

**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, 26th February, 2013 a.m.

Instructions

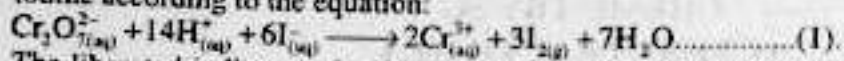
1. This paper consists of **four (4)** questions.
2. Answer **three (3)** questions including question number **one (1)**.
3. Question number **one (1)** carries 20 marks and the other **three (3)**, 15 marks each.
4. Mathematical tables and non programmable calculators may be used.
5. Cellular phones 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:

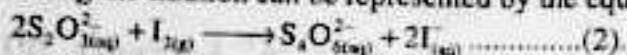
- T₁: A solution containing 0.65 g of impure potassium dichromate (K₂Cr₂O₇) in 0.10 dm³ of distilled water;
- T₂: A solution made by dissolving 0.04 moles of sodium thiosulphate pentahydrate (Na₂S₂O₃·5H₂O) in 0.4 dm³ of distilled water;
- T₃: 10% potassium iodide solution;
- T₄: 1M sulphuric acid;
- T₅: 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 cm³ or 25 cm³ of solution T₁ into a clean conical flask.
- (ii) Add 20 cm³ or 25 cm³ of solution T₄ followed by 20 cm³ or 25 cm³ of solution T₃ and shake the mixture.
- (iii) Immediately titrate the mixture against solution T₂ from the burette until the solution becomes pale yellow.
- (iv) Add about 2 cm³ of solution T₅ 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 T₁ in moldm⁻³.
- (b) Calculate the concentration of pure potassium dichromate in
 - (i) moldm⁻³
 - (ii) gdm⁻³.
- (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:

- A₁: Distilled water;
- A₂: 4 g anhydrous copper (II) sulphate (CuSO₄);
- A₃: 6 g copper (II) sulphate pentahydrate (CuSO₄·5H₂O);
- Thermometer and Stirrer;
- Cotton wool.

Procedure

- (i) Take 100 ml beaker and put it into a 250 cm³ beaker. Fill the space between using cotton wool as an insulator.
- (ii) Pour 50 cm³ of A₁ into a 100 cm³ beaker in (i).
- (iii) Stir the water and record the temperature, T₁.
- (iv) Add A₂ into a beaker containing water. Stir gently until dissolution is complete.
- (v) Record the final temperature of the solution, T₂.
- (vi) Clean and dry the beaker, stirrer and thermometer. Then repeat steps (i) to (v) using A₃.
- (vii) Record your results in a tabular form as indicated in Table 1.

Table 1

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

Questions

- Find the temperature change $T = T_2 - T_1$ in each experiment.
 - 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 g cm^{-3} .
 - 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 cm^3 or 25 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

_____ cm^3 of solution JJ required _____ cm^3 of PP for complete reaction.

Part 2

- Using a measuring cylinder measure 50 cm^3 of OO and transfer it into a separating funnel.
- Measure 50 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 cm^3 or 25 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

_____ cm³ of JJ required _____ cm³ 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/dm³.
 - concentration of JJ in water after mixed with OO in g/dm³.
 - concentration of JJ in ether in g/dm³.
 - 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 ₂ SO ₄ and warm gently.		
4	Prepare a solution of M and divide it into four portions.		
	(i) In the first portion add AgNO ₃ solution to excess.		
	(ii) In the second portion add fresh FeSO ₄ solution followed by concentrated sulphuric acid added slowly through the side of the test tube.		
	(iii) In the third portion add BaCl ₂ 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 _____.