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

132/3C

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

Time: 3:20 Hours **Tuesday, 17th May 2016 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, Mg = 24, O = 16, S = 32, Na = 23, K = 39, Mn = 55, Cr = 52, I = 127.
   - Molar gas constant = 8.314 J $K^{-1}mol^{-1}$.

1. You are provided with the following:
   - **S**: A solution made by taking 10.00 cm^3 of 0.50 M $K_2Cr_2O_7$ and diluting it to exactly 0.25 dm^3 with distilled water;
   - **R**: 5% KI solution;
   - **B**: 1M H_2SO_4 solution;
   - **T**: Starch solution;
   - **Q**: A solution of sodium thiosulphate.

Theory:
Potassium dichromate reacts quantitatively with acidified potassium iodide to liberate iodine. The reaction can be represented by the following equation:

$Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$.....(1).

The liberated iodine is titrated with sodium thiosulphate and the equation is represented as follows:

$2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$.....(2).

Procedure:

(i) Pipette 20.00 cm^3 or 25 cm^3 of solution **S** into a 250 cm^3 conical flask.
(ii) Add 10.00 cm^3 of solution **R** in the conical flask containing solution **S**.
(iii) Add 20.00 cm^3 of solution **B** in the conical flask containing solution **S**.
(iv) Put solution **Q** in the burette and titrate it against the liberated iodine until the solution becomes pale yellow in colour.
(v) Add 2 – 3 cm^3 of solution **T** in step (iv) above and then continue the titration until the dark blue colour just disappears and a pale green colour appears. Record your titration result in tabular form.
(vi) Repeat step (i) to (v) to obtain three more readings.

Summary:
_____ cm^3 of solution **S** required _____ cm^3 of solution **Q** for complete reaction.

Questions

(a) Write down the half reaction equations to show the oxidation and reduction processes for reactions equation 1 and 2.
(b) For each reaction, identify the oxidant and the reductant. Give a reason for your answer.
(c) Show mole relationship between $Cr_2O_7^{2-}$ and $S_2O_3^{2-}$ ions.
(d) Calculate the concentration of **S** in mol/dm^3 and g/dm^3.
(e) Calculate the concentration of **Q** in mol/dm^3 and g/dm^3.
(f) The pale green colouration at the end of the titration indicates the present of _____ in the solution.

2. You are provided with the following:

K_1: A solution of 0.05 M potassium iodate;
K_2: A solution of 0.1 M of sodium sulphite;
K_3: A solution of 0.1 M sulphuric acid;

- Starch solution;
- Stop watch/clock.

Theory:

When potassium iodate and sodium sulphite are mixed together in acidic medium the following reactions take place.

$IO_3^- + 3HSO_3^- \longrightarrow I^- + 3HSO_4^-$ .....(1)

$5I^- + IO_3^- + 6H^+ \longrightarrow 3I_2 \downarrow + 3H_2O$.....(2)

Reaction (1) is slow and reaction (2) is rapid but does not take place until reaction (1) is complete. Hence presence of iodine indicates the end of reaction (1).

Procedure:

(i) Measure 50 cm^3 of solution **K_1** and pour it into a clean beaker. Add about 2 cm^3 of starch solution and 2.5 cm^3 of **K_3**.

(ii) Measure 50 cm^3 of solution **K_2** and pour it into the beaker containing solution **K_1** and starch in step (i), simultaneously start the stop watch/clock.

(iii) Record the time taken for a dark blue coloration to appear.

(iv) Repeat step (i) to (iii) above using 5 cm^3, 7.5 cm^3, 10 cm^3 of solution **K_3**.

(v) Record your results in a tabular form as shown in Table 1.

Table1

Volume of acid, V, (cm3)	**Time for blue colour to appear, t (sec)**	$\frac{1}{t}(sec^{-1})$

Questions

(a) Plot a graph of reciprocal of time against volume of acid.

(b) Determine the slope of the graph.

(c) If the volume of sulphuric acid is proportional to its concentration in the reaction mixture, suggest the order of reaction with respect to the acid.

(d) What is the rate constant for the reaction?