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: 2010**

Instructions

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

2. Each question carries 10 marks

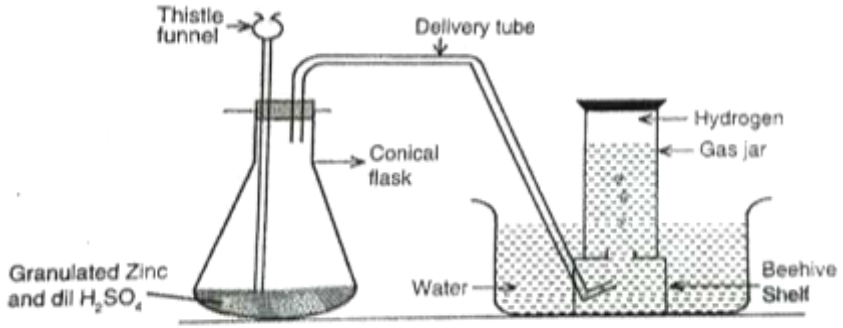
1. The following are some drawings of pieces of apparatus. The pieces, if correctly assembled together, can form the apparatus for the preparation of hydrogen gas.

(a) Name each piece of apparatus A - G.
(b) Draw a neat diagram of the apparatus for the preparation of hydrogen using the pieces of apparatus above.
(c) Label the hydrogen gas collected and any other substances involved in the preparation of hydrogen using such apparatus.
(d) The piece of apparatus marked A can be replaced by another relatively simpler piece of apparatus. Name and draw the alternative piece of apparatus which can take the function of apparatus A.

Answer:

(a) The apparatus are:
A - Conical flask
B - Delivery tube
C - Test tube
D - Thistle funnel
E - Stand and clamp
F - Trough
G - Gas jar

(b)



Laboratory preparation of hydrogen

(c) The hydrogen gas is collected in the gas jar. The reaction between zinc and hydrochloric acid produces zinc chloride and hydrogen gas. The labeled substances include:
- Zinc (Zn)
- Hydrochloric acid (HCl)
- Zinc chloride ($ZnCl_2$)
- Hydrogen gas (H_2)

(d) The conical flask (A) can be replaced with a test tube (C) if only a small amount of gas is needed. A cork with a hole can be used to hold the delivery tube, simplifying the setup.

2. In a practical examination, a student was given the following solutions for titration:

Solution QP containing 4.0g/dm³ of MOH
Solution LL containing 0.1M H_2SO_4
Methyl orange (MO) indicator.

On titrating 20cm³ of solution QP with 0.1M H_2SO_4 acid, the following titre values were obtained:

Burette reading	Pilot	1	2	3
Final volume/cm³	10.00	20.00	30.00	40.00
Initial volume/cm³	0.00	10.00	20.00	30.00
Volume used/cm³	10.00	10.00	10.00	10.00

(a) Use the above information to calculate:
(i) the molarity of solution QP (MOH)
(ii) the molecular weight of MOH
(iii) the atomic mass of M.
(b) Name the element M.

Answer:
(a) (i) The reaction equation between MOH and H_2SO_4:
$MOH + H_2SO_4 \text{ ----> } M_2SO_4 + H_2O$
From the table, the average volume of acid used is 10.00 cm³.
Using the formula:
$M_1V_1 = nM_2V_2$
where:
M_1 = molarity of MOH
V_1 = volume of MOH (20 cm³)
n = mole ratio (1:1 for monovalent MOH)
M_2 = molarity of H_2SO_4 (0.1M)
V_2 = volume of acid used (10 cm³)
$M_1 \times 20 = 0.1 \times 10$
$M_1 = (0.1 \times 10) / 20$
$M_1 = 0.05$ M

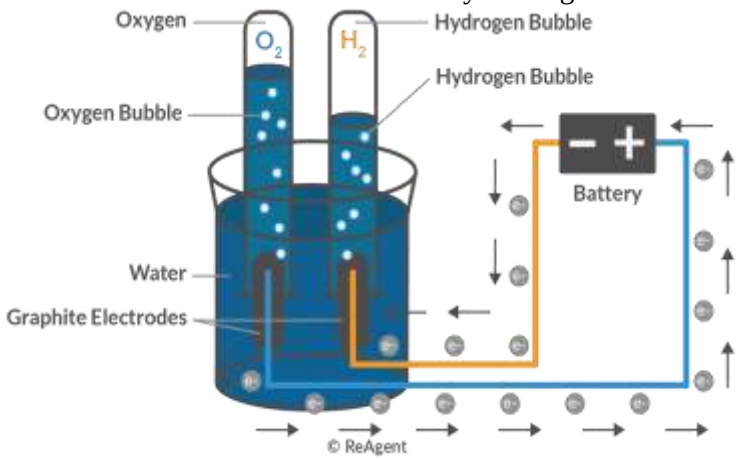
(ii) The molecular weight of MOH can be calculated from:
Mass concentration = Molarity × Molar mass
4.0 g/dm³ = 0.05 M × Molar mass
Molar mass = 4.0 / 0.05
Molar mass = 80 g/mol

