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: 2011**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following:
AA: A solution of 0.2 M nitric acid (HNO_3)
BB: A solution of 4.2 g Na_2CO_3 per 0.5 dm^3 of solution
MO: Methyl orange indicator

Questions
(a)
(i) Calculate the average titre volume.
Assume average titre = 25.0 cm^3

(ii) Summary:
25.0 cm^3 of solution BB required 25.0 cm^3 of solution AA for complete reaction.

(b) If the mole ratio for the reaction is 1:1, find:
(i) Concentration of Na_2CO_3 in mol/dm^3 and g/dm^3
Molar mass of Na_2CO_3 = 106 g/mol
Moles = mass/molar mass = 4.2 g / 106 g/mol = 0.0396 mol
Volume = 0.5 dm^3
Concentration in mol/dm^3 = 0.0396 mol / 0.5 dm^3 = 0.0792 mol/dm^3
Concentration in g/dm^3 = 4.2 g / 0.5 dm^3 = 8.4 g/dm^3

(ii) Molecular mass of Na_xCO_3
Let the molar mass of Na_xCO_3 be M = 106
M = x(23) + 12 + 3(16)
106 = 23x + 60
x = (106 - 60)/23 = 2
(iii) Atomic mass of x and replace it in the formula Na_2CO_3
x = 2
Formula: Na_2CO_3

(c) Write a balanced chemical equation for the reaction in this experiment.
$Na_2CO_3(aq) + 2HNO_3(aq) \longrightarrow 2NaNO_3(aq) + H_2O(l) + CO_2(g)$

(d) What is the significance of the indicator in this experiment?
Methyl orange indicates the endpoint of titration by changing colour when the acid completely reacts with the base.

(e) Why is there a colour change when enough acid has been added to the base?
Because all carbonate ions react with H^+ ions, the solution becomes acidic, causing the indicator to shift colour from yellow to red.

2. You are provided with the following materials:
TT: A solution of 0.13 M $Na_2S_2O_3$ (sodium thiosulphate)

HH: A solution of 2 M HCl
Distilled water
Stopwatch

Table 1: Table of results

Exp. No.	Vol. of HH (cm^3)	Vol. of TT (cm^3)	Vol. of Distilled water (cm^3)	Time (sec)	1/t (s^{-1})
1	10	20	0	20	0.050
2	10	15	5	25	0.040
3	10	10	10	33	0.030
4	10	5	15	50	0.020

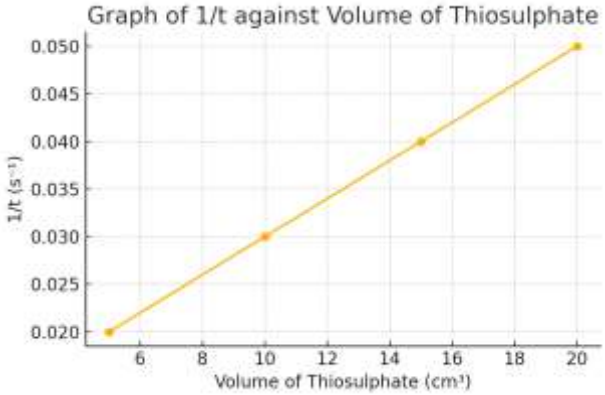
Questions
(a) Complete filling the table of results (Table 1).
Done above.

(b) Write a balanced equation for reaction between TT and HH.
$Na_2S_2O_3(aq) + 2HCl(aq) \text{----> } 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$

(c) What is the reaction product which causes the solution to cloud the letter X?
Sulphur (S)

(d) How was the factor of concentration varied in this experiment?
By diluting the sodium thiosulphate solution with different amounts of water while keeping the acid volume constant.

(e) Plot a graph of 1/t against the volume of the thiosulphate.



(f) Use the graph to explain how variation of concentration affects the rate of chemical reaction.
As the volume (and thus concentration) of thiosulphate increases, the rate of reaction (1/t) also increases, showing a direct relationship between concentration and reaction rate.

3. Sample S is a simple salt containing one cation and one anion. Carry out the experiments described below. Record your observations and inferences as shown in Table 2.

Table 2: Experimental results

S/n	Experiment	Observation	Inference
(a)	Observe the appearance of sample S.	White crystalline solid	Likely a salt
(b)	Place a spoonful of sample S in a test tube, add water and shake to dissolve.	Dissolved completely	Salt is soluble
(c)	Put a spatulaful of sample S in a test tube and heat.	No visible change	Thermally stable
(d)	Add three drops of sodium hydroxide solution to the solid sample in a test tube.	White precipitate formed	Presence of Pb^{2+} ion
(e)	Put a spatulaful of sample S in a dry test tube and add concentrated sulphuric acid. Warm the mixture and test for any gas evolved.	Colourless gas with pungent smell evolved	Release of HCl gas
(f)	Put a spatulaful of sample S in a dry test tube and add concentrated sulphuric acid and manganese dioxide. Warm the mixture and test for any gas evolved.	Greenish yellow gas evolved	Presence of chloride ion (Cl^-) confirmed
(g)	To a portion of the solution from (f) add aqueous silver nitrate followed by aqueous ammonia.	White precipitate soluble in ammonia	Confirms presence of Cl^- ion

Conclusion:
(a) The cation present in S is Pb^{2+} and the anion is Cl^-
(b) The name of sample S is lead(II) chloride
(c) Write a balanced chemical equation for the reactions taking place in (c) and (d):
(c) No chemical change observed (stable compound)
(d) $PbCl_2(s) + 2NaOH(aq) \longrightarrow Pb(OH)_2(s) + 2NaCl(aq)$