2915/106
ANALYTICAL CHEMISTRY I
PRACTICE
Oct./Nov. 2022
Time: 4 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE I

ANALYTICAL CHEMISTRY I PRACTICE

4 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
A battery operated calculator.
*This paper consists of **THREE** questions.*
*Answer **ALL** questions in the answer booklet provided.*
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 8 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. **Question 1** (50 marks)

(a) You are provided with the following:

- 1 g of KIO_3 (AR)
- Five $250\,cm^3$ conical flasks
- 2 M KI acidified
- Sodium thiosulphate solution
- $25.00\,cm^3$ pipette
- $50.00\,cm^3$ burette
- Solution of $Cu^{2+}_{(aq)}$ from a metal ore in $250\,cm^3$ volumetric flask
- $200\,cm^3$ graduated measuring cylinder

(b) You are required to:

(i) Standardise the sodium thiosulphate solution.
(ii) Determine the amount of copper in a given mass of copper ore.

(c) **Proceed as follows:**

Part I

(i) Measure 200 cm^3 of the acidified 2 M $KI_{(aq)}$ and transfer into a 250 cm^3 conical flask.

(ii) Add the 1 g of AR KIO_3 into the 2 M $KI_{(aq)}$ solution while in a fume chamber and shake to homogenise.

(iii) Pipette $25.00\,cm^3$ of the reaction mixture and transfer into a 250 cm^3 conical flask.

(iv) Fill the burette with the sodium thiosulphate solution

(v) Titrate the reaction mixture with the sodium thiosulphate solution until the reaction mixture turns colourless.

(vi) Repeat the experiment three more times and tabulate the results. (9 marks)

(vii) Calculate the molarity of the sodium thiosulphate solution. (K = 39, I = 127, O = 16) (15 marks)

(d) **Part II**

(i) Measure 25.00 cm^3 of the digested copper (II) ore into a 250 cm^3 conical flask and add 50 cm^3 of the acidified KI and shake to form an homogenous solution.

(ii) Write an ionic equation for the reaction that takes place between $Cu^{2+}_{(aq)}$ and $I^-_{(aq)}$. (2 marks)

(iii) Titrate the reaction mixture with standardised sodium thiosulphate from the burette until the reaction mixture turns colourless. Repeat the experiment three more times and tabulate the results. (9 marks)

(iv) If 2 g of the metal ore malchite ($CuCO_3.Cu(OH)_2$) was digested into a 250 cm^3 volumetric flask calculate the %w/w of copper in the crude metal ore. (CU = 64.586) (13 marks)

(v) State two functions of acidified KI in these experiments. (2 marks)

Question 2 (20 marks)

(a) You are provided with the following:

- 100 cm^3 measuring cylinder
- A sample of hard water
- 0.01M EDTA solution
- Buffer of pH 10
- De-ionized water
- Eriochrome black T indicator
- 25 cm^3 pipette and burette

(b) You are required to determine the water hardness as ppm_{caco_3}

(c) **Proceed as follows:**

(i) Pipette 25.00 cm^3 of the hard water sample into a clean conical flask and dilute with de-ionied water upto 50 cm^3.

(ii) Add about 1.00 cm^3 of the buffer solution followed by 3 drops of the metal-ion indicator, eriochrome black T.

(iii) Titrate the hard water sample with the EDTA solution.

(iv) Titrate hard water sample with the EDTA from a burette until colour changes from wine red to sky blue. Repeat the experiment three more time and table the results.

(9 marks)

(v) Express the concentration of the total water hardness as ppm_{caco_3}.
(Ca = 40, C = 12, O = 16) (11 marks)

3. **Question 3** (20 marks)

(a) You are provided with the following:

- 4 (four) labelled test tubes containing solids **A, B, C** and **D**.
- 4 (four) stoppers with delivery tubes
- Test tube rack
- Lime water (12 ml)
- Measuring cylinder (5 ml)
- Stopwatch
- Bunsen burner
- Platinum wire
- 10 empty test tubes
- 6 ml concentrated HCl
- Beaker for waste concentrated HCl
- 2 g of solid **A, B, C** and **D** in weigh boats

(b) You are required to:

(i) Identify the cations in solids **A, B, C** and **D**.

(ii) Identify the carbonates of S - block elements (group I and II).

(iii) Estimate the order of thermal stability of the S - block carbonates.

Part I

(i) Place the labelled 6 (six) test tubes in the test tube rack.
(ii) For the test tube containing solid carbonate A, set up the apparatus as shown in figure 1.

