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 **Wednesday, 07th May, 2014 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, N = 14, O = 16, S = 32, Na = 23, K = 39, Mn = 55, Fe = 56.
   - Molar gas constant = 8.314 J $K^{-1}mol^{-1}$.

1. You are provided with the following solutions:
   - **L**: 0.02 M potassium permanganate;
   - **M**: 39.2 g/dm^3 hydrated ammonium iron (II) sulphate, $(NH_4)_2Fe(SO_4)_2.xH_2O$;
   - **P**: 1 M sulphuric acid.

Theory

The manganate (VII) ion, MnO_4^-, usually found as $KMnO_4$, is a good oxidizing agent in acidic medium solution, being easily reduced to Mn^{2+} ions. It can oxidise Fe^{2+} ions to Fe^{3+} ions. It is usually prepared as a solution of concentration 0.02 moldm^{-3} and is always placed in the burette.

Procedure

(i) Pipette 25 cm^3 of solution **M** into a conical flask.
(ii) Add 25cm^3 of solution **P** into a conical flask containing solution **M**.
(iii) Titrate the mixture against solution **L** until a permanent pink colour appears in the conical flask.
(iv) Record the titre volume and repeat the titration to obtain three readings.
(v) Record the volume of the pipette used.

Questions

(a) Write a half equation for the reduction of MnO_4^- ions to Mn^{2+} ions in acidic solution.
(b) Write a half equation for the oxidation of Fe^{2+} to Fe^{3+}.
(c) Write an ionic equation to show the oxidation of Fe^{2+} to Fe^{3+} by MnO_4^- ions in acidic solution.
(d) Deduce the value of x in hydrated ammonium iron (II) sulphate.
(e) Suggest two advantages and disadvantages of using $KMnO_4$ in volumetric analysis.

2. You are provided with the following:
   - **U**: 0.1 M hydrogen peroxide;
   - **V**: 0.25 M sulphuric acid;
   - **W**: 0.05 M sodium thiosulphate;
   - **X**: 0.3 M potassium iodide;
   - **Y**: Starch solution;
   - Distilled water;
   - Stop watch.

Theory

Hydrogen peroxide reacts with iodide ions to form iodine. The iodine produced reacts with thiosulphate ions as indicated by the following equations:

$H_2O_{2(aq)} + 2H^+_{(aq)} + 2I^-_{(aq)} \rightarrow I_{2(aq)} + 2H_2O_{(l)}$ ..... (1).

$2S_2O_3^{2-} + I_{2(aq)} \rightarrow S_4O_{6(aq)}^{2-} + 2I^-_{(aq)}$ ..... (2).

The initial rate of oxidation of iodide ions by hydrogen peroxide in acidic solution is found by measuring the time taken to liberate sufficient iodine to react with the thiosulphate ions present and then produce a blue colour with starch solution.

The rate law equation can be written as follows: Rate $= k[H_2O_2]^a[H^+]^b[I^-]^c$. By varying the concentration of each reactant independently, you can determine the orders of reaction a, b and c.

Procedure

(i) Measure 10 cm^3 of solution **U**, 25 cm^3 of solution **V**, and 5 cm^3 of solution **W** into a 100 cm^3 beaker.

(ii) Add approximately 1 cm^3 of solution **Y**.

(iii) Measure from the burette 5 cm^3 of solution **X** and put into another beaker and add 20 cm^3 of distilled water. Call this mixture A.

(iv) Add mixture A (**X**/water mixture) to the first beaker and start a stop watch/clock. Swirl the contents to mix thoroughly. Record the time taken for the blue colour to appear.

(v) Repeat procedures (i) to (iv), but this time using the mixtures as indicated in Table 1:

Table 1

Mixture	X/cm^3	Water/cm^3
A	5	20
B	10	15
C	15	10
D	20	5
E	25	0

Questions

(a) Record all your observation results in a tabular form.

(b) Plot a graph of log (1/t) against log (volume of **X**).

(c) Calculate the gradient of the graph.

(d) Determine the order of reaction with respect to **X**.

(e) Plan a simple procedure experiment that can be used to determine the order of reaction with respect to **U**.

3. **You are provided with sample X containing one cation and one anion. Carry out the experiments described in Table 2. Record carefully your observations, make appropriate inferences and finally identify the anion and cation present in sample X.**

Table 2: Table of results

S/n	Experiments	Observation	Inference
(a)	Appearance of sample **X**.		
(b)	Heat a little sample **X** in a dry test tube.		
(c)	Prepare a sample solution **X** and divide the resulting solution into three portions.		
	(i) To the first portion add NaOH.		
	(ii) To the second portion add NH_4OH solution.		
	(iii) To the third portion add $FeCl_3$ solution followed by dilute HCl then boil.		
(d)	Perform flame test for sample **X**		
(e)	Perform one confirmatory test for: (i) Cation. (ii) Anion.		

Conclusion

(i) The cation in sample **X** is _____.

(ii) The anion in sample **X** is _____.

(iii) The molecular formula for sample **X** is _____.

(iv) Write a balanced chemical equation of the reaction for experiment (b).