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

132/3A **CHEMISTRY 3A**
(PRACTICAL A)
(For Both School and Private Candidates)

Time: 3:20 Hours **Year: 2020**

Instructions

1. This paper consists of **three (3)** questions. Answer **all** the questions.
2. Question number **one (1)** carries **twenty (20)** marks and the other **two (2)**, carry **fifteen (15)** marks each.
3. Qualitative Analysis Guide (QAG) sheet authorized by NECTA may be used.
4. Mathematical tables and non programmable calculators may be used.
5. Cellular phones and any unauthorised materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. You may used the following atomic masses:

   H = 1, C = 12, N = 14, O = 16, S = 32, Na = 23, K = 39, Mn = 55, Fe = 56.

1. You are provided with the following:
   C1: A solution of sodium oxalate, $Na_2C_2O_4$ made by dissolving 3.35 g of the salt in a 0.5 dm^3 of a solution;
   C2: A solution of potassium permanganate $KMnO_4$;
   C3: A solution of hydrated iron (II) ammonium sulphate, $FeSO_4(NH_4)_2SO_4XH_2O$ made by dissolving 33.3 g of the salt in a distilled water to form a 1 dm^3 of an aqueous solution.
   C4: Dilute sulphuric acid;
   Thermometer.

   Theory
   Standardization of **C2** solution is done by titrating it against the standard solution of **C1** in acidic medium. The resulting reaction equation is as follows:
   $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$. The standardized $KMnO_4$ is then titrated against **C3**, whose number of molecules of water of crystallization can then be calculated. The resulting equation is as follows:
   $MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$.

   Procedure
   Part I
   (i) Measure 10 cm^3 of solution **C1** into a titration flask and then add 10 cm^3 of solution **C4**.
   (ii) Heat the contents near to boiling (about 80°C).
   (iii) Titrate this hot mixture against solution **C2** from the burette until there is a colour change.
   (iv) Repeat the procedures (i) to (iii) to obtain three more readings and record your titration results in a tabular form.

   Summary
   _____ cm^3 of a solution **C1** required _____ cm^3 of a solution **C2** for complete reaction.

   Part II

   (i) Measure 10 cm^3 of a solution **C3** into a titration flask and then add 10 cm^3 of a solution **C4**.
   (ii) Titrate the reaction mixture against the solution **C2** from the burette until there is a colour change.
   (iii) Repeat the procedures (i) to (ii) to obtain three more readings and record your results in tabular form.

   Questions

   (a) Calculate the:
      (i) Molarity of potassium permanganate.
      (ii) concentration of potassium permanganate in gdm^{-3}.
      (iii) molarity of iron (II) salt.
      (iv) concentration of anhydrous iron (II) salt in gdm^{-3}.

   (b) Find the value of X in the formula $FeSO_4(NH_4)_2SO_4XH_2O$.

2. You are provided with the following:
T1: A solution of 0.02 M KMnO4;
T2: A solution of 0.05 M oxalic acid in 0.5 M H_2SO_4;
Thermometer and stopwatch.

Theory
In an acidic medium, oxalic acid is oxidized by $KMnO_4$. The completion of this reaction is indicated by disappearance of a purple colour of permanganate ion.

Procedure
(i) Fill a 250 or 300 cm^3 beaker with water to about three quarters and then heat the beaker. This is your water bath.
(ii) Measure 10 cm^3 of **T1** and 10 cm^3 of **T2** and put them into separate test tubes.
(iii) Heat the test tube containing **T1** until the temperature is 50°C.
(iv) Pour hot **T1** and **T2** simultaneously into a 50 cm^3 beaker, immediately start a stopwatch and record the time taken for the purple colour to disappear.
(v) Repeat the experiments (ii) to (iv) at the temperatures 60°C, 70°C and 80°C.
(vi) Record your results in tabular form.

Questions
(a) Write half ionic equations for the reaction.

(b) Plot a graph of log t (sec) against 1/T (K^{-1}).

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

3. Sample **U** contains two **cations** and **anions**. Use the information given in the experiment column in Table 1 to complete the observations and inferences columns and hence identify the two cations and anions.

Table 1: Experimental Table

S/n	Experiments	Observations	Inferences
(a)	Put a spatulaful of sample **U** into a boiling tube and add distilled water. Boil the mixture for about 1 minute. Filter or centrifuge the mixture to obtain the residue and a clear solution. Divide the resulting clear solution into two portions. (i) In the first portion, add sodium hydroxide solution till in excess. (ii) In the second portion add dil. HNO_3 followed by $AgNO_3$.		
(b)	To a little quantity of the residue in step (a) add hydrochloric acid.		
(c)	Dilute the resulting solution in step (b) with distilled water and divide the solution into two portions and do the following; (i) To the first portion add dilute sodium hydroxide solution. (ii) To the second portion add dilute ammonia solution.		
(d)	Perform one confirmatory test for each ion.		

Conclusion

The two cations in the sample **U** are _____ and _____: the anions are _____ and _____.