

**CHEMISTRY I**

**002**

**23/11/2018 8.30 AM - 11.30 AM**



**Rwanda Education Board**

**ORDINARY LEVEL NATIONAL EXAMINATIONS, 2018**

**SUBJECT: CHEMISTRY I**

**DURATION: 3 HOURS**

**INSTRUCTIONS:**

- 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 do not need the Periodic Table.
- 5) Silent non-programmable calculator 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) The atomic number of helium, neon and argon are 2, 10 and 18 respectively. The three elements are in group VIIa.
- (a) Write the electronic configuration of argon, Ar. (1 mark)
- (b) Explain briefly why these elements are not reactive. (2 marks)
- 2) Briefly explain how the following mixtures can be separated:
- (a) Water and ethanol. (2 marks)
- (b) Sand and iron nails. (2 marks)
- 3) (a) Describe what is observed when a solution containing magnesium ions,  $Mg^{2+}$  is added to a solution of sodium hydroxide, NaOH. (2 marks)
- (b) Write the chemical equation for the reaction between magnesium metal, Mg and dilute hydrochloric acid, HCl. (2 marks)
- 4) The atomic mass of magnesium, oxygen and chlorine are 24, 16 and 35.5 respectively.
- (a) Calculate the number of moles in 18g of MgO. (2 marks)
- (b) Calculate the mass of  $MgCl_2$  produced when 18g of MgO react completely with excess HCl. (2 marks)
- Equation:
- $$MgO + 2HCl \longrightarrow MgCl_2 + H_2O$$
- 5) State a reagent that can be used to distinguish between the following pairs of ions and state the observable change in each case.
- (a)  $CO_3^{2-}$  and  $Cl^-$  (2 marks)
- (b)  $Cu^{2+}$  and  $Ca^{2+}$ . (2 marks)
- 6) Consider the following oxides: CaO,  $NO_2$  and  $Al_2O_3$ .
- (a) Indicate the oxide among the 3 above that is:
- (i) Acidic (1 mark)
- (ii) Amphoteric. (1 mark)
- (b) Write a balanced chemical equation of the reaction between CaO and  $H_2O$ . (2 marks)
- 7) (a) Write the structural formula of ethanol,  $C_2H_5OH$ . (1 mark)
- (b) State 2 uses of ethanol on a large scale. (2 marks)



- 8)  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  of 16.5g by mass is heated to drive off water of crystallisation.



(a) Calculate the mass of anhydrous  $\text{CuSO}_{4(s)}$  formed. **(2 marks)**

(b) State the colour change that takes place when all  $\text{H}_2\text{O}$  is removed from  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ . **(2 marks)**

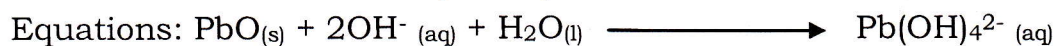
(Atomic mass: Cu = 63.5, S = 32, O = 16, H = 1)

- 9) (a) Complete the following equation of combustion reaction and balance it:



(b) State 2 uses of alkanes on a large scale. **(2 marks)**

- 10) Lead oxide,  $\text{PbO}$  reacts with aqueous sodium hydroxide,  $\text{NaOH}$  as well as dilute nitric acid,  $\text{HNO}_3$ .



(a) State a reagent and condition that can be used to test for the presence of  $\text{Pb}^{2+}$  ions in  $\text{Pb}(\text{NO}_3)_{2(aq)}$  solution and mention the observable colour change. **(2 marks)**

(b) Write the chemical equation of the reaction between  $\text{ZnO}$  and the following reactant to show its amphoteric properties:

(i)  $\text{ZnO}$  and aqueous dilute  $\text{HCl}$  solution **(1 mark)**

(ii)  $\text{ZnO}$  and aqueous  $\text{NaOH}$  solution. **(1 mark)**

- 11) Sulphur reacts with some metals:

(a) Write a balanced equation of the reaction between sulphur and iron. **(1 mark)**

(b) State the names of 2 allotropes of sulphur. **(2 marks)**

- 12) (a) Consider the equation of the reaction that is given below and answer the question that follows:



State the type of reaction that takes place to convert  $\text{CuO}$  to  $\text{Cu}$ . **(1 mark)**

(b) Indicate the observable changes that take place when  $\text{CO}_2$  is bubbled in lime water slowly until in excess of  $\text{CO}_2$  gas in the solution. **(2 marks)**

