THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2A **CHEMISTRY 2A**

(ACTUAL PRACTICAL A)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2015**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following solutions:
G: Containing 0.1 mole hydrochloric acid per dm^3 of solution;
B: Containing 2.65 g $MgCO_3$ per 0.5 dm^3 of solution;
Methyl orange indicator.

Questions

(a) Titrate G (in burette) against B (in a conical flask) using two drops of your indicator. Obtain three titre values. Record your data in a tabular form.
Assume titre values recorded were: 25.0 cm^3, 24.8 cm^3, and 25.2 cm^3
Average titre volume = (25.0 + 24.8 + 25.2) ÷ 3 = 25.0 cm^3

(b) (i) ___ cm^3 of B required ___ cm^3 of G for complete reaction.
25.0 cm^3 of B required 25.0 cm^3 of G for complete reaction.

(b) (ii) Write a balanced chemical equation between B and G and the corresponding ionic equation with state symbols.
$MgCO_3(s) + 2HCl(aq) \text{----> } MgCl_2(aq) + CO_2(g) + H_2O(l)$
Ionic: $CO_3^{2-}(s) + 2H^+(aq) \text{----> } CO_2(g) + H_2O(l)$

(b) (iii) Showing your procedures clearly, calculate the molar mass of $MgCO_3$ and hence identify element M.
Volume of HCl = 25.0 cm^3 = 0.025 dm^3
Molarity = 0.1 mol/dm^3
Moles of HCl = 0.1 × 0.025 = 0.0025 mol
From equation: HCl : $MgCO_3$ = 2:1
Moles of $MgCO_3$ = 0.0025 ÷ 2 = 0.00125 mol
Mass = 2.65 g in 0.5 dm^3 → 5.3 g in 1 dm^3
Molar mass = 5.3 ÷ 0.00125 = 424 g/mol (this value suggests overestimation; correct mass in 25 cm^3 = 0.1325 g)
Correct molar mass = 0.1325 ÷ 0.00125 = 106 g/mol
Mg = 24, so CO_3 = 60, total = 24 + 12 + 48 = 84 g/mol
Therefore, element M is magnesium.

2. You are provided with the following:
U: A solution containing 79 g of sodium thiosulphate in one litre;
V: A solution containing 0.1 mol/dm^3 hydrochloric acid;
T: Distilled water;
Stopwatch;
Plain paper marked X.

Procedure
(i) Place a 100 cm^3 beaker on top of letter X on a plain paper provided.

(ii) Measure 8.0 cm^3 of U and 2 cm^3 of T and put them in the beaker in (i).
(iii) Measure 10 cm^3 of V and put it into a beaker containing U and T. Immediately start stopwatch.
(iv) Record the time taken for the disappearance of letter X.
(v) Repeat steps (i) to (iv) using the data shown in Table 1.

Questions

(a) What is the aim of the whole experiment?
To investigate the effect of concentration of sodium thiosulphate (U) on the rate of reaction with hydrochloric acid (V).

(b) Complete Table 1.

Number of experiment	Volume of V (cm^3)	Volume of U (cm^3)	Volume of T (cm^3)	Time (s)	1/t (s^{-1})
1	10	8	2	12	0.0833
2	10	6	4	18	0.0556
3	10	4	6	26	0.0385
4	10	2	8	34	0.0294
5	10	1	9	45	0.0222

(c) Giving reason(s), identify the experiment in which the reaction was:
(i) fast
Experiment 1 — high volume of U, higher concentration, faster reaction.
(ii) slow
Experiment 5 — lowest volume of U, lowest concentration, slower reaction.

(d) With state symbols, write the balanced chemical equation for the reaction between U and V.
$Na_2S_2O_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$

(e) List four factors which can affect the rate of chemical reaction.
- Concentration of reactants
- Temperature
- Surface area of reactants
- Presence of a catalyst

(f) Write the electronic configuration of the product which causes the solution to cloud letter X.
The product is sulphur (S), atomic number = 16
Electronic configuration: 2:8:6

(g) What can you conclude from the data obtained?

As the concentration of sodium thiosulphate increased, the rate of reaction increased (time decreased), confirming that concentration affects reaction rate.

3. Sample M contains one cation and one anion. Using systematic qualitative analysis procedures, carry out the experiment and record carefully your observations, inferences and finally identify the anion and cation present in the sample M. Record your work in a tabular form as shown in Table 2.

S/n	Experiment	Observation	Inference
a	Observe dry sample	Blue crystalline solid	Copper(II) salt
b	Heat sample	Turns black	Formation of CuO
c	Add conc. H_2SO_4 and warm	Effervescence observed	CO_3^{2-} present
d	Dissolve in water, add NH_3	Blue ppt, dissolves in excess	Cu^{2+} present
e	Add NaOH	Blue ppt, dissolves in excess	Cu^{2+} confirmed
f	Add $FeSO_4$ + conc. H_2SO_4 down the side	Brown ring formed	NO_3^- present
g	Add $K_4Fe(CN)_6$	No visible reaction	No Fe^{2+} present

Conclusion

(i) The cation in sample M is Cu^{2+}

(ii) The anion in sample M is NO_3^-

(iii) The chemical formula of sample M is $Cu(NO_3)_2$