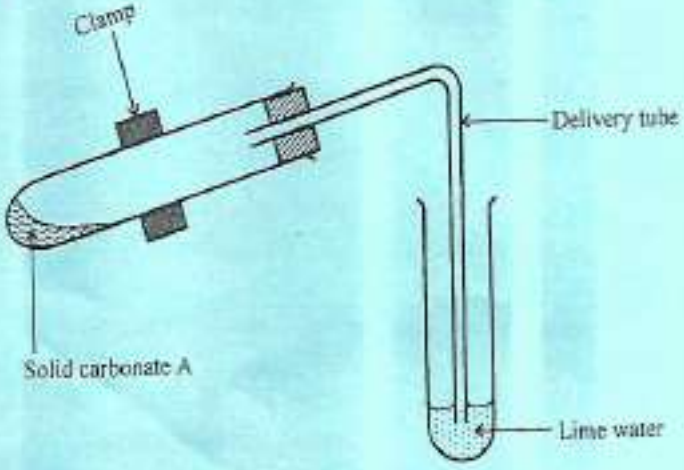

Fig. 1

(iii) Begin by heating the solid carbonate A and immediately start the stopwatch. Make sure the end of the test tube is held directly above the blue cone of the Bunsen burner flame.

(iv) Stop the stopwatch and note the time for the lime water to just turn milky, if it does at all. Record the observation in table 4

(v) Lift the delivery tube out of the lime water before removing the flame to prevent the lime water from being sucked back into the test tube.

(vi) Repeat steps (ii) - (v) for solid carbonate B, C and D making sure the tube height and the flame size are the same for each compound. Record your observations in table I .

Table I

Carbonate	Time to detect CO_2	Observations	Inference
Solid **A**			
Solid **B**			
Solid **C**			
Solid **D**			

(4 marks)

Part II

(i) Clean the platinum wire by dipping it in concentrated HCl in a test tube and holding it in the hot Bunsen flame.

(ii) Repeat until the wire produces no colour in the flame.

(iii) Dip the platinum wire into a second test tube containing concentrated HCl and then dip the wire into a weight boat containing solid A so that the solid sticks to the platinum wire.

(iv) Place the platinum wire back in the flame and note the colour imparted on the flame.

(v) Record the observations as in table **II**

Table II

Solid	Observation	Inference
A		
B		
C		
D		

(4 marks)

(vi) Identify the carbonates using results from parts **I** and **II** as in table **III**.

Table III

Carbonate	Identify
A	
B	
C	
D	

(4 marks)

(vii) Arrange the carbonate in order of thermal stability.

(viii) Indicate where sodium carbonate (Na_2CO_3) would be placed in the order of thermal stability in (vii). (1 mark)

4. (a) You are provided with the following:

- liquid A
- liquid B
- Blue litmus paper
- Red litmus paper
- Wooden splint
- 0.5 magnesium powder
- 0.5 g anhydrous sodium carbonate
- Bromine water
- Beakers
- Boiling tubes in a rack
- Distilled water

(b) You are required to perform the following experiments:

	Solid	Observation	Inference
(a)	(i) Dissolve 3 ml of liquid A in 5 ml of distilled water in a test tube	$(\frac{1}{2}$ mk$)$	$(\frac{1}{2}$ mk$)$
	(ii) Dissolve 3 ml of liquid B in 5 ml of distilled water in a test tube	$(\frac{1}{2}$ mk$)$	$(\frac{1}{2}$ mk$)$
(b)	(i) Put 3 ml of liquid: (i) A in a test tube. (ii) B in a test tube Test each liquid with: (I) blue litmus paper	(1 mk)	$(\frac{1}{2}$ mk$)$
	(II) red litmus paper	(1 mk)	$(\frac{1}{2}$ mk$)$
(c)	(i) Put 5 ml of compound A in a test tube - Add 0.5 g of sodium carbonate. Shake the mixture		
	(ii) Put 5 ml of compound B in a test tube. Put 0.5 g of sodium carbonate. Shake the mixture.	$(\frac{1}{2}$ mk$)$	$(\frac{1}{2}$ mk$)$
(d)	(i) Put 5 ml of compound A in a test tube. Add 0.5 g magnesium powder. Test any gas with a lighted splint.	$(\frac{1}{2}$ mk$)$	$(\frac{1}{2}$ mk$)$
	(ii) Put 5 ml of compound B in a test tube. Add 0.5 g of magnesium powder. Test any gas with a lighted splint.	$(\frac{1}{2}$ mk$)$	$(\frac{1}{2}$ mk$)$

	Solid	Observation	Inference
(e)	(i) Put 3 ml of compound A in a test tube. - Add three drops of bromine water. (ii) Put 3 ml of compound B in a test tube. Add three drops of bromine water.	($\frac{1}{2}$ mk)	($\frac{1}{2}$ mk)

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