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

132/3A **CHEMISTRY 3A**

ALTERNATIVE A PRACTICAL

(For Both School and Private Candidates)

Time: 3 Hours *2009 February, 11 Wednesday a.m.*

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question **number 1** carries 20 marks and the other **two (2)**, 15 marks each.
4. Non-programmable calculators may be used.
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).

You may use the following:

C=12, H=1, O=16, S=32, Na=23, I=127, K=39, Cr =52,

Molar gas constant, R = 8.314 J $mol^{-1}K^{-1}$

This paper consists of 5 printed pages.

1. You are provided with the following:

MM: A solution made by dissolving 3.25 g of impure potassium chromate (VI), $K_2Cr_2O_7$, in 500 cm^3 of distilled water.

NN: A solution made by dissolving 12.40 g of sodium thiosulphate pentahydrate, $Na_2S_2O_3 . 5H_2O$ in 500 cm^3 of distilled water

PP : 10 % potassium iodide, KI, solution

Starch indicator

1M sulphuric acid

Procedure:

(i) Pipette 20.00 cm^3 (or 25.00 cm^3) of MM into a clean titration flask

(ii) Add to it 20 cm^3 (or 25 cm^3) of sulphuric acid solution

(iii) Add to it 20 cm^3 (or 25 cm^3) of PP

Solution PP in considerably excess amount liberates the iodine according to the equation.

$$Cr_2O_{7(aq)}^{2-} + I_{(aq)}^{-} + H_{(aq)}^{+} \rightarrow Cr_{(aq)}^{3+} + I_{2(aq)} + H_2O_{(\ell)}$$

(iv) Titrate the liberated iodine with NN using starch as an indicator.

Quantitative reaction takes place between iodine and the thiosulphate ion is given by the following equation:

$$I_{2(aq)} + 2S_2O_{3(aq)}^{2-} \rightarrow S_4O_{6(aq)}^{2-} + 2I^{-}(aq)$$

(2 marks)

The end point is when the blue colour of the starch – iodine complex is just replaced by the green colour of Cr^{3+} ions.

(v) Repeat procedures (i) to (iv) to obtain three other readings.

Results:

The volume of the pipette used was _____ cm^3

Burette readings

Titration Number	Pilot	1	2	3
Final volume (cm^3)				
Initial volume (cm^3)				
Volume used (cm^3)				

Summary

_____ cm^3 of MM liberated sufficient iodine required to oxidize _____ cm^3 of NN

Questions:

(a) Write balanced redox equations for:

(i) chromate (VI) reacting with iodine.

(ii) iodine reacting with thiosulphate.

(b) Calculate the molarity of potassium chromate (VI).

(c) Calculate the concentration of $K_2Cr_2O_7$ in g/dm^3.

(d) Calculate the percentage impurity of the chromate salt.

(20 marks)

2. You are provided with the following:

MN: A solution of 0.5 M sodium thiosulphate

PQ: A solution of 0.1 M Nitric acid

A stopwatch

A thermometer (0 – 100 °C)

Theory:

A white precipitate of amorphous sulphur can be obtained by the action of the dilute acid on sodium thiosulphate according to the equation:

$$S_2O_3^{2-}{}_{(aq)} + 2H_3O^+{}_{(aq)} \rightarrow 3H_2O_{(l)} + S_{(s)} + SO_{2(g)}$$

The precipitation of sulphur causes the solution to become opaque. From this phenomenon, you can assess the rate of sulphur precipitation by measuring the time taken for the solution to become totally opaque by the sulphur.

Procedure:

(i) Using a blue/black pen, draw a clear letter X on a white piece of paper and place a small beaker provided on top of the letter X such that the letter is visible through the solution.

(ii) Pour about 200 cm^3 of clear water into a 250 cm^3 beaker (use this as your waterbath).

(iii) Measure out exactly 10.00 cm^3 of MN and 10.00 cm^3 of PQ into separate boiling tubes. Put the two tubes into the waterbath in 2(ii) above, and warm the contents to about 50 °C.

(iv) Immediately pour the hot solutions of MN and PQ in the small beaker in 2(i) above and simultaneously start the stop watch.

(v) Using a glass rod, stir the reaction mixture in 2(iv) above and record the time taken, in second, for the letter X to disappear completely.

(vi) Repeat the whole procedure 2(iii) to 2(v) using temperatures 60 °C, 70 °C and 80 °C and record your readings in tabular form as shown below.

Temperature of Reaction mixture		Time of reaction, t (sec)	$\frac{1}{T}(K^{-1})$	$\frac{1}{t}(sec^{-1})$	$\log\frac{1}{t}(sec^{-1})$
T/°C	T/K				
50					
60					
70					
80					

(a) Plot a graph of $\log\frac{1}{t}(sec^{-1})$ against $\frac{1}{T}(K^{-1})$

(b) Determine the slope of the graph obtained in 2(a) above.

(c) Using the equation $K = Ae^{-Ea/RT}$ which gives a relationship describing the dependence of the rate constant on temperature, determine the value of A and E_a for the given equation using data obtained from 2(b) above.

(15 marks)

3. You are provided with:

V = 0.5 g of succinic acid ($HOOC - CH_2CH_2 - COOH$)

W = 0.2 M sodium hydroxide

X = Diethyl ether

Distilled water

Phenolphthalein indicator (P.O.P)

Procedure:

(i) Fill your burette with solution W.

(ii) Measure 50 cm^3 of distilled water using a measuring cylinder and pour it into a separating funnel.

(iii) Measure 50 cm^3 of diethyl ether and pour into the separating funnel containing 50 cm^3 of distilled water.

(iv) To the same separating funnel add 0.5 g of succinic acid. Close the funnel with a stopper and shake the mixture vigorously to ensure proper mixing.

(v) Allow the liquid in the funnel to settle so that the two layers can separate.

(vi) Tape off the lower aqueous layer into a beaker and from it pipette 25 cm^3 into a clean conical flask. Add P.O.P indicator and titrate it against sodium hydroxide from the burette, until a pink colour is observed.

(a) Volume of NaOH used was ____cm^3.

(b) Write the equation for the reaction between succinic acid and sodium hydroxide.

(c) Calculate the

(i) molarity of succinic acid in the aqueous layer.

(ii) concentration of the acid in 50cm^3 of the aqueous layer.

(iii) concentration of the acid in 50cm^3 of the ether layer.

(iv) partition coefficient of succinic acid between water and diethyl ether at room temperature.

(15 marks)