

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: 2016

Instructions

1. This paper consists of two questions.
2. Answer all questions.

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1. You are provided with the following:

A. Sodium hydroxide solution, 0.05 mol/dm^3

B. Ethanoic acid solution of unknown concentration

POP. Phenolphthalein indicator

Procedure:

(i) By using POP, titrate B against A until the end point is reached.

(ii) Record the results in a tabular form.

Questions

(a) (i) State the volume of the pipette and the burette used.

The pipette used was 25 cm^3 and the burette used was 50 cm^3 .

(a) (ii) State the colour change at the end point.

The colour changed from pink to colourless.

(a) (iii) Calculate the average volume of B used.

Assuming titre values are 24.80 cm^3 , 24.60 cm^3 , and 24.70 cm^3 :

Average = $(24.80 + 24.60 + 24.70) \div 3 = 24.70 \text{ cm}^3$

(b) Calculate the number of moles of sodium hydroxide used in the titration.

Molarity = 0.05 mol/dm^3

Volume = $25 \text{ cm}^3 = 0.025 \text{ dm}^3$

Moles = $0.05 \times 0.025 = 0.00125 \text{ mol}$

(c) Write an equation for the reaction of sodium hydroxide with ethanoic acid.

$\text{CH}_3\text{COOH(aq)} + \text{NaOH(aq)} \rightarrow \text{CH}_3\text{COONa(aq)} + \text{H}_2\text{O(l)}$

(d) (i) Calculate the number of moles of ethanoic acid present in 25 cm^3 .

From the balanced equation, mole ratio is 1:1

Therefore, moles of ethanoic acid = 0.00125 mol

(d) (ii) Calculate the concentration of ethanoic acid in mol/dm^3 .

Volume used = $24.70 \text{ cm}^3 = 0.0247 \text{ dm}^3$

Concentration = moles $\div$ volume = $0.00125 \div 0.0247 = 0.0506 \text{ mol/dm}^3$

(d) (iii) Convert the value of moles of ethanoic acid calculated in (d)(i) into grams of ethanoic acid.

Molar mass of $\text{CH}_3\text{COOH} = 60 \text{ g/mol}$

Mass = moles $\times$ molar mass = $0.00125 \times 60 = 0.075 \text{ g}$

2. You are provided with the following:

G₁: A solution of 0.3 M sodium thiosulphate

G₂: A solution of 2 M hydrochloric acid

G₃: Distilled water

Stop watch/clock; A sheet of white paper and a thermometer

Procedure

- Put a small beaker (100 cm³) on top of the cross on the paper provided in such a way that the mark is seen through the solution when viewed from above.
- Measure 2 cm³ of G₁ and 6 cm³ of G₃ using measuring cylinder of 10 cm³ and put them in a clean beaker and stir using a glass rod.
- Using another measuring cylinder measure 10 cm³ of G₂ and pour into the beaker containing the mixture and immediately start the stop watch.
- Stir the mixture and look through it from above, record the time taken for the cross to disappear.
- Repeat the procedures for different sets of concentrations as shown in Table 1.

Table 1

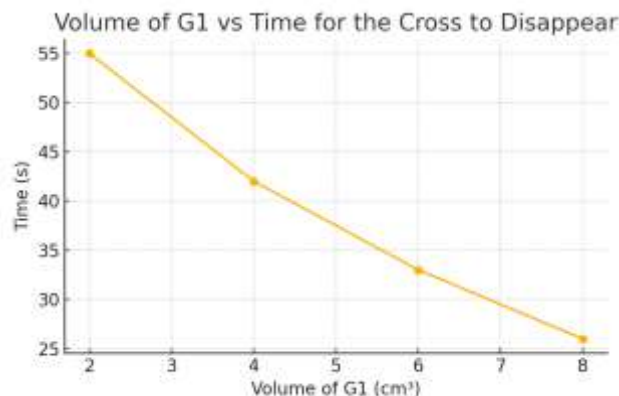
Volume of G ₁ (cm ³)	Volume of G ₃ (cm ³)	Volume of G ₂ (cm ³)	Time (s)	Rate (1/t) (s ⁻¹)
2	6	10	55	0.0182
4	4	10	42	0.0238
6	2	10	33	0.0303
8	0	10	26	0.0385

Questions

(a) Complete Table 1.

The table above is completed with estimated time and rate values.

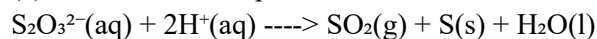
(b) (i) Plot a graph of volume of G₁ (vertical axis) against time taken for the cross (X) to disappear.



(b) (ii) What does the shape of the graph indicate?

The graph shows that as the volume of G₁ increases, the time taken for the cross to disappear decreases. This means the rate of reaction increases with concentration.

(c) Write the ionic equation for the reaction between G_1 and G_2 .



(d) Why did the cross disappear?

The sulphur produced formed a precipitate which made the solution cloudy, obstructing the visibility of the cross.

(e) Describe two factors which can affect the rate of the given reaction.

- Concentration: Higher concentration increases the rate of reaction.
- Temperature: Increasing temperature increases kinetic energy and speeds up the reaction.

3. Sample J is a simple salt which contains one cation and one anion. Carefully carry out the experiments indicated below on the sample J. Make appropriate observations and inferences.

S/N	Experiment	Observation	Inference
a	Observe the appearance of sample J	Blue crystals	Transition metal salt
b	Transfer about 0.5 g of J in a dry test tube, then heat	Turned black	Cu^{2+} present
c	Add 3 drops of concentrated H_2SO_4 to J, warm gently.	Effervescence	CO_3^{2-} confirmed
d	Dissolve J in water, divide into portions. Add ammonia to first portion	Light blue ppt, soluble in excess Cu^{2+} confirmed	
e	Add sodium hydroxide to second portion	Blue ppt, soluble in excess	Cu^{2+} confirmed
f	Add freshly prepared iron(II) sulphate to third portion and conc. H_2SO_4 down the side of the tube	Brown ring formed	Nitrate ion present
g	Add potassium hexacyanoferrate(II) solution to fourth portion	No visible reaction No Fe^{2+} present	

Conclusion

- (i) The cation in J is Cu^{2+}
- (ii) The anion in J is NO_3^-
- (iii) The formula for sample J is $Cu(NO_3)_2$
- (iv) The name of sample J is copper(II) nitrate
- (v) Reaction at (b):

$$Cu(NO_3)_2(s) \rightarrow CuO(s) + 2NO_2(g) + \frac{1}{2}O_2(g)$$