowered in a gas jar of oxygen and water added to the products.
- (i) Hot sodium. **(3marks)**
- (ii) Ignited magnesium. **(2marks)**
- (iii) Hot iron. **(2marks)**
- c) Name one natural process by which oxygen can be obtained. **(1mark)**
- d) State one use of oxygen. **(1mark)**