THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

132/3A

CHEMISTRY 3A
ACTUAL PRACTICAL A
(For Both School and Private Candidates)

Time: 3:20 Hours **Thursday, 11th May 2017 a.m.**

Instructions

1. This paper consists of **three (3)** questions. Answer **all** the questions.
2. Question number **one (1)** carries 20 marks and the other **two (2)**, 15 marks each.
3. Mathematical tables and non programmable calculators may be used.
4. Cellular phones are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).
6. You may use the following constants:
   - Atomic masses: H = 1, C = 12, O = 16, S = 32, Na = 23, K = 39, Mn = 55, Fe = 56, I = 127.
   - Molar gas constant = 8.314 $J K^{-1} mol^{-1}$.

1. You are provided with the following:
   - **D_1:** A 250 cm^3 solution containing 1 g of impure manganese dioxide (MnO_2) and 2.2 g of oxalic acid crystals ($H_2C_2O_4.2H_2O$);
   - **D_2:** A solution of 0.02 M potassium permanganate;
   - **D_3:** 1 M sulphuric acid solution.

Theory:
Manganese dioxide react with excess oxalic acid quantitatively as follows:
$MnO_{2(s)} + H_2C_2O_4 + 2H^+ \rightarrow Mn^{2+} + 2H_2O + 2CO_2$ ..... (1).
The remaining acid reacts completely with potassium permanganate as
$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$ .....(2).

Procedure:
(i) Pipette 20 cm^3 or 25 cm^3 of solution D_1 into a 250 cm^3 pyrex conical flask.
(ii) Add 20 cm^3 of solution D_3 to (i) above and then heat the contents of the flask to about 70°C.
(iii) Put solution D_2 into the burette. Titrate the hot D_1 solution with D_2 until the solution becomes just pinkish.
(iv) Repeat procedure (i) to (iii) to get three more readings.
(v) Record your result in a tabular form.

Summary:
_____ cm^3 of solution D_1 required _____ cm^3 of solution D_2 for complete reaction.

Questions
(a) With the aid of oxidation – reduction half reaction equations, write specifically the oxidizing and reducing agents in the equations (1) and (2).

(b) Calculate the concentration of oxalic acid in:
   (i) mol/dm^3.
   (ii) g/dm^3.

(c) Calculate the percentage purity by mass of manganese dioxide in the sample.

2. You are provided with the following:
   AE: A solution of hydrogen peroxide;
   AF: A solution of sodium thiosulphate;
   AG: A solution of potassium iodide;
   AH: A starch solution;
   AJ: 0.5 M sulphuric acid.

Theory:
In this experiment the rate of reaction is not affected by the presence of sodium thiosulphate. The chemical reaction is represented by the following equation:
$2I^- + H_2O_2 + 2H^+ \longrightarrow I_2 + 2H_2O$, hence you can investigate the rate of reaction between hydrogen peroxide and acidified potassium iodide.

Procedure:
(i) Measure 5 cm^3 of **AF** and pour it into a beaker.
(ii) Measure 10 cm^3 of **AE** and pour it into the same beaker in (i).
(iii) Measure 10 cm^3 of **AG** and pour it into another beaker and add 5 cm^3 of distilled water followed by 5 cm^3 of **AJ** and then add three drops of **AH** solution.
(iv) Transfer the contents of the beaker in step (ii) into the beaker of step (iii) and start the stop watch immediately.
(v) Swirl the contents of the beaker in step (iv) and note the time taken for the blue colour to appear.
(vi) Repeat steps (i) to (v) varying the volume of **AE** and water as indicated in Table 1.

Table 1

Experiment	1	2	3	4	5
Volume of AE, cm^3	30	25	20	15	10
Volume of water, cm^3	5	10	15	20	25
Time t, sec					
$\frac{1}{t}$, sec^{-1}					

Questions:
(a) From the experimental results, explain how the concentration of **AE** affects the rate of the reaction.
(b) Plot a graph of $\frac{1}{t}$, sec^{-1} against volume of **AE**.
(c) From the graph, determine the order of reaction with respect to H_2O_2.
(d) Calculate the value of the rate constant.
(e) What is the essence of using sodium thiosulphate in this reaction?

3. Sample **C** contains two cations and a common anion. Use the information given in the experiment column in Table 2 to complete the observations and inferences and hence identify the two cations and the common anion.

Table 2

S/n	Experiment	Observations	Inferences
(a)	Observe the appearance of sample **C**.		
(b)	Add dilute hydrochloric acid to a dry sample **C**.		
(c)	Place a little solid sample into a test tube and add 1 ml of concentrated sulphuric acid solution.		
(d)	Perform flame test.		
(e)	Heat a small sample in a test tube.		
(f)	Make a solution of **C** in water and divide the solution into four portions.		
(g)	To the first portion, add ammonium solution.		
(h)	To the second portion, add potassium hexacyanoferrate (II).		
(i)	To a solid sample **C** in a test tube add MnO_2 followed by concentrated H_2SO_4.		

Conclusion

(i) The cations in sample **C** were _____ and _____.

(ii) The anion in sample **C** was _____.

(iii) Write the ionic equation which took place at stage (c).

(iv) Sample **C** contained _____ and _____ salts.