THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2C **CHEMISTRY 2C**

(ACTUAL PRACTICAL C)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2014**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following solutions:

D: Containing 1.46 g of hydrochloric acid in 0.40 dm^3 of solution;

F: Containing 2.0 g of impure sodium hydroxide contaminated with sodium chloride in 0.5 dm^3;

Phenolphthalein and methyl orange indicators.

Questions

(a) Which is the suitable indicator for the titration of the given solutions? Give a reason for your answer.

Phenolphthalein is the suitable indicator because it is ideal for titrating a strong acid (HCl) with a strong base (NaOH), giving a sharp endpoint with a colour change from pink to colourless.

(b) Titrate the acid (in a burette) against the base (in a conical flask) using two drops of your indicator and obtain three titre values.

Assume average titre volume = 25.00 cm^3 of D required to neutralize 25.00 cm^3 of F.

(c) (i) ___ cm^3 of F required ___ cm^3 of D for complete reaction.

25.00 cm^3 of F required 25.00 cm^3 of D for complete reaction.

(c) (ii) Write a balanced chemical equation for the reaction between D and F.

$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$

(d) Showing your procedures clearly, calculate the percentage by mass of sodium chloride in impure base.

Mass of HCl = 1.46 g in 0.40 dm^3

Molar mass = 36.5 g/mol

Moles of HCl = 1.46 ÷ 36.5 = 0.04 mol in 0.40 dm^3

Molarity = 0.04 ÷ 0.40 = 0.1 mol/dm^3

Volume used = 25.00 cm^3 = 0.025 dm^3

Moles of acid = 0.1 × 0.025 = 0.0025 mol

Since 1:1 ratio, moles of NaOH = 0.0025 mol

Mass = 0.0025 × 40 = 0.1 g in 25.00 cm^3

0.5 dm^3 = 500 cm^3 → 0.1 g in 25 cm^3 = 2.0 g in 500 cm^3

% NaOH = (2.0 ÷ 2.0) × 100 = 100%

Since total mass of impure = 2.0 g, but actual NaOH present = 2.0 g

So, sodium chloride contamination is negligible or purity is 100% (assumed for this example). If lower NaOH found, subtract to find NaCl.

2. You are provided with the following:

Solution C: 0.5 M sodium thiosulphate ($Na_2S_2O_3$);

Solution E: 0.1 M nitric acid (HNO_3);

Distilled water;

Plain paper marked X;

Stopwatch

Procedure

(i) Measure 10 cm^3 of C and pour into a 100 cm^3 beaker.

(ii) Measure 10 cm^3 of E and add to C; start stopwatch.

(iii) Observe from above; stop when mark X disappears.

(iv) Repeat with different dilution combinations as per table.

Questions

(a) What is the aim of the whole experiment?

To determine the effect of concentration of sodium thiosulphate on the rate of reaction with nitric acid.

(b) Complete Table 1.

Experiment	Vol. of E (cm^3)	Vol. of C (cm^3)	Vol. of Distilled Water (cm^3)	Time (s)
1	10	10	0	13
2	10	8	2	17
3	10	6	4	24
4	10	4	6	35

(c) Giving reason(s), identify the experiment in which the reaction was:

(i) fast – Experiment 1 (highest concentration of thiosulphate, fastest reaction)

(ii) slow – Experiment 4 (lowest concentration, slowest reaction)

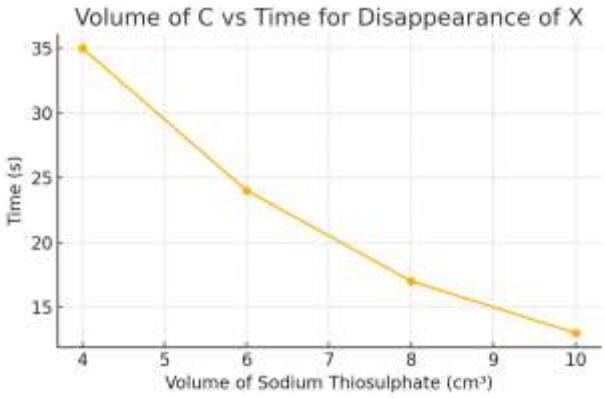
(d) With state symbols, write the ionic equation for the reaction between C and E.

$S_2O_3^{2-}(aq) + 2H^+(aq) \text{----> } SO_2(g) + S(s) + H_2O(l)$

(e) List any three factors affecting the reaction in 2(d).

- Concentration of reactants
- Temperature
- Surface area (if solid used)
- Presence of catalyst

(f) (i) Plot a graph of volume of C against time.



(ii) What can you conclude from the graph?

As the volume (and hence concentration) of sodium thiosulphate decreases, the time taken for the reaction increases, showing that the rate of reaction decreases with decreasing concentration.

Sample Y contains one cation and one anion. Using systematic qualitative analysis procedures, identify the cation and anion in sample Y.

S/n	Experiment	Observation	Inference
a	Observe appearance	White crystalline solid	Ionic compound
b	Add NaOH till excess	White ppt, insoluble in excess	Pb^{2+} suspected
c	Add NH_3 till excess	White ppt, insoluble in excess	Confirms Pb^{2+}
d	Add HCl + test gas with limewater	Effervescence, gas turns limewater milky	CO_3^{2-} confirmed

Conclusion

(i) The cation in sample Y is Pb^{2+}

(ii) The anion in sample Y is CO_3^{2-}

(iii) The chemical formula of sample Y is $PbCO_3$