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, 6th May 2015 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, Cr = 52, Mn = 55, Fe = 56, I = 127.
   - Molar gas constant = 8.314 $J\,K^{-1}mol^{-1}$.

1. You are provided with the following:
   - **S**: A solution made by diluting 10.00 cm^3 of 0.50 M standard potassium dichromate solution to exactly 250 cm^3 of water;
   - **Q**: Sodium thiosulphate solution;
   - **A**: Dilute sulphuric acid solution;
   - **B**: Starch solution;
   - **C**: A 10% potassium iodide solution.

Theory

Potassium dichromate reacts quantitatively with acidified potassium iodide and an equivalent amount of iodine is liberated.

The reaction can be represented by the following equations:

$Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$.....(i).

The liberated iodine is titrated with thiosulphate in which the reaction taking place is represented as follows: $2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$.....(ii).

Procedure

(i) Pipette 25 cm^3 of solution **S** into a conical flask. Add 25 cm^3 of solution **C**, then 20 cm^3 of solution **A**.

(ii) Titrate the liberated iodine with solution **Q** until the solution is pale yellow green in colour.

(iii) Add 2 cm^3 of solution **B** and continue titrating until the blue colour just disappears and a pale green colour remains. Record the volume used.

(iv) Repeat procedure (i) to (iii) three times and record your results in a tabular form.

Questions

(a) Calculate the concentration of **S** in moles per dm^3.

(b) Write down the half reaction equations to show the oxidation and reduction processes for the reactions in procedures (i) and (ii).

(c) Calculate the:
   - (i) Molarity of **Q**.
   - (ii) Concentration in g/dm^3 of **Q**.

(d) The orange colouration during the experiment indicates the presence of _____ in solution and the pale green colouration at the end of the experiment indicates the presence of _____ in solution.

2. You are provided with the following:
   - **P_1**: A solution containing 20 g of $Na_2S_2O_3.5H_2O$ in 0.5 dm^3 of solution;
   - **P_2**: A solution of dilute hydrochloric acid;
   - **P_3**: Distilled water;
   - Stop watch.

Procedure

(i) Draw a clear letter "W" on a piece of white paper provided and place a 100 cm^3 beaker on top of the letter "W" in such a way that the letter is visible when viewed from the top.

(ii) Measure 10 cm^3 of **P_1** into a beaker in (i) followed by 2 cm^3 of **P_3**.

(iii) Add 5 cm^3 of $\mathbf{P_2}$ into the solution in (ii) and immediately start the stop watch, Swirl the mixture and record the time taken for the letter "W" to disappear completely.

(iv) Repeat procedures (i) to (iii) using the specifications given in Table 1.

Table 1: Volume of the mixture

S/n	Volume of P_1	Volume of P_2	Volume of P_3
1	10	5	0
2	8	5	2
3	6	5	4
4	4	5	6

(v) Record your results as indicated in Table 2.

Table 2

S/n	T (Sec)	$\frac{1}{t}(Sec^{-1})$	$[P_1]/M$
1			
2			
3			
4			

Questions

(a) Plot a graph of $[\mathbf{P_1}]$ against time, t.

(b) Plot a graph of $\frac{1}{t}$ against $[\mathbf{P_1}]$.

(c) From the graphs in (a) and (b):

(i) What is the effect of concentration of $\mathbf{P_1}$ on the rate of the reaction?

(ii) What is the order of reaction with respect to $\mathbf{P_1}$? Give a reason for your answer.

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

Table 3

S/n	Experiment	Observations	Inference
(a)	Appearance.		
(b)	Heat a little of sample **T** in a dry test tube.		
(c)	Dissolve a little of sample **T** in water and divide the resulting solution into four portions.		
	(i) To one portion add NaOH solution and warm gently.		
	(ii) To the second portion add $AgNO_3$ solution till excess.		
	(iii) To the third portion add few drops of potassium hexacyanoferrate (III).		
	(iv) To the fourth portion add ethanoic acid followed by lead ethanoate solution.		
(d)	To a little sample **T** in a dry test tube, add dilute sodium hydroxide solution.		

Conclusion

(i) The cations in sample **T** are _____ and _____.

(ii) Write the molecular formula of sample **T**.

(iii) Write the reaction equation in experiment (d).