TITRATION NO. 2

Quantitative Analysis

Read through the whole method before starting any practical work. Where appropriate, prepare a table for your results in the space provided.

Show your working and appropriate significant figures in the final answer to **each** step of your calculations.

Acids are defined as substances that can donate hydrogen ions, H^+, to bases. Monoprotic acids contain one H^+ that can be donated per molecule. Diprotic acids contain two H^+ that can be donated per molecule.

You will determine by a titration method whether acid **Z** is monoprotic or diprotic.

FA 1 is a solution containing 6.10 g dm^{-3} of acid **Z**.
FA 2 is 0.105 mol dm^{-3} aqueous sodium hydroxide, NaOH.
methyl orange indicator

(a) Method

- Pipette 25.0 cm^3 of **FA 1** into a conical flask.
- Fill a burette with **FA 2**.
- Add several drops of methyl orange indicator to the conical flask.
- Carry out a rough titration and record your burette readings in the space below.

final burette reading / cm^3	26.90
initial burette reading / cm^3	0.40
titre / cm^3	26.50

The rough titre is ....26.50........ cm^3.

- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make sure any recorded results show the accuracy of your practical work.
- Record, in a suitable form below, all of your burette readings and the volume of **FA 2** added in each accurate titration.

final burette reading / cm^3	31.70	41.70	32.50
initial burette reading / cm^3	5.40	15.60	6.30
titre / cm^3	26.30	26.10	26.20
best titre		✓	✓

I	
II	
III	
IV	
V	
VI	
VII	

[7]

(b) From your accurate titration results, obtain a suitable value for the volume of **FA 2** to be used in your calculations. Show clearly how you obtained this value.

$\frac{26.10 + 26.20}{2}$

25.0 cm^3 of **FA 1** required ....26.15.......... cm^3 of **FA 2**. [1]

(c) Calculations

(i) Calculate the number of moles of sodium hydroxide present in the volume of **FA 2** calculated in **(b)**.

$n = CV$

$= 0.105 \times \frac{26.10}{1000}$

moles of NaOH = ...2.74×10^{-3}.......... mol

Then deduce the number of moles of H^+ present in 25.0 cm^3 of **FA 1**.

$H^+ : OH^-$
$1 : 1$

2.74×10^{-3} mol

moles of H^+ in 25.0 cm^3 of **FA 1** = ...2.74×10^{-3}.......... mol
[1]

(ii) Calculate the number of moles of H^+ present in 1 dm^3 of **FA 1**.

$\frac{25.0}{1000}$ dm^3 — 2.74×10^{-3} mol

1 dm^3 — x

moles of H^+ in 1 dm^3 of **FA 1** = ...0.110.......... mol [1]

(iii) **FA 1** contains 6.10 g dm^{-3} of acid **Z**. The relative molecular mass of **Z** is 126.

Calculate the number of moles of **Z** in 1 dm^3 of **FA 1**.

$n = \frac{m}{M_r} = \frac{6.10}{126} = 0.484$ mol

moles of **Z** in 1 dm^3 of **FA 1** = ...0.484.......... mol [1]

(iv) Use your answers to **(ii)** and **(iii)** to determine whether **Z** is a monoprotic or a diprotic acid. Explain your answer.

moles of Z : moles of H^+
0.0484 : 0.110
1 : x

$\frac{0.110}{0.0484} = 2.27 \approx 2$

1 : 2

....So the acid Z is diprotic...

.... [1]

[Total: 12]