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: 2005**

Instructions

1. This paper consists of five questions. Answer all questions.
2. Each question carries 10 marks

1. Figure 1 below represents the laboratory preparation of nitrogen from the atmosphere. Study it carefully and answer the questions that follow.

(a) Write the names of the apparatuses labelled A to G.
A - Flask containing water
B - Air inlet tube
C - Flask containing heated copper turnings
D - Flask containing concentrated potassium hydroxide solution
E - Gas outlet tube
F - Delivery tube
G - Copper turnings

(b) What is the function of
(i) concentrated potassium hydroxide solution?
It absorbs carbon dioxide from the air, ensuring that only nitrogen remains.

(ii) copper turnings?
They react with oxygen in the air to remove it by forming copper(II) oxide.

(iii) water?
It prevents backflow of air and helps to ensure that only nitrogen gas is collected.

(c) What are the chief impurities of nitrogen gas at the end of the experiment?
The main impurities include noble gases such as argon, which are not removed by the process.

2. A student titrated 25.00 cm^3 of 0.094 M KOH against oxalic acid ($H_2C_2O_4$). The burette readings were as tabulated in table 1 below.

EXPERIMENT	Pilot	1	2	3
Final reading (cm^3)	23.90	24.40	48.40	22.30
Initial reading (cm^3)	0.00	2.00	22.00	0.00
Titre volume (cm^3)	23.90	22.40	22.40	22.30

(a) Complete the table above.
Values have been completed in the table above.

(b) Calculate the average titre volume.
Average titre volume = (22.40 + 22.40 + 22.30) / 3
= 22.37 cm^3

(c) Calculate the concentration of oxalic acid in
(i) mol/dm³
Using the reaction equation:
$H_2C_2O_4 + 2KOH \text{ ----> } K_2C_2O_4 + 2H_2O$

Moles of KOH = 0.094 × 25.00 / 1000
= 0.00235 moles

Since oxalic acid reacts in a 1:2 ratio with KOH,
Moles of oxalic acid = 0.00235 / 2
= 0.001175 moles

Concentration of oxalic acid = 0.001175 × 1000 / 22.37
= 0.0525 mol/dm³

(ii) g/dm³
Molar mass of oxalic acid ($H_2C_2O_4$) = 90 g/mol
Concentration in g/dm³ = 0.0525 × 90
= 4.73 g/dm³

3. Figure 2 below shows the apparatus assembled by a student to prove that the charge carried by silver ion is +1 and that carried by an unknown metal Q is +2, given that the atomic mass of Q is 119 g/mol.

(a) (i) Why was it necessary to clean the metal electrodes before the experiment started?
To remove any impurities or oxide layers that could affect the accuracy of the results.

(ii) What is the importance of a variable resistor?
To control the current flow, ensuring a constant rate of deposition of the metal ions.

(iii) At the end of the experiment, electrodes were carefully washed and dried before weighing them. Why was it necessary to wash and dry the electrodes?
To remove any unreacted ions or moisture that could falsely increase the measured mass.

(b) If 193 coulombs of electricity were used during the experiment, show that the charge
(i) on silver ion is +1 if 0.216 g of silver was deposited

Using Faraday's equation:
Mass = (ItM) / (nF)
where:
I = current
t = time
M = molar mass of Ag = 108 g/mol
F = Faraday's constant = 96500 C/mol

n = charge of the ion

Rearranging for n:
n = (ItM) / (mass × F)

n = (193 × 108) / (0.216 × 96500)
n = 1.00, proving that the charge on Ag^+ is +1.

