CHEMISTRY
PAPER 3
FORM THREE
END OF YEAR EXAM – 2025
TIME: 1 ¾ HOURS

1. **You are provided with:**
   - Dilute hydrochloric acid labeled A
   - Solution B containing 3.15g of dibasic acid $H_2C_2O4.2H_2O$ dissolved to form $500cm^3$ of solution.
   - Sodium hydroxide solution labeled as solution C.

You are required to:
- Standardize the sodium hydroxide solution C.
– Use the standardized solution C to determine the concentration of solution A.

Procedure:
(i) Place solution B in a clean burette.
(ii) Using a pipette and a pipette filler, place $25cm^3$ of solution C into a conical flask and add two drops of phenolphthalein indicator. Titrate with solution B and record your results in table 1.

Table 1
Volume of pipette used = **$25.0cm^3$** (1 mk)

	I	II	III
Final burette reading (cm^3)	**25.0**	**25.0**	**25.3**
Initial burette reading (cm^3)	**0.0**	**0.0**	**0.0**
Volume of solution B used (cm^3)	**25.0**	**25.0**	**25.3**

(4 mks)=5

(a) Calculate the:
(i) Average volume of solution B used. (1 mk)=6

Average volume = $\frac{25.0 + 25.0}{2}$ = $25.0cm^3$

(ii) Concentration of the dibasic solution B in moles per litre. (H = 1, O = 16, C =12) (4 mks)=10

RFM of H2C2O4.2H2O = (1x2) + (12 x 2) + (16 x4) + (2 x 18)
3.15g – $500cm^3$
? - 1000cm3
$\frac{1000 \times 3.15}{500}$ = 6.3g
Molarity = $\frac{6.3}{126}$
= 0.05M

(iii) Concentration of the sodium hydroxide solution C in moles. (4 mks)=14

$2NaOH_{(aq)} + H_2X_{(aq)} \rightarrow Na_2X_{(aq)} + 2H_2O$

where H_2X is the dibasic acid.

Number of moles of solution B = $\frac{25 \times 0.05}{1000}$

Moles of NaOH = 2 x 0.00125 = 0.0025 moles = 0.00125moles

0.0025 moles **25cm^3**

? moles **1000cm^3** $\frac{1000 \times 0.0025}{25} = \underline{0.1M}$

Procedure II:

(i) Using a clean measuring cylinder, measure 25cm^3 of solution A and transfer into 250ml volumetric flask.
(ii) Use distilled water to top up the solution in the volumetric flask to the mark.
(iii) Mix the solution well and label it a solution K.
(v) Clean the burette and place solution K.
(v) Using a pipette and pipette filler, place 25cm^3 of solution C into a conical flask and add two drops of phenolphthalein indicator.
(vi) Titrate the concentration in the conical flask with solution K. Record the results in table 2. Repeat the titration two more times and record your results.

TABLE 2

Volume of pipette used = **25cm^3** (1 mk)=15

	I	II	III
Final burette reading (cm^3)	**25.1**	**25.0**	**24.9**
Initial burette reading	**0.0**	**0.0**	**0.0**
Volume of solution K used (cm^3)	**25.1**	**25.0**	**24.9**

(4 mks)

(a) What is the average volume of solution K used? (1 mk)=16

Average volume = $\frac{25.1 + 25.0 + 24.9}{3} = \underline{25.0cm^3}$

(b) Calculate the concentration of solution K in moles per litre. (4 mks) =20

HCl(aq) + NaOH(aq) → NaCl(aq) + H2O(l)

Moles of NaOH used = $\frac{25 \times 0.1}{1000}$ **= 0.0025 moles**

Moles of HCl (solution K) **0.0025 (mole ratio = 1:1)**

Molarity of solution K = $\frac{1000 \times 0.0025}{25}$ **= 0.1M**

(c) Determine the concentration of solution A in moles per litre. (3 mks)=23

$M_1V_1 = M_2V_2$

$X \times 25 = 250 \times 0.1$

$X = \frac{250 \times 0.1}{25} = \underline{1.0M}$

2. You are provided with solid D. Carry out the tests below and record your observations and inferences in the spaces provided.

(a) Place solid D in a boiling tube. Add about 8cm3 of distilled water to dissolve the solid. Divide the solution into four portions. (3 mks)=26

Observations	Inferences

A colourless solution is formed	**CU^{2+}, Fe^{2+}, Fe^{3+} absent (Polar substance**

(b) To the first portion, add aqeous sodium hydroxide dropwise until in excess. (3 mks)=29

Observations	Inferences
White precipitate soluble in excess	**Zn^{2+}, Al^{3+}, Pb^{2+} present**

(c) To the second portion, add aqeous ammonia dropwise until in excess. (2 mks)=31

Observations	Inferences
White precipitate soluble in excess	**Zn^{2+} present (confirmed present**

(d) To the third portion, add barium chloride solution (3 mks)=34

Observations	Inferences
A white precipitate is formed	**SO_4^{2-}, SO_3^{2}-, CO_3^{2-} present**

(e) To the fourth portion, add acidified lead (II) nitrate solution. (2 mks)=36

Observations	Inferences
A white precipitate is formed.	**SO_4^{2-} (confirmed present).**

Solid B is Zinc Sulphate.