

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 Hours

Tuesday, 26<sup>th</sup> February, 2013 a.m.

Instructions

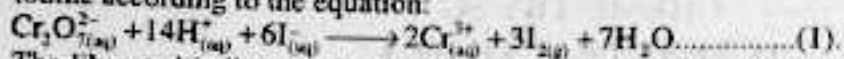
1. This paper consists of **four (4)** questions.
2. Answer **three (3)** questions including question number **one (1)**.
3. Question number **one (1)** carries 20 marks and the other **three (3)**, 15 marks each.
4. Mathematical tables and non programmable calculators may be used.
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. 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, I = 127, Cu = 64.
  - Molar gas constant =  $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ .

1. You are provided with the following:

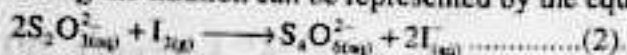
- T<sub>1</sub>: A solution containing 0.65 g of impure potassium dichromate (K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>) in 0.10 dm<sup>3</sup> of distilled water;
- T<sub>2</sub>: A solution made by dissolving 0.04 moles of sodium thiosulphate pentahydrate (Na<sub>2</sub>S<sub>2</sub>O<sub>5</sub>·5H<sub>2</sub>O) in 0.4 dm<sup>3</sup> of distilled water;
- T<sub>3</sub>: 10% potassium iodide solution;
- T<sub>4</sub>: 1M sulphuric acid;
- T<sub>5</sub>: Starch solution.

### Theory

Acidified potassium dichromate reacts quantitatively with potassium iodide solution liberating iodine according to the equation:



The liberated iodine can be titrated against sodium thiosulphate and the reaction taking place during the titration can be represented by the equation:



### Procedure

- (i) Pipette 20 cm<sup>3</sup> or 25 cm<sup>3</sup> of solution T<sub>1</sub> into a clean conical flask.
- (ii) Add 20 cm<sup>3</sup> or 25 cm<sup>3</sup> of solution T<sub>4</sub> followed by 20 cm<sup>3</sup> or 25 cm<sup>3</sup> of solution T<sub>3</sub> and shake the mixture.
- (iii) Immediately titrate the mixture against solution T<sub>2</sub> from the burette until the solution becomes pale yellow.
- (iv) Add about 2 cm<sup>3</sup> of solution T<sub>5</sub> and continue titrating until a green colour appears.
- (v) Repeat procedures (i) to (iv) three times and record your data in a tabular form.

### Questions

- (a) Calculate the concentration of T<sub>2</sub> in moldm<sup>-3</sup>.
- (b) Calculate the concentration of pure potassium dichromate in
  - (i) moldm<sup>-3</sup>
  - (ii) gdm<sup>-3</sup>.
- (c) Find the percentage purity of potassium dichromate.
- (d) Write down the half reactions for the reaction equations (1) and (2) above.

2. You are provided with the following:

- A<sub>1</sub>: Distilled water;
- A<sub>2</sub>: 4 g anhydrous copper (II) sulphate (CuSO<sub>4</sub>);
- A<sub>3</sub>: 6 g copper (II) sulphate pentahydrate (CuSO<sub>4</sub>·5H<sub>2</sub>O);
- Thermometer and Stirrer;
- Cotton wool.

### Procedure

- (i) Take 100 ml beaker and put it into a 250 cm<sup>3</sup> beaker. Fill the space between using cotton wool as an insulator.
- (ii) Pour 50 cm<sup>3</sup> of A<sub>1</sub> into a 100 cm<sup>3</sup> beaker in (i).
- (iii) Stir the water and record the temperature, T<sub>1</sub>.
- (iv) Add A<sub>2</sub> into a beaker containing water. Stir gently until dissolution is complete.
- (v) Record the final temperature of the solution, T<sub>2</sub>.
- (vi) Clean and dry the beaker, stirrer and thermometer. Then repeat steps (i) to (v) using A<sub>3</sub>.
- (vii) Record your results in a tabular form as indicated in Table 1.

