THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2   **CHEMISTRY 2**

ALTERNATIVE TO PRACTICAL

(For Both School and Private Candidates)

Time: 3 Hours   **ANSWERS**   **Year: 2004**

Instructions

1. This paper consists of five questions. Answer all questions.

2. Each question carries 10 marks

1. Figure 1 below represents an experimental set-up of the laboratory preparation of dry chlorine.

(a) State the names of the apparatus labeled J, K, L, and M.
J - Funnel
K - Gas washing bottle
L - Another gas washing bottle
M - Drying tower

(b) Name compounds A, B, and C.
A - Manganese(IV) oxide (MnO_2)
B - Hydrochloric acid (HCl)
C - Chlorine gas (Cl_2)

(c) Write a balanced chemical equation that represents the reaction between compound A and conc. hydrochloric acid.
$MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

(d) State the function of K and C in the preparation of chlorine gas.
K - Removes acidic impurities like HCl gas by washing chlorine gas through water.
C - Chlorine gas is the final product collected after purification.

(e) State one chemical test you could use to confirm that the gas in the tube is chlorine.
Introduce a damp blue litmus paper into the gas; it turns red and then bleaches white, confirming chlorine gas.

2. In an experiment, titration of 0.094 M potassium hydroxide (KOH) solution and sulphuric acid was done, and the results shown in the table below.

(a) (i) Complete the table above.
Given data:
First burette reading (cm³): 0.1, 23.60, 23.10
Final burette reading (cm³): 45.00, 23.00, 45.40
Titration volume (cm³) = Final reading - Initial reading
Completed table:

Experiment	Initial reading (cm³)	Final reading (cm³)	Titre volume (cm³)
1	0.1	45.00	44.90
2	23.60	23.00	0.60
3	23.10	45.40	22.30

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(ii) Calculate the mean titre of this experiment.
Mean titre = (44.90 + 0.60 + 22.30) / 3 = 22.60 cm³

(b) Write a balanced chemical equation for the reaction.
$H_2SO_4 + 2KOH \longrightarrow K_2SO_4 + 2H_2O$
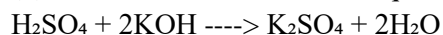
(c) Calculate the concentration of sulphuric acid in:
(i) Moles per dm³
Moles of KOH used = Molarity × Volume (in dm³)
= 0.094 × (22.60/1000)
= 0.0021244 moles
From the reaction equation, 2 moles of KOH react with 1 mole of H_2SO_4.
So, moles of H_2SO_4 = 0.0021244 / 2 = 0.0010622 moles

Concentration of H_2SO_4 = moles/volume
= 0.0010622 / (25/1000)
= 0.0425 mol/dm³

(ii) g per dm³
Mass = moles × molar mass
Molar mass of H_2SO_4 = 98 g/mol
Mass = 0.0425 × 98 = 4.165 g/dm³

(d) If the indicator used in this experiment was methyl orange, the color change at the end point was from yellow to pink.

3. The diagram below (Figure 2) represents a copper voltameter used for the electrolysis of aqueous copper sulphate where copper plates were used as electrodes.

(a) By using ionic equations, show the chemical reactions that took place at the:
(i) Cathode: $Cu^{2+} + 2e^- \longrightarrow Cu$
(ii) Anode: $Cu \longrightarrow Cu^{2+} + 2e^-$
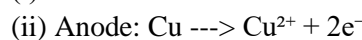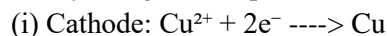
(b) If 0.05 F were used during electrolysis, calculate the mass of the substance discharged at the cathode.
1 Faraday deposits 1 mole of Cu^{2+} per 2 F.
Atomic mass of Cu = 63.5 g/mol
Mass deposited = (63.5 × 0.05) / 2 = 1.59 g
(c) What will happen to the color of the electrolyte as electrolysis continues?
The blue color of the copper sulfate solution will fade as Cu^{2+} ions are removed from the solution and deposited as copper metal on the cathode.

(d) What changes in mass will occur at the copper anode as electrolysis continues?
The mass of the anode will decrease as copper atoms dissolve into the solution as Cu^{2+} ions.

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4. The rate of production of a certain gas from the decomposition of potassium chlorate ($KClO_3$) was studied in a certain school laboratory by heating different masses of potassium chlorate. The results of the experiment were tabulated as shown in Table 2.

(a) How does the rate of production of the gas vary with mass?
The rate of gas production increases as the mass of potassium chlorate increases.

(b) What will happen to the rate of production of the gas if potassium chlorate was mixed with manganese dioxide and heated together? Give reasons for your answer.
The rate of gas production will increase because manganese dioxide acts as a catalyst, speeding up the decomposition of potassium chlorate without being consumed in the reaction.

(c) Write a balanced chemical equation for the reaction of the decomposition of potassium chlorate when heated together with manganese dioxide.
$2KClO_3 ---> 2KCl + 3O_2$
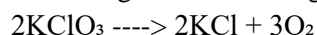
(d) What is the name of the gas produced during the decomposition of potassium chlorate?
Oxygen (O_2)

(e) What is the test of the gas in the laboratory?
The test for oxygen is inserting a glowing splint into the gas; if the splint relights, the gas is oxygen.

5. Sample PP is a simple salt containing one cation and one anion. The tests performed on sample PP and the observations made were recorded in the table as shown below (Table 3). Complete the table and deduce the anion and the cation present in sample PP.

Experiment	Observation	Inference
1. Appearance	White deliquescent crystals.	The salt is hygroscopic, indicating it is a highly soluble ionic compound.
2. A solution of PP in distilled water was prepared.	Soluble salt which forms a colourless solution.	The salt dissolves completely, suggesting a strong electrolyte like a Group 1 metal salt.
3. To one portion of the solution of PP from (2) above, dilute HNO_3 was added followed by $AgNO_3$ solution, then ammonia solution.	White curdy precipitate formed which was soluble in ammonia solution.	The presence of chloride ions (Cl^-) is confirmed because silver chloride ($AgCl$) is soluble in ammonia.
4. Flame test.	A brick-red flame was observed.	The brick-red flame suggests the presence of calcium ions (Ca^{2+}).

Conclusion
The cation was calcium (Ca^{2+}) and the anion was chloride (Cl^-).