THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

2/2

CHEMISTRY 2
ALTERNATIVE TO PRACTICAL
(For Both School and Private Candidates)

ime: **2:30 Hours**   **Tuesday, 11th November 2014 a.m.**

Instructions

This paper consists of **five (5)** questions. Answer **all** the questions.

Each question carries **ten (10)** marks.

Qualitative Analysis Guidance Pamphlets may be used after a thorough check by the Supervisor.

Calculators and cellular phones are **not** allowed in the examination room.

Write your **Examination Number** on every page of your answer booklet(s).

You may use the following constants:

Atomic masses: $C = 12$, $O = 16$, $Na = 23$, $Ag = 108$, $H = 1$, $Cu = 64$

1 faraday $= 96500$ coulombs.

GMV s.t.p. $= 22.4$ dm^3.

1 litre $= 1$ dm^3 $= 1000$ cm^3.

1. Study the following experimental set up (Figure 1) for the laboratory preparation of hydrogen chloride gas and then answer the questions that follow.
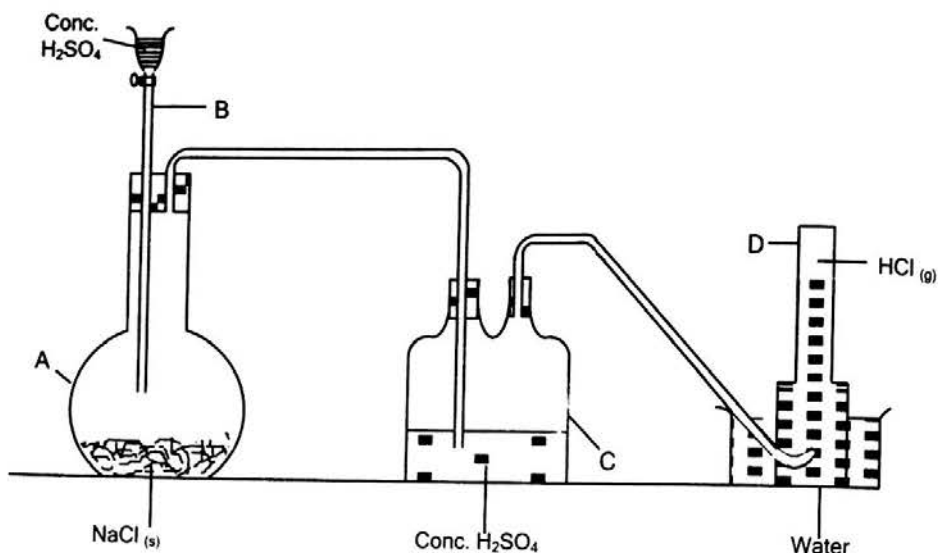

Figure 1

(a) (i) Name the apparatuses represented by the letters A, B, C and D and state the use of each.

(ii) Which part of the set up is not correct for the above experiment? Give reason for your answer. **(5 marks)**

(b) (i) Write a balanced chemical equation for the reaction in A.

(ii) State the function of sulphuric acid in the apparatus C. **(2 marks)**

(c) (i) What is the chemical test of the hydrogen chloride gas prepared in the above experiment?

(ii) State two physical properties of hydrogen chloride gas. **(3 marks)**

2. In a certain experiment, solution **AA** was prepared by dissolving 4.2 g of NaXCO₃ in 0.5 dm³ of water. The solution was titrated against solution **BB** of 0.2 M nitric acid. The results were tabulated as shown in Table 1.

Table 1

Titration	Pilot	1	2	3
Final reading (cm³)	12.50	22.50	32.40	27.60
Initial reading (cm³)	0.00	10.00	20.00	15.00
Titre volume (cm³)				

The volume of the pipette used was 25 cm³.

Questions

(a) Complete Table 1.

(2 marks)

(b) (i) Name an apparatus which is suitable for measuring nitric acid.

