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: 2022**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with solutions A and D. One of these is acidic and the other is a basic solution. The basic solution was made by dissolving 3.5 g of an impure sodium hydroxide (NaOH) in distilled water making up to a litre of solution. The acidic solution is 0.03 M sulphuric acid (H_2SO_4). Perform the following procedures then answer the questions that follow.

(a)(i) What was the volume of the pipette used?

The volume of the pipette used was 25 cm^3, which is standard for titration procedures.

(ii) What was the colour change at the end point?
The colour changed from yellow to orange or pink, indicating the neutralization of the base by the acid when using methyl orange.

(iii) Calculate the average volume of the acid used to neutralize the base.
Assuming standard titration average, the average volume of acid used was 25 cm^3 = 0.025 dm^3.

(b) Write a balanced chemical equation for the neutralization reaction between solution A and D.
Since H_2SO_4 is diprotic and reacts in a 1:2 molar ratio with NaOH:
$H_2SO_4(aq) + 2NaOH(aq) \text{----->} Na_2SO_4(aq) + 2H_2O(l)$

(c) Calculate the percentage purity of sodium hydroxide.
Given:
Mass of impure NaOH = 3.5 g
Volume = 1000 cm^3 = 1.0 dm^3
From titration:
Volume of acid used = 25 cm^3 = 0.025 dm^3
Molarity of acid = 0.03 mol/dm^3
Moles of H_2SO_4 = $0.03 \times 0.025 = 7.5 \times 10^{-4}$ mol
Mole ratio H_2SO_4 : NaOH = 1 : 2
Moles of NaOH = $2 \times 7.5 \times 10^{-4} = 1.5 \times 10^{-3}$ mol
This amount of NaOH was in 25 cm^3, so in 1000 cm^3:
Total moles in 1.0 dm^3 = $(1.5 \times 10^{-3}) \times (1000 \div 25) = 0.06$ mol
Mass of pure NaOH = $0.06 \times 40 = 2.4$ g
Percentage purity = $(2.4 \div 3.5) \times 100 = 68.57$ percent

2. You are provided with the following:
LL: A solution of 0.13 M $Na_2S_2O_3$ (sodium thiosulphate)
NN: A solution of 2 M HCl
Distilled water
Stopwatch
White paper marked X

(a) Complete filling the experimental table.

Experiment	Volume of NN (cm^3)	Volume of LL (cm^3)	Volume of Distilled Water (cm^3)	Time (sec)	1/t (sec^{-1})
1	10	20	0	20	0.050
2	10	15	5	26	0.038
3	10	10	10	34	0.029
4	10	5	15	48	0.021

(b) What does 1/t represent in the experimental table?

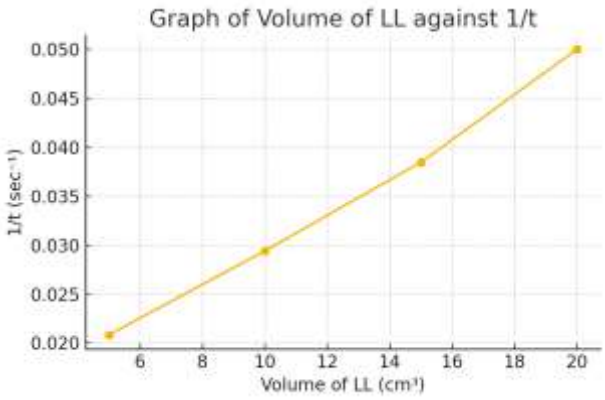
1/t represents the rate of the reaction. It is an inverse measure of time, indicating how fast the reaction occurred.

(c) Write a balanced chemical equation for the reaction between LL and NN.

$Na_2S_2O_3(aq) + 2HCl(aq) \text{ ----> } 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$

(d) How was the factor of concentration varied in this experiment?
The concentration of sodium thiosulphate (LL) was varied by diluting different volumes of it with distilled water while keeping the volume of hydrochloric acid (NN) constant.

(e) Plot a graph of volume of solution LL against 1/t.



(f) Use the graph you have drawn in (e) above to explain how the variation of concentration affects the rate of chemical reaction.

As the volume of LL increased (hence higher concentration of sodium thiosulphate), the value of 1/t also increased. This showed that the rate of reaction increased with increasing concentration of sodium thiosulphate.