(iii) If MOH is a hydroxide (MOH), the atomic mass of M is found as:
M + 17 = 80
M = 80 - 17
M = 63

(b) The element M is copper (Cu), which has an atomic mass of 63.

3. (a) Define the terms oxidizing agent and reducing agent.

(b) Write molecular equations for the oxidation of copper metal by concentrated:
(i) sulphuric acid
(ii) nitric acid
(c) Draw a labeled diagram of a voltameter for the electrolysis of potassium iodide solution. Indicate the movement of ions towards electrodes in your diagram.



(d) If a current of 2A was passed for 1 hour, calculate the mass of iodine liberated.

Answer:
(a) An oxidizing agent is a substance that gains electrons and gets reduced in a chemical reaction. A reducing agent is a substance that loses electrons and gets oxidized.

(b)
(i) $Cu + 2H_2SO_4 \text{ ----> } CuSO_4 + SO_2 + 2H_2O$
(ii) $Cu + 4HNO_3 \text{ ---> } Cu(NO_3)_2 + 2NO_2 + 2H_2O$

(c) The labeled diagram consists of two electrodes submerged in potassium iodide solution. Iodine is liberated at the anode, and potassium ions migrate to the cathode.

(d) Using the equation:
Mass = (ItM) / (nF)
where:
I = 2A
t = 3600 s
M = 127 g/mol (iodine)
n = 2 (I_2 requires 2 moles of electrons)
F = 96500 C/mol

Mass = (2 × 3600 × 127) / (2 × 96500)
Mass = (914400) / 193000
Mass = 4.74 g

4. A small quantity of hydrochloric acid was added to a large quantity of marble in an evaporating dish, which was placed on the pan of a balance. The mass of the dish and its contents was recorded every half minute. The results are shown in the following graph.

(a) Why does the curve slope down?
(b) What was the mass of the evaporating dish and contents at the
(i) start of the experiment
(ii) end of the experiment?
(c) What mass of carbon dioxide was produced?
(d) How long did the reaction last?
(e) Which result would seem to be incorrect? Give reasons.

Answer:
(a) The curve slopes down because carbon dioxide gas is escaping from the reaction, reducing the total mass of the dish and its contents.

(b)(i) The starting mass of the dish and contents was 25.1 g.
(ii) The final mass of the dish and contents was 24.6 g.

(c) The mass of carbon dioxide produced is the difference:
25.1 - 24.6 = 0.5 g

(d) The reaction lasted until the mass stabilized, which occurred at around 3 minutes.

(e) If any result deviated significantly from the trend (such as an abrupt increase in mass), it would be incorrect. This could happen due to experimental errors like improper recording, balance fluctuations, or condensation of water vapor instead of gas release.

5. An unknown sample P was analyzed and found to contain one cation and one anion. Complete the table and identify the cation, anion and write the formula and the name of the compound.

S/N Experiments Observations Inferences

(a) Appearance of sample P White deliquescent crystals.

(b) Sample P was heated in a test tube. White acidic fumes which turned dense white fumes with ammonia. The residue was white when cold and yellow when hot.

(c) Dilute HCl acid was added to the small portion of the sample in a test tube. No gas was evolved.

(d) To a small portion of the sample P in a test tube conc. H_2SO_4 was added. White acidic fumes which turned dense white fumes with ammonia.

(e) Sample P was dissolved in the distilled water. The solution was divided into three and the following was done to the portions:
(i) dilute silver nitrate followed by ammonia solution were added to the first portion. White precipitate was formed which dissolved in excess ammonia solution to form a clear solution.
(ii) a little ammonia solution was added then in excess to the second portion. White gelatinous precipitate was formed which was soluble in excess ammonia.
(iii) potassium hexacyanoferrate (II) solution was added to the third portion. A white precipitate was formed.

Conclusion
(i) The cation is Pb^{2+}.
(ii) The anion is NO_3^-.
(iii) The molecular formula of compound P is $Pb(NO_3)_2$.
(iv) Name of compound P is Lead(II) nitrate.