- ✓13) Calcium reacts with dilute sulphuric acid according to the following equation:

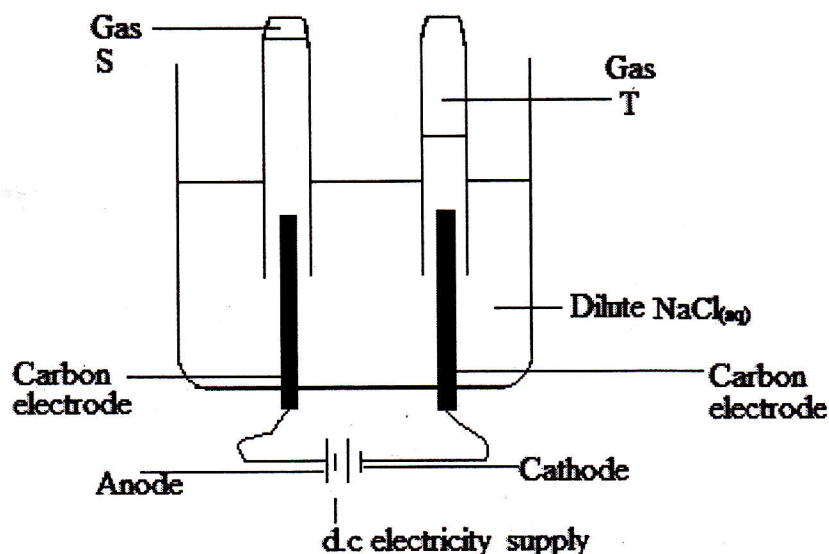


(a) Give one reason to explain why the above reaction occurs for

- a short period of time and stops.  
(b) State 2 uses of compounds of group IIA elements.

(1 mark)  
(2 marks)

14. The diagram below represents electrolysis of aqueous sodium chloride; NaCl solution prepared using distilled water.



(a) Write the symbols of all ions present in the solution of aqueous sodium chloride, NaCl.

(2 marks)

(b) Write the chemical equation of the reaction that takes place at the:

(i) Anode

(1 mark)

(ii) Cathode.

(1 mark)

15) Chlorine gas is prepared in the laboratory using HCl acid and  $\text{MnO}_2$  powder.

(a) Write a balanced equation of the reaction between HCl acid and  $\text{MnO}_2$  powder when hot.

(2 marks)

(b) State 2 uses of chlorine by man.

(2 marks)



**SECTION B: Attempt only 3 questions in this section (30Marks)**

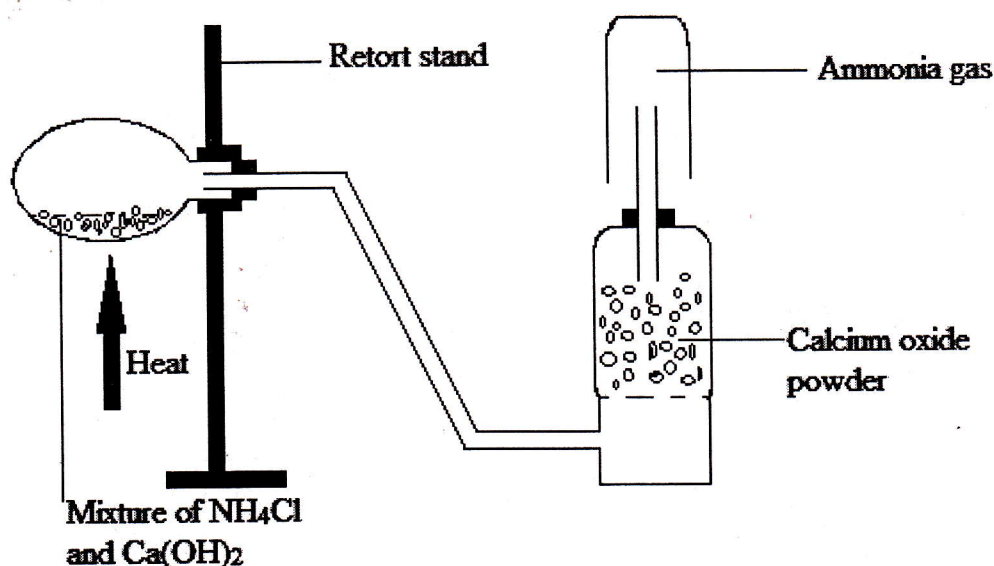
- 16) During titration, 25 ml of a 0.2 mole/litre NaOH solution was poured in a beaker. An appropriate indicator (phenolphthalein) was added to the NaOH base. Titration of  $\text{H}_2\text{SO}_4$  (aq) from a burette was done. Neutralisation of the base was reached on addition of 23.50ml of  $\text{H}_2\text{SO}_4$  (aq).

