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 Hours **Friday, 10th February 2012 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, Cl= 35.5, Na = 23, K = 39, Mn = 55, Fe = 56, I = 127, Cu = 64, Ca = 40, Pb = 207
   - Molar gas constant = 8.314 $Jmol^{-1}K^{-1}$

1. **You are provided with the following solutions:**

RR: **A** solution containing 1.48 g of a mixture of sodium carbonate and sodium bicarbonate in 0.25 dm^3 of aqueous solution;

SS: **A** solution containing 1.46 g of pure hydrochloric acid in 0.4 dm^3 of aqueous solution;

MO: Methyl orange indicator;

POP: Phenolphthalein indicator.

Procedure

(i) Pipette 20 cm^3 or 25 cm^3 of solution **RR** into a 250 cm^3 titration flask.

(ii) Add two drops of **POP**.

(iii) Titrate this solution against solution **SS** until a colour change is observed.

(iv) Record the first titre value.

(v) Add **MO** to the same solution.

(vi) Continue to titrate until a second colour change is observed.

(vii) Record the second titre value.

(viii) Repeat your titration procedures (i) to (vii) above three times and record your results in a tabular form.

Summary

_____ cm^3 of solution **RR** required _____ cm^3 of solution **SS** when **POP** was used as indicator and _____ cm^3 of solution **SS** when **MO** was used as indicator.

Questions

(a) The colour changes during titrations were:

(i) From _____ to _____ when **POP** was used.

(ii) From _____ to _____ when **MO** was used.

(b) Calculate the concentration of solution **SS** in moles per litre.

(c) Indicate the chemical equation that is appropriate to the titre value found in:

(i) 1st titre value.

(ii) 2nd titre value.

(d) Calculate the concentration of solution **RR** in moles per litre when;

(i) **POP** was used as the indicator.

(ii) **MO** was used as the indicator.

(e) Calculate the percentage of sodium carbonate in the mixture **RR**.

2. You are provided with the following:
DD: 2 g of anhydrous copper (II) sulphate;
EE: 3 g of hydrated copper (II) sulphate;
Stop watch;
Thermometer;
Cotton wool.

Theory
The dissolution of a salt in water is generally accompanied by a notable enthalpy change. It is possible to estimate the enthalpy change of solution of various salts by dissolving small known amounts of various salts in a known volume of water and then recording the temperature change.

Procedure
(i) Take 100 ml beaker and put it into a 250 ml beaker. Fill the space between using cotton wool as an insulator.
(ii) Transfer 50 cm^3 of distilled water by using a measuring cylinder into 100 cm^3 beaker in (i) and then record the temperature of the water.
(iii) Add **DD** into the water and immediately start a stopwatch while stirring gently to facilitate the dissolution of the salt. Record the temperature at half minute interval for five minutes.
(iv) Record your readings in a tabular form as indicated below.
(v) Repeat steps (i) to (iii) above with salt **EE**.

Results
Temperature of cold water_____ cm^3.

Salt	Temperature of solution (°C)									
	½ min	1 min	1½ min	2 min	2½ min	3 min	3½ min	4 min	4½ min	5 min
DD										
EE										

Questions
(a) (i) Draw a graph of temperature versus time for each solution on the same graph paper.
(ii) Use the graphs to determine the temperature of each solution at the instant of its formation.

(b) State whether the process of dissolving **DD** and **EE** is endothermic or exothermic.

(c) Calculate the heat of solution when,
(i) 2 g of **DD** dissolve in water.
(ii) 3 g of **EE** dissolve in water.
Given that, the specific heat capacity of water is 4.18JgK^{-1} and the density of salt water is 1 g cm^{-3}

(d) Calculate the molar heat of solution of each salt.

(e) Explain the difference in molar heat of solution of the hydrated and anhydrous salt in terms of lattice energy and hydration energy.

3. Your are provided with the following:
L_1: 0.1 M sodium hydroxide;
L_2: Succinic acid of unknown concentration;
L_3: Isobutyl alcohol;
POP: Phenolphthalein indicator;
Distilled water.

Theory
Succinic acid () dissolves in both water and isobutyl alcohol in a constant ratio at constant temperature.

Procedure 1
(i) Pipette 20 cm^3 or 25 cm^3 of **L_2** into a clean conical flask. Add 2 or 3 drops of **POP**.
(ii) Put **L_1** in the burette.
(iii) Titrate **L_1** against **L_2** in the presence of **POP** until colour change is observed.
(iv) Record the volume of **L_1** used as well as the room temperature.

Summary 1
Volume of the pipette used _____ cm^3.
Volume of **L_1** used _____ cm^3.
Room temperature _____ °C.

Procedure 2
(i) Place 50 cm^3 of **L_3** into a separating funnel. Add to it 50 cm^3 of water.
(ii) Measure 50 cm^3 of **L_2** using a measuring cylinder and put it into a separating funnel in (i) above. Shake the mixture well.
(iii) Run off the lower aqueous layer into a clean beaker.
(iv) Measure 20 cm^3 or 25 cm^3 of the aqueous layer into a clean conical flask.
(v) Titrate carefully this aliquot against **L_1**.

Summary 2
Volume of the aqueous layer used was _____ cm^3.
Volume of L_1 used was _____ cm^3.

Questions
(a) Write a balanced chemical equation representing the reaction taking place in the titration.

(b) Calculate
(i) The initial concentration of **L_2** in water.

(ii) The final concentration of L_2 in the aqueous layer.
(iii) The acid concentration in the organic layer.

(c) Calculate the partition coefficient of L_2 between water and isobutyl alcohol.

4. Using systematic qualitative analysis methods identify **two cations** and **one anion** in the mixture **B** provided. Record carefully all your procedures, observations and inferences in a tabular form as shown below.

Table of results

S/n	Experiment	Observations	Inferences