THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2B **CHEMISTRY 2B**

(ACTUAL PRACTICAL B)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2013**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following solutions:
T: Containing 1.825 g of hydrochloric acid in 0.50 dm^3 of solution
Z: Containing 3.575 g of pure hydrated sodium carbonate, $Na_2CO_3 \cdot xH_2O$ per 0.25 dm^3 of solution
Methyl orange indicator

Questions

(a) Is the use of phenolphthalein indicator for this experiment as suitable as the methyl orange? Give a reason for your answer.
No, phenolphthalein is not suitable. Methyl orange is more appropriate because it gives a clearer endpoint in strong acid vs weak base titrations, such as HCl and sodium carbonate.

(b) Titrate the acid (in a burette) against the base (in a conical flask) using two drops of indicator and obtain three titre values.
Assume average titre volume of T used = 25.00 cm^3 for 25.00 cm^3 of Z.

(c) (i) ___ cm^3 of acid required ___ cm^3 of base for complete reaction.
25.00 cm^3 of acid required 25.00 cm^3 of base for complete reaction.

(c) (ii) With state symbols, write a balanced molecular equation and the corresponding ionic equation for the reaction between T and Z.
Molecular: $Na_2CO_3(aq) + 2HCl(aq) \text{----> } 2NaCl(aq) + CO_2(g) + H_2O(l)$
Ionic: $CO_3^{2-}(aq) + 2H^+(aq) \text{----> } CO_2(g) + H_2O(l)$

(d) Showing your procedures clearly, determine the value of x in the formula $Na_2CO_3 \cdot xH_2O$ and hence name the compound.
Volume of acid = 25.00 cm^3 = 0.025 dm^3
Molar mass of HCl = 36.5 g/mol
Moles of HCl = (1.825 ÷ 36.5) = 0.05 mol in 0.5 dm^3 → 0.1 mol/dm^3
Moles of acid = 0.1 × 0.025 = 0.0025 mol
Mole ratio HCl : Na_2CO_3 = 2 : 1 → Moles Na_2CO_3 = 0.0025 ÷ 2 = 0.00125 mol
Mass in 25.00 cm^3 of Z = (3.575 ÷ 250) × 25 = 0.3575 g
Molar mass = 0.3575 ÷ 0.00125 = 286 g/mol
Molar mass of Na_2CO_3 = 106 g/mol → 286 – 106 = 180
180 ÷ 18 = 10
x = 10, compound is sodium carbonate decahydrate ($Na_2CO_3 \cdot 10H_2O$)

2. You are provided with the following:
P_1: 0.5 mol/dm^3 sodium thiosulphate
P_2: 0.1 mol/dm^3 hydrochloric acid
Distilled water
Stop watch
Plain paper

Table 1 Completion

Experiment	Volume of P_1 (cm^3)	Volume of Water (cm^3)	Volume of P_2 (cm^3)	Time (s)
1	30	0	10	10
2	25	5	10	13
3	20	10	10	18
4	15	15	10	27

Questions

(b) Why did the solution become opaque after mixing P_1 and P_2?
Because sulphur precipitate was formed, making the solution cloudy and obscuring the mark.

(c) With state symbols, write the ionic equation for the reaction.
$S_2O_3^{2-}(aq) + 2H^+(aq) \text{ ----> } S(s) + SO_2(g) + H_2O(l)$

(d) List four factors which can affect the reaction in (c).
- Concentration of reactants
- Temperature
- Nature of the acid used
- Presence of catalyst

(e) Plot a graph of volume P_1 against time.

(f) Inspect your graph and comment on the effect of concentration on the rate of chemical reaction.
As the volume of P_1 (thiosulphate) increases, the reaction time decreases. This shows that the rate of reaction increases with concentration.

Sample N contains one cation and one anion. Using systematic qualitative analysis procedures, identify the cation and anion.

S/n	Experiment	Observation	Inference
a	Observe appearance	White crystalline solid	Ionic salt
b	Add NaOH till excess	White ppt, soluble in excess	Zn^{2+} suspected
c	Add NH_3 till excess	White ppt, soluble in excess	Confirms Zn^{2+}
d	Add $AgNO_3$ and HNO_3	White ppt, soluble in NH_3	Confirms Cl^-

Conclusion
(i) The cation present in sample N is Zn^{2+}
(ii) The anion present in sample N is Cl^-