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 **Wednesday, 09th February 2011 a.m.**

INSTRUCTIONS

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question number **one (1)** carries 20 marks and the other **two**, 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).
7. You may use the following constants:
   Atomic masses: H = 1, C = 12, O = 16, Na = 23,
   S = 32, K = 39, Mn = 55, Cu = 63.5.

This paper consists of 4 printed pages.

1. You are provided with the following solutions:

KO: Solution containing 3.35 g of pure sodium oxalate in 0.50 dm^3 of solution.

DM: Solution containing 3.20 g of impure potassium permanganate in 1 dm^3 of solution.

GS: 3M sulphuric acid.

Theory:

An acidified oxalate solution warmed at 70°C - 80°C is titrated against permanganate solution. From the titration results, the purity of the potassium permanganate can be calculated.

In acid solution, oxalate ions react quantitatively with permanganate ions as represented by the equation.

$$5C_2O_4^{-2} + 2MnO_4 + 16H^+ \rightarrow 2Mn^{-2} + 10CO_2 + 8H_2O$$

Procedure:

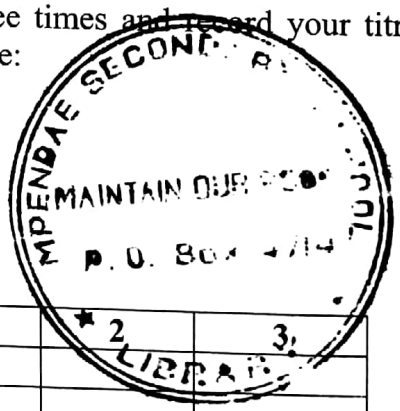
(i) Pipette 25 cm^3 or 20 cm^3 of solution KO into a 250 cm^3 titration flask.

(ii) Add 60 cm^3 of solution GS.

(iii) Heat the mixture to about 80°C.

(iv) Titrate the hot solution with the permanganate solution DM until complete colour change is observed.

(v) Repeat your titration procedure (i) to (iv) three times and record your titration results in a tabular form as in the following table:



Results:

The volume of the pipette used was_____cm^3.

Burette readings:

Titration numbers	Pilot	1	2	3
Final readings (cm^3)				
Initial readings (cm^3)				
Titre (volume used) cm^3				

Summary:

_____ cm^3 of solution KO require _____ cm^3 of solution DM for completion of the reaction.

Questions:

(a) Calculate the concentration of KO in moles per litre (dm^3).

(b) Calculate the concentration of solution DM in
  (i) moles per litre
  (ii) grams per dm^3.

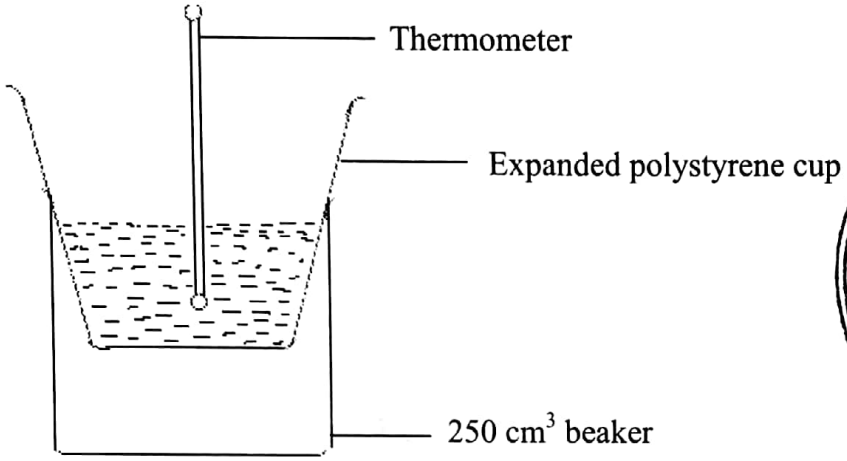
(c) Calculate the percentage purity of potassium permanganate.

(d) Give the half reaction equations for the above reaction and indicate which of the species are oxidized or reduced.

(20 marks)

2. You are provided with the following:
PQ: 1.6 g of anhydrous copper sulphate.
MQ: 2.5 g of hydrated copper sulphate ($CuSO_4.5H_2O$).

Procedure:
(a) Set up the apparatus as shown in the following figure.



(b) Pour 50 cm^3 of distilled water into the polystyrene cup and measure its temperature.
(c) Tip the solid PQ of about 1.6 g provided on a watch glass into the water and stir gently with a thermometer until dissolution is complete.
(d) Note the maximum temperature reached T.
(e) Repeat the above experiment using about 2.5 g of MQ provided on a watch glass in place of PQ.

Results:

Sample	Temperature T°C
PQ	
MQ	

N.B: Assume that the densities and specific heat capacities of the solutions are the same as those of water and that the salts and water were both at the same temperature at the beginning of the experiment. Specific heat capacity of water is 4.2 $Jg^{-1} K^{-1}$.

Questions:
(a) Calculate the enthalpy of solution of the two forms of the salt PQ and MQ.
(b) Explain the difference in the values of enthalpy of solution obtained for the two forms of the salt. **(15 marks)**

3. You are provided with the following:
W_1: 0.1M sodium hydroxide.
W_2: Solution of succinic acid.
W_3: Phenolphthlaien indicator.
W_4: Diethyl ether.

Theory
At constant temperature succinic acid dissolves in both water and diethyl ether while maintaining a constant ratio of concentration in solvents under consideration.

Procedure 1
(i) Pipette 25 cm^3 or 20 cm^3 of W_2 into a clean conical flask. Add to it 2-3 drops of W_3.
(ii) Put W_1 into the burette.
(iii) Titrate very carefully solution W_2 against W_1 till there is a colour change. Record the volume of W_1 used.

(a) **Results**
(i) The volume of p pette used was _____ cm^3.
(ii) Volume of W_1 used was _____ cm^3.

Procedure 2
(i) Measure 100 cm^3 of W_4 using a measuring cylinder and place it into a separating funnel.
(ii) Add 100 cm^3 of W_2 by means of measuring cylinder into the funnel in (i) above, shake well and allow the system to stand for a few minutes.
(iii) Run off the aqueous layer into a clean beaker. Using measuring cylinder put 25 cm^3 of the aqueous layer into a clean conical flask. Titrate very careful this aliquot against W_1 using W_3 as an indicator. Record the volume of W_1 used.

(b) **Results**
(i) Volume of aqueous layer taken was _____ cm^3.
(ii) Volume of W_1 used was _____ cm^3.

(c) Write a balanced chemical equation representing the reaction taking place in procedures (1) and (2) above.

(d) Calculate the following:
(i) initial concentration of W_2 in water before mixing.
(ii) final concentration of W_2 in the aqueous layer.

(e) Deduce the concentration of W_2 in the organic layer.

(f) Calculate the partition coefficient of W_2 between water and diethyl ether W_4, i.e

$$Kd = \frac{\text{Concentration of } W_2 \text{ in aqueous layer}}{\text{Concentration of } W_2 \text{ in ether layer}}$$

(15 marks)