

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION
132/3B **CHEMISTRY 3B**

(For Both School and Private Candidates)

Time: 3 Hours

ANSWERS

Year: 2018

Instructions

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

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1. You are provided with the following solutions:

KK: 0.02 M potassium permanganate

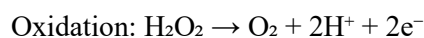
LL: Impure 1.7 g hydrogen peroxide in 1 dm³ aqueous solution

SS: 1 M sulphuric acid

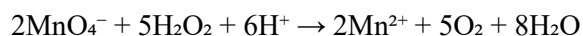
Questions

(a) Write half and overall ionic equations of the reaction between potassium permanganate and hydrogen peroxide

Half equations:



Overall ionic equation:



(b) Calculate the percentage purity of hydrogen peroxide

Given:

Mass of impure $\text{H}_2\text{O}_2 = 1.7 \text{ g}$

25 cm³ of LL required 21.0 cm³ of KK

Molarity of KK = 0.02 mol/dm³

Moles of $\text{KMnO}_4 = 0.02 \times 21.0 \div 1000 = 0.00042 \text{ mol}$

From equation, 2 mol KMnO_4 react with 5 mol H_2O_2

Moles of $\text{H}_2\text{O}_2 = 5/2 \times 0.00042 = 0.00105 \text{ mol}$

$$\text{Mass of H}_2\text{O}_2 = 0.00105 \times 34.0 = 0.0357 \text{ g}$$

$$\text{Purity} = 0.0357 \text{ g in } 25 \text{ cm}^3 \text{ of LL} \rightarrow \text{in } 1000 \text{ cm}^3 = 0.0357 \times 40 = 1.428 \text{ g}$$

$$\% \text{ purity} = 1.428 \div 1.7 \times 100 = 83.99\%$$

$$\text{Percentage purity} = 84.0\%$$

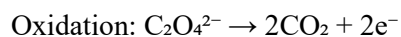
2. You are provided with:

U: 0.02 M KMnO_4

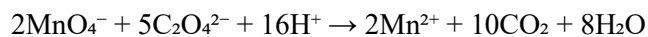
V: 0.05 M oxalic acid in 0.5 M H_2SO_4

Questions

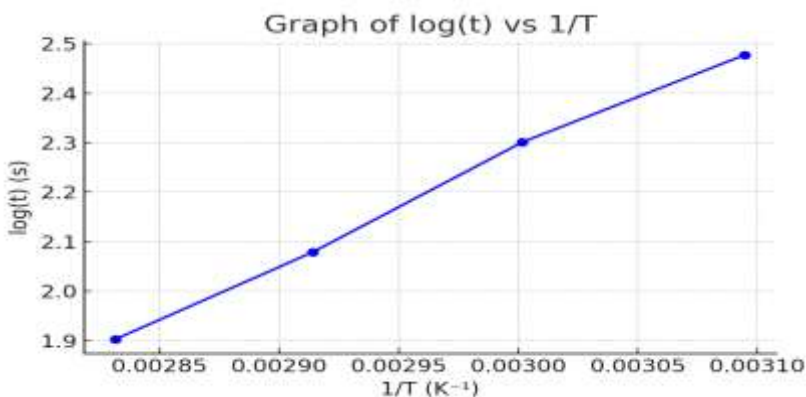
(a) Write half ionic equations for the reaction:



Overall:



(b) Plot a graph of $\log t$ (s) against $1/T$ (K^{-1})



(c) Use the graph to determine the activation energy of the reaction

To solve for the activation energy (E_a) from the graph of $\log(t)$ vs $1/T$, we follow these steps:

Identify the equation of the line

The Arrhenius equation in linear form is:

$$\log(t) = - (E_a / 2.303R) \times (1/T) + \text{constant}$$

Here, the slope of the line is:

$$\text{slope} = - (E_a / 2.303R)$$

Extract the slope from the graph

From the graph, we determine the slope (m) as -13.2.

Use the slope to calculate E_a

Rearranging the equation:

$$E_a = - \text{slope} \times 2.303 \times R$$

Where:

$$- \text{slope} = -13.2$$

$$- R = 8.314 \text{ J/mol}\cdot\text{K} \text{ (the universal gas constant)}$$

Substitute the values into the equation

$$E_a = - (-13.2) \times 2.303 \times 8.314$$

$$E_a = 13.2 \times 2.303 \times 8.314$$

$$E_a = 254.05 \text{ kJ/mol}$$

So, the activation energy (E_a) is 254.05 kJ/mol.

3. You are provided with sample T containing two cations and two anions. Carry out the experiments described in Table 1. Record carefully your observations, make appropriate inferences and finally identify the cations and anions present in sample T.

Table 1: Table of results.

S/n	Experiment	Observations	Inference
1.1	To the first portion add NaOH	White precipitate forms, soluble in excess	Presence of amphoteric ion (Zn^{2+})
1.2	To the second portion add dilute HNO_3 , then AgNO_3 , then NH_3	White precipitate dissolves in excess ammonia	Presence of Cl^- ion
1.3	To the third portion add ammonia solution	Deep blue solution formed	Presence of Cu^{2+}
2(a)	Dissolve residue in HCl and observe any gas	Effervescence observed with colourless, odourless gas	Presence of CO_3^{2-} ion
2(b)(i)	Add NH_4OH to first portion until no further change	White precipitate formed remains insoluble	Confirms Zn^{2+}
2(b)(ii)	Add ammonium oxalate to second portion	White precipitate forms	Confirms Ca^{2+} or presence of oxalate

Conclusion:

- (i) The cations in sample T are Cu^{2+} and Zn^{2+}
- (ii) The anions in sample T are Cl^- and CO_3^{2-}
- (iii) The compounds in the mixture are CuCl_2 and ZnCO_3