Equation:



- (a) State the name of another acid-base indicator that can be used to detect NaOH solution and the colour of this indicator in the base. (2 marks)
- (b) Calculate the number of moles of NaOH present in 25ml of solution. (2 marks)
- (c) Determine the number of moles of  $\text{H}^+$  ions (aq) in 23.50ml of  $\text{H}_2\text{SO}_4$  solution. (2 marks)
- (d) Calculate the number of moles of  $\text{H}_2\text{SO}_4$  (aq) in 23.50ml of its solution. (2 marks)
- (e) Calculate the molarity (moles /litre) of  $\text{H}_2\text{SO}_4$  (aq). (2 marks)

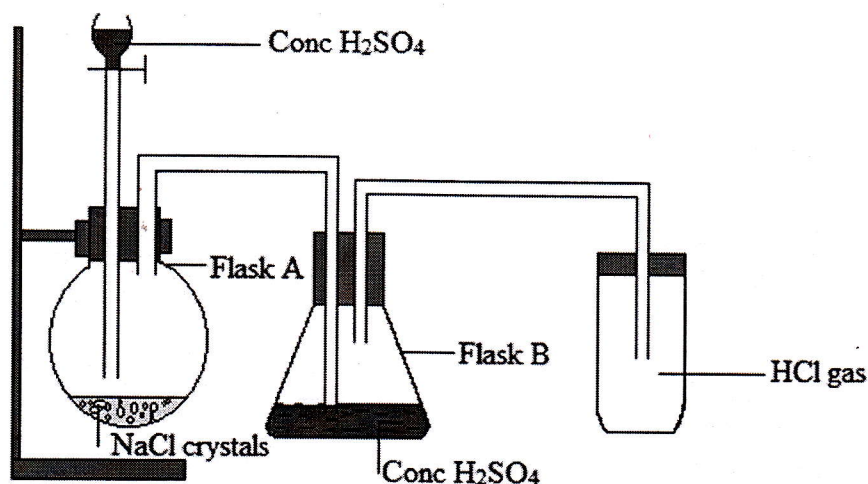
- 17) Study the diagram below and answer the questions that follow:



- (a) Explain the reason why calcium oxide, CaO is used instead of  $\text{H}_2\text{SO}_4$  to dry ammonia gas in the apparatus set-up. (1 mark)
- (b) Write a chemical equation of reaction between  $\text{NH}_4\text{Cl}$  and  $\text{Ca}(\text{OH})_2$ . (2 marks)
- (c) State the name of the method of collection of ammonia gas used in the apparatus set-up above. (1 mark)

- (d) Indicate the observable colour changes that take place when ammonia solution is dissolved in a solution of  $\text{Cu}^{2+}$  ions until in excess. **(2 marks)**
- (e) Write the equation of reaction that takes place when  $\text{NH}_3$  gas reacts with  $\text{HCl}$  gas and state the observable change. **(2 marks)**
- (f) State 2 physical properties of ammonia,  $\text{NH}_3$ . **(2 marks)**
- 18) Organic compound X is constituted of 85.71% carbon and 14.28% hydrogen by mass. The mass of 4.2g of hydrocarbon X occupies a volume of  $2400 \text{ cm}^3$  when it is vapourised at room temperature and pressure.
- (a) Calculate the molar mass of compound X. **(3 marks)**
- (b) Determine the empirical formula of compound X. **(2 marks)**
- (c) Determine the molecular formula of compound X. **(2 marks)**
- (d) Write a balanced equation for the reaction of combustion of organic compound X in oxygen. **(2 marks)**
- (e) State 1 use of compound X on a large scale. **(1 mark)**
- (Atomic mass:  $\text{C}=12$ ,  $\text{H}=1$ )
- (Molar volume of a gas at room temperature and pressure =  $24000 \text{ cm}^3$ )

