

## EXPERIMENT 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  $6.10 \text{ g dm}^{-3}$  of acid **Z**.

**FA 2** is  $0.105 \text{ mol dm}^{-3}$  aqueous sodium hydroxide, NaOH.  
bromophenol blue indicator

#### (a) Method

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

final burette reading/ $\text{cm}^3$	26.90
initial burette reading/ $\text{cm}^3$	0.40
titre/ $\text{cm}^3$	26.50

The rough titre is .....26.50.....  $\text{cm}^3$ .

- 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/ $\text{cm}^3$	31.70	41.70	32.50
initial burette reading/ $\text{cm}^3$	5.40	15.60	6.30
titre/ $\text{cm}^3$	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<sup>3</sup> of **FA 1** required ... 26.15 ... cm<sup>3</sup> of **FA 2**. [1]

(c) Calculations

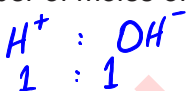
- (i) Calculate the number of moles of sodium hydroxide present in the volume of **FA 2** calculated in (b).

$$n = CV$$

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

moles of NaOH = ...  $2.74 \times 10^{-3}$  ... mol

Then deduce the number of moles of H<sup>+</sup> present in 25.0 cm<sup>3</sup> of **FA 1**.



$$2.74 \times 10^{-3} \text{ mol}$$

moles of H<sup>+</sup> in 25.0 cm<sup>3</sup> of **FA 1** = ...  $2.74 \times 10^{-3}$  ... mol [1]

- (ii) Calculate the number of moles of H<sup>+</sup> present in 1 dm<sup>3</sup> of **FA 1**.

$$\frac{25.0 \text{ dm}^3}{1000} \text{ --- } 2.74 \times 10^{-3} \text{ mol}$$

$$1 \text{ dm}^3 \text{ --- } x$$

moles of H<sup>+</sup> in 1 dm<sup>3</sup> of **FA 1** = ... 0.110 ... mol [1]

- (iii) **FA 1** contains 6.10 g dm<sup>-3</sup> of acid **Z**. The relative molecular mass of **Z** is 126.

Calculate the number of moles of **Z** in 1 dm<sup>3</sup> of **FA 1**.

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

moles of **Z** in 1 dm<sup>3</sup> 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 <b>Z</b>	:	moles of H <sup>+</sup>		$\frac{0.110}{0.484} = 2.27 \approx 2$
0.484	:	0.110		
1	:	x		<span style="border: 1px solid black; padding: 2px;">1 : 2</span>

So the acid **Z** is diprotic.

..... [1]

[Total: 12]