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: 2006**

Instructions

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

2. Each question carries 10 marks

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1. The diagram in figure 1 below represents the apparatus used in demonstrating fractional distillation of miscible liquids, which are ethanol and water.

(a) What do the letters A, B, C, D, E, G, X, and Y in the diagram represent?
A - Thermometer
B - Fractionating column
C - Condenser
D - Distillation flask
E - Receiving flask
G - Heat source
X - Vapors of ethanol and water
Y - Condensed ethanol distillate

(b) What is the function of C in the experiment?
The condenser cools and condenses the vapor back into a liquid for collection in the receiving flask.

(c) Differentiate between fractional distillation and distillation.
Fractional distillation separates two or more miscible liquids with close boiling points using a fractionating column, while simple distillation separates a liquid from a solution or from another liquid with a large difference in boiling points.

(d) Which liquid from the ethanol-water mixture will be present in the first drop of the distillate collected in E?
Ethanol, because it has a lower boiling point (78°C) compared to water (100°C).

2. 20 cm^3 portions of POH solution were titrated against 0.10 M HCl using methyl orange indicator. The burette readings obtained were recorded in the table as shown below.

Experiment	Pilot	1	2	3
Final burette reading (cm^3)	25.10	49.10	27.00	25.30
Initial burette reading (cm^3)	0.00	24.10	2.00	0.20
Volume used (cm^3)	25.10	25.00	25.00	25.10

(a) (i) Complete the table by filling in the values of the titre volume in each column.
Values have been completed in the table above.

(ii) Calculate the mean titre volume in cm^3.
Mean titre volume = (25.10 + 25.00 + 25.00 + 25.10) / 4
= 25.05 cm^3

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(b) Write a balanced chemical equation for the reaction between POH and HCl.
$POH + HCl \rightarrow PCl + H_2O$

(c) If POH solution was made by dissolving 1.75 g of POH in water to make 250 cm^3 of the solution, what is the
(i) molar mass of POH?
Molarity (M) = moles / volume in dm^3
Moles of POH = (0.1 × 25.05) / 20
= 0.12525 moles in 1 dm^3

Molar mass = 1.75 g / (0.12525 × 0.25)
= 56 g/mol

(ii) atomic mass of P?
Assuming POH is a hydroxide compound (P represents the cation), and hydroxide (OH) has a molar mass of 17 g/mol,
Atomic mass of P = 56 - 17
= 39 g/mol

3. The following table shows the investigation of the amount of substance liberated in electrolysis by different quantities of electricity when a constant current was passed. The electrolysis was done using copper sulfate solution and platinum electrodes.

Current (A)	Time (s)	Quantity of electricity (C)	Mass of copper deposited (g)
0.21	180	37.8	
0.21	378	79.4	
0.21	576	121.0	
0.21	756	158.8	

(a) Complete the table by filling in the columns of time and mass of copper deposited.
Using the relationship:
Mass of copper deposited = (electrochemical equivalent of Cu × quantity of electricity)
Electrochemical equivalent of Cu = 0.000329 g/C

Mass of copper deposited = 0.000329 × Quantity of electricity

Quantity of electricity (C)	Mass of copper deposited (g)
37.8	0.0124
79.4	0.0261
121.0	0.0398
158.8	0.0523

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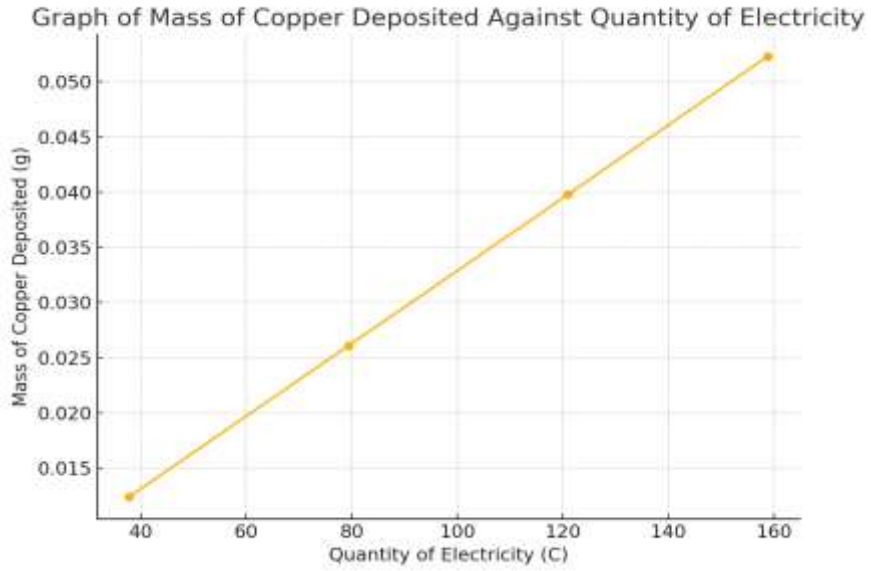
(b) Plot the graph of mass of copper deposited against quantity of electricity.



(c) From the graph, explain how the amount of copper deposited varies with the quantity of electricity passed.
The amount of copper deposited is directly proportional to the quantity of electricity passed, as per Faraday's laws of electrolysis.

4. (a) State Le-Chatelier's principle.
If a system at equilibrium is subjected to a change in temperature, pressure, or concentration, the system will adjust to counteract the imposed change and restore equilibrium.

(b) The equation for the dissociation of calcium carbonate is:
$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ $\Delta H = +175.5$ kJ/mol

What will be the effect on the proportion of $CaCO_3$ in the equilibrium mixture if:
(i) the temperature is increased?
The proportion of $CaCO_3$ will decrease as the equilibrium shifts to favor the endothermic decomposition reaction.

(ii) the pressure is increased?
The proportion of $CaCO_3$ will increase as the equilibrium shifts to the side with fewer gas molecules.

(iii) carbon dioxide is removed?

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The proportion of $CaCO_3$ will decrease as the equilibrium shifts to produce more CO_2 to replace the removed gas.

5. A series of qualitative analysis experiments were carried out on sample Z in order to identify one cation and one anion. Complete the table below by filling in the inference column.

Experiment	Observation	Inference
(a) Appearance of sample Z	White amorphous powder	Could be a carbonate or sulfate salt
(b) To solid sample Z in a test tube, distilled water was added and stirred.	Insoluble in water even after stirring.	Indicates presence of a sparingly soluble salt like $BaSO_4$ or $PbSO_4$
(c) Solid sample Z in a dry test tube was heated first gently and then strongly. The gas evolved was tested.	Colorless gas which turned lime water milky was evolved. Solid residue which was yellow when hot and white when cold remained.	Indicates presence of $ZnCO_3$, as zinc carbonate decomposes to ZnO (yellow when hot, white when cold) and CO_2 gas

Conclusion
The cation in sample Z is Zn^{2+} and the anion is CO_3^{2-}.

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