19) Study the diagram below and answer the questions that follow:



- (a) Write the equation of reaction between concentrated sodium chloride  $\text{NaCl}$  solution and concentrated sulphuric acid,  $\text{H}_2\text{SO}_4$  to liberate  $\text{HCl}$  gas. **(2 marks)**
- (b) State the role of concentrated  $\text{H}_2\text{SO}_4$  in conical flask B. **(1 mark)**
- (c) State 2 physical properties of hydrogen chloride gas,  $\text{HCl}$ . **(2 marks)**
- (d) Write a balanced equation of the reaction between magnesium metal,  $\text{Mg}$  and  $\text{HCl}$  acid. **(2 marks)**



- (e) (i) Write the equation of the reaction between concentrated  $\text{KMnO}_4$  solution and concentrated  $\text{HCl}$  acid to liberate chlorine gas,  $\text{Cl}_2$ . (1 mark)
- (ii) State a reagent that can be used to detect  $\text{Cl}_2$  gas and describe the observable colour change for a positive test. (2 marks)

20) The table below shows a part of the periodic table. The letters are not the correct symbols of elements.

Periods	Groups																
	I	II									III	IV	V	VI	VII	VIII	
	1																F
	2	A											C		E		
	3		B											D			
	4																
5																	

- (a) Which letters shown on the diagram are:
- (i) Two elements that are metals? (2 marks)
  - (ii) Two elements that are in one period? (1 mark)
  - (iii) An unreactive inert gas? (1 mark)
- (b) Write the formula of a compound formed between A and E. (2 marks)
- (c) State 2 physical properties of element B. (2 marks)
- (d) State the type of bond that exists between element D and E. (1 mark)
- (e) Element C is in group IV and in period 2. Write the electronic configuration of C. (1 mark)

### SECTION C: Attempt only One question (15 marks)

- 21) Oxides are formed by reaction of oxygen with different elements.
- (a) State the name of a compound resulting from combination of oxygen with another element. (1 mark)
  - (b) Write a chemical formula of such a compound mentioned in 21(a) above. (1 mark)
  - (c) Write the name of 1 rare gas found in the atmosphere and state its important use by man. (2 marks)
  - (d) Describe the properties of oxygen that allows it to be collected upwards in a water tank. (1 mark)

- (e) State 1 example of:
- (i) Slow oxidation. (1 mark)
- (ii) Rapid oxidation. (1 mark)
- (f) Draw a labeled diagram of the laboratory preparation of ethene from ethanol. (3 marks)
- (g) State 2 main chemical reactants used for the preparation of soap. (2 marks)
- (h) 1g of sucrose sugar is put in a pyrex test tube, 2 ml of concentrated  $\text{H}_2\text{SO}_4$  is added to it:
- (i) State what is observed after 1 hour of reaction. (1 mark)
- (ii) Give a brief description of the term "**hygroscopic substance**" and give an example of such a substance. (2 marks)

22) You are provided with substance Y. Study the observations in the table below and deduce the type of cation S and anion T present in substance Y.

Test	Y(solution) + Reagent	Observation	Possible ions present (symbols of ions)
1	$\text{Y}_{(\text{aq})} + \text{NaOH}$	Pale blue precipitate formed	
2	$\text{Y}_{(\text{aq})} + \text{KI}_{(\text{aq})}$	Brown precipitate formed	
3	$\text{Y}_{(\text{aq})} + \text{Na}_2\text{CO}_{3(\text{aq})}$	Pale blue precipitate formed	
4	$\text{Y}_{(\text{aq})} + \text{NH}_{3(\text{aq})}$ then add in excess of $\text{NH}_{3(\text{aq})}$	Pale blue precipitate formed that turns deep blue in excess of $\text{NH}_{3(\text{aq})}$	
5	$\text{Y}_{(\text{aq})} + \text{BaNO}_{3(\text{aq})}$	White precipitate formed	
6	$\text{Y}_{(\text{aq})} + \text{Mg}_{(\text{s})}$	Brown solid deposited on the bottom of the test tube	

- (a) Copy the table and write the possible ions present in tests 1, 2,3,4,5 and 6 respectively. (12 marks)
- (b) Cation present in Y is:.....(1mark)
- (c) Anion present in Y is:.....(1mark)
- (d) The chemical formula of substance Y is:.....(1mark)