Table 1

Salt	Volume of water (cm <sup>3</sup> )	Mass of salt (g)	Initial temp. of water T <sub>1</sub> (°C)	Final temp. of solution T <sub>2</sub> (°C)	Tempe. Change T = T <sub>2</sub> - T <sub>1</sub> (°C)	Molecular weight of salt (Mr)
A <sub>2</sub>						
A <sub>3</sub>						

**Questions**

- (a) Find the temperature change  $T = T_2 - T_1$  in each experiment.
- (b) Calculate the enthalpy of solution of each salt, given that the specific heat of water is  $4.18 \text{ Jg}^{-1}\text{K}^{-1}$  and the density of salt water is  $1 \text{ g cm}^{-3}$ .
- (c) Accepted values for these two experiments are :  $\Delta H_{\text{solution}}^{\circ}(\text{CuSO}_4) = -66.10 \text{ kJmol}^{-1}$  and  $\Delta H_{\text{solution}}^{\circ}(\text{CuSO}_4 \cdot 5\text{H}_2\text{O}) = +11.30 \text{ kJmol}^{-1}$ . How the calculated enthalpies of each salt differ from the expected values? Give reasons.
3. You are provided with the following:
- JJ:** A solution of succinic acid in water;  
**PP:** 0.2 M sodium hydroxide;  
**SS:** Phenolphthalein indicator;  
**OO:** Diethyl ether.

**Theory**

Ether and water are immiscible, when succinic acid is dissolved, it will distribute itself in the two liquids in such a way that  $\frac{\text{concentration of succinic acid in water}}{\text{concentration of succinic acid in ether}} = \text{constant}$ .

In this experiment you are required to determine the partition coefficient of succinic acid between water and diethyl ether at room temperature.

**Procedure****Part 1**

- Pipette  $20 \text{ cm}^3$  or  $25 \text{ cm}^3$  of **JJ** into a clean conical flask and add two drops of **SS**.
- Put **PP** into the burette and titrate it against **JJ** until colour change is observed. A single accurate titration is enough.

**Summary**

\_\_\_\_\_  $\text{cm}^3$  of solution **JJ** required \_\_\_\_\_  $\text{cm}^3$  of **PP** for complete reaction.

**Part 2**

- Using a measuring cylinder measure  $50 \text{ cm}^3$  of **OO** and transfer it into a separating funnel.
- Measure  $50 \text{ cm}^3$  of **JJ** and transfer it into a separating funnel containing **OO** and then shake well. Leave the mixture to stand for about 3 minutes.
- Run the lower layer (aqueous layer) into a clean beaker. Measure  $20 \text{ cm}^3$  or  $25 \text{ cm}^3$  of the aqueous layer into a conical flask. Add to it two drops of **SS**.
- Put **PP** into a burette and titrate it against the aqueous layer in a conical flask until there is a colour change. Record the volume of **PP** used. A single accurate titration is enough.

### Summary

\_\_\_\_\_ cm<sup>3</sup> of JJ required \_\_\_\_\_ cm<sup>3</sup> of PP for complete reaction.

### Questions

- (a) The colour of the solution during titration changed from \_\_\_\_\_ to \_\_\_\_\_.
- (b) Write down the equation for the reaction between JJ and PP.
- (c) Calculate the
- concentration of JJ before it was mixed with OO in g/dm<sup>3</sup>.
  - concentration of JJ in water after mixed with OO in g/dm<sup>3</sup>.
  - concentration of JJ in ether in g/dm<sup>3</sup>.
  - partition coefficient of succinic acid between water and ether at the temperature of the experiment.
4. Substance M contains a common cation and two anions. Use the information given in the experiment column in Table 2 to complete the observations and inferences and hence identify the common cation and the two anions.

Table 2

S/n	Experiment	Observations	Inferences
1	Appearance.		
2	Perform flame test.		
3	To a little sample M, add Conc. H <sub>2</sub> SO <sub>4</sub> and warm gently.		
4	Prepare a solution of M and divide it into four portions.		
	(i) In the first portion add AgNO <sub>3</sub> solution to excess.		
	(ii) In the second portion add fresh FeSO <sub>4</sub> solution followed by concentrated sulphuric acid added slowly through the side of the test tube.		
	(iii) In the third portion add BaCl <sub>2</sub> solution.		
	(iv) In the last portion add aqueous ammonia till excess.		
5	Perform two confirmatory tests for the cation.		

### Conclusion

The cation in the sample M is \_\_\_\_\_ and the anions are \_\_\_\_\_ and \_\_\_\_\_.