(ii) Calculate the average volume of solution **BB**.

(1 mark)

(c) If the reaction in the experiment gives a mole ratio of 1:1 for the reactants, calculate:
 (i) The concentration of solution **AA** in g/dm^3.
 (ii) The molar mass of **AA**.
 (iii) The atomic mass of element **X**.
                                                                          (4.5 marks)

(d) (i) Name element **X** in $NaXCO_3$.
 (ii) Write a balanced chemical equation for the reaction between solutions **AA** and **BB**.
 (iii) State one indicator which would be suitable in the titration, and give a reason for your answer.
                                                                          (2.5 marks)

An electric current was passed through dilute copper (II) sulphate and silver nitrate voltameters which were connected in series. In each voltameter carbon rods were used as electrodes.

(a) (i) Which cations were discharged at the cathode electrodes in each voltameter? Give reason(s).
 (ii) Name the gas produced at one of the electrodes in each voltameter.
 (iii) At which electrode was the gas produced?   **(3.5 marks)**

(b) A metal coating was formed on one of the electrodes in each voltameter. Write ionic equations to show the discharging process which resulted into the metal coating in each voltameter.   **(2 marks)**

(c) If 2.0 amperes were passed through the voltameters for 4.0 minutes, calculate:
 (i) The mass of silver deposited.
 (ii) The number of moles of each metal deposited.   **(4.5 marks)**

Two pieces of fresh calcium metal of equal masses were used in two separate experiments. In one experiment a piece of calcium was added to excess water. In the other experiment a piece of calcium was added to excess dilute hydrochloric acid. The volume of hydrogen gas produced was measured at intervals in both experiments. The results of the experiments were as shown in Table 2.

Table 2

Time (seconds)	Total volume of hydrogen produced using water (cm^3)	Total volume of hydrogen produced using HCl (cm^3)
10	6	24
20	12	50
30	20	80
50	40	116
60	54	120
80	88	120
90	109	120
100	119	120
110	120	120

Questions

(a) Plot on the same axes a graph of volume of hydrogen gas produced against time for e **(4 marks)** experiment.

(b) Use your graph to predict the volumes of hydrogen gas produced in each experin after:

    (i)   40 seconds. **(2 marks)**

    (ii)   70 seconds.

(c) Which reaction was more rapid at the beginning of the experiment? **(1 mark)**

(d) At what time were the rates of both reactions the same? **(1 mark)**

(e) Write balanced chemical equations of the reactions for the two experiments.
(2 marks)

Sample **M** contained one cation and one anion. Several tests were performed on the sample. The test procedures and the observations made were recorded as shown in Table 3. Fill in the inferences column; identify the ions present in sample **M** and hence write the chemical formula of sample **M**.

Table 3

	Experiment	Observation	Inference
(a)	Appearance of sample **M**.	White deliquescent solid.	
(b)	A little amount of sample **M** was dissolved in distilled water.	Sample **M** dissolved in distilled water to form a colourless solution.	
(c)	A little amount of dry sample **M** was heated in a test tube.	A reddish brown gas evolved. The residue was brown when hot and turned yellow on cooling. It was formed with decrepitating sound.	
(d)	A trace of sample **M** on the tip of a nichrome wire was placed in a non-luminous flame during flame test.	Bluish flame was formed.	
(e)	To a portion of solution **M** a freshly prepared ferrous sulphate solution (FeSO$_4$) was added followed by concentrated sulphuric acid along the sides of the test tube.	A brown ring between the two layers was formed .	
(f)	To a portion of solution **M**, ammonium hydroxide (NH$_4$OH) solution was added dropwise, then in excess.	White precipitate insoluble in excess.	

(6 marks)

Conclusion

(i) The cation in sample **M** was _____ and the anion was _____.

(ii) The chemical formula of sample **M** is _____.

(iii) Write a balanced chemical equation for the reaction taking place in experiment (f).

(4 marks)