(ii) on Q ion is +2 if 0.119 g of Q was deposited

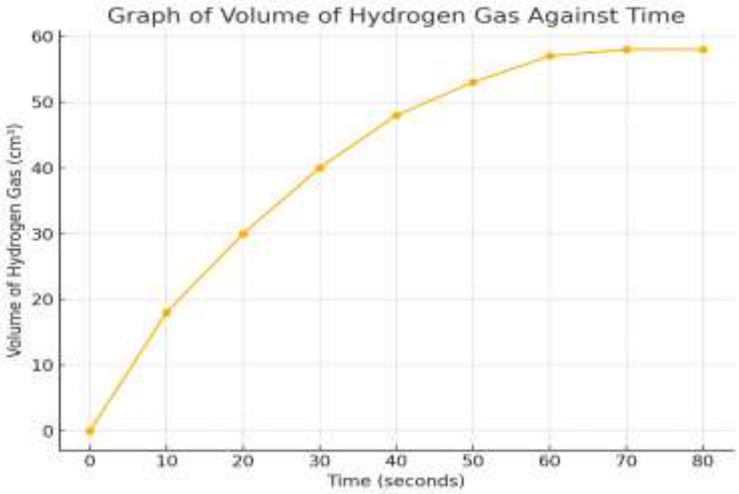
Using the same formula:
n = (193 × 119) / (0.119 × 96500)
n = 2.00, proving that the charge on Q^{2+} is +2.

(c) Write an ionic equation for the discharge of Q^{2+} ions at the cathode.
$Q^{2+} + 2e^- \text{---->} Q$

4. A small flask was connected to a gas syringe by means of a stopper and delivery tube. Zinc granules and excess dilute hydrochloric acid of concentration 0.1M were placed in the flask and quickly stoppered. The readings of the volume of hydrogen gas in the syringe were recorded every 10 seconds as shown in table 2 below.

Time (sec)	0	10	20	30	40	50	60	70	80
Volume (cm^3)	0	18	30	40	48	53	57	58	58

(a) (i) Plot a graph of volume of hydrogen (in cm^3) against time (in sec).



(ii) Why has the volume of hydrogen collected at the 70th second remained the same up to the 80th second?
The reaction has completed, meaning all the limiting reactant (zinc or acid) has been consumed, stopping further hydrogen production.

(b) What will happen to the rate of production of hydrogen gas if

(i) Zinc dust was used instead of zinc granules?
The rate would increase because zinc dust has a larger surface area, allowing for a faster reaction.

(ii) The concentration of hydrochloric acid was increased?
The rate would increase because a higher concentration of HCl provides more hydrogen ions for the reaction, increasing the frequency of collisions between reactant particles.

5. Use the information given under the test and observation columns to complete the inference column in table 3 below.

Test	Observation	Inferences
(a) Appearance	Colourless/white deliquescent salt	Possible presence of Group I or Group II metal cation
(b) A spatulaful in a test tube was stirred in distilled water.	A colourless solution was formed.	The salt is soluble in water, indicating a possible chloride, nitrate, or sulfate salt
(c) To one portion of the salt solution, sodium hydroxide was added until excess.	White precipitate soluble in excess.	Presence of Al^{3+}, Zn^{2+}, or Pb^{2+}
(d) A portion of the salt was heated in a test tube.	Brownish fumes with a gas which rekindles a glowing splint evolved. Also, a brownish residue when hot and yellow when cold was formed.	Presence of nitrate (NO_3^-) anion and lead (Pb^{2+}) cation
(e) To a mixture of the salt and copper turnings, conc. H_2SO_4 acid was added.	Heavy brown fumes were given out.	Confirmation of nitrate (NO_3^-) anion, as nitrates decompose to nitrogen dioxide (NO_2) gas
(f) To one portion of the salt solution, dilute HCl was added, boiled, and then cooled.	White precipitate soluble when hot, reappeared on cooling.	Presence of Pb^{2+} cation as lead chloride ($PbCl_2$) is soluble in hot water but precipitates upon cooling
(g) To another portion of the salt solution, KI solution was added.	Yellow precipitate was formed.	Confirmation of Pb^{2+} as lead iodide (PbI_2) forms a yellow precipitate

Conclusion
In the salt, the cation was Pb^{2+} and the anion was NO_3^-.
The molecular formula of the salt is $Pb(NO_3)_2$.