TITRATION NO. 3

The concentration of aqueous ammonia used in qualitative analysis is 2 mol dm^{-3} but it is supplied in a much more concentrated form. This is referred to as '.880 ammonia'. You are to determine the concentration of '.880 ammonia' by titration of a solution of ammonia, **FB 1**, with hydrochloric acid of known concentration. The equation for the reaction is given below.

$$NH_3(aq) + HCl(aq) \rightarrow NH_4Cl(aq)$$

FB 1 is a dilute solution of ammonia, NH_3(aq). It was prepared by measuring out 5.91 cm^3 of the '.880 ammonia' and then adding distilled water until the solution had a volume of 1 dm^3.
FB 2 is 0.100 mol dm^{-3} hydrochloric acid, HCl(aq).
bromophenol blue indicator

(a) Method

- Fill the burette with **FB 2**.
- Use the pipette to transfer 25.0 cm^3 of **FB 1** into a conical flask.
- Add a few drops of bromophenol indicator.
- Perform a **rough titration** and record your burette readings in the space below.

final burette reading / cm^3	24.20
initial burette reading / cm^3	0.10
titre / cm^3	24.10

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

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

final burette reading / cm^3	47.90	30.60	
initial burette reading / cm^3	24.10	6.90	
titre / cm^3	23.80	23.70	
best titres	✓	✓	

I	
II	
III	
IV	
V	
VI	
VII	

[7]

(b) From your accurate titration results, obtain a suitable value to be used in your calculations. Show clearly how you obtained this value.

$$\frac{23.80 + 23.70}{2}$$

25.0 cm^3 of **FB 1** required 23.75 cm^3 of **FB 2**. [1]

(c) Calculations

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

(i) Calculate the number of moles of hydrochloric acid present in the volume of **FB 2** calculated in **(b)**.

$n = CV$

$= 0.100 \times \frac{23.75}{1000}$

moles of HC*l* = 2.38×10^{-3} mol

(ii) Use your answer to **(i)** to determine the number of moles of ammonia present in 25.0 cm^3 of **FB 1**, pipetted into the conical flask.

$NH_3 : HCl$

$1 : 1$

moles of NH_3 = 2.38×10^{-3} mol

(iii) Use your answer to **(ii)** to calculate the concentration, in mol dm^{-3}, of the diluted ammonia, **FB 1**.

$C = \frac{n}{V} = \frac{2.38 \times 10^{-3}}{25/1000}$

concentration of NH_3 (diluted) in **FB 1** = 0.0952 mol dm^{-3}

(iv) Use your answer to **(iii)** and the information on page 1 to calculate the concentration, in mol dm^{-3}, of '.880 ammonia'.

no. of moles in 1 dm^3 = no. of moles in 5.91 cm^3 of .880

0.0952 : 0.0952

$C = \frac{n}{V} = \frac{0.0952}{5.91/1000}$

concentration of '.880 ammonia' = 16.1 mol dm^{-3}

[3]

(d) A student analysed a different sample of concentrated ammonia and determined the concentration to be 15.0 mol dm^{-3}. Calculate the percentage difference in concentration of the '.880 ammonia' you have determined compared with that of the student.
(If you have been unable to complete the calculation, assume the concentration of '.880 ammonia' was 9.35 mol dm^{-3}. This is not the correct value.)

difference : $16.1 - 15.0 = 1.10$

% difference : $\frac{1.10}{15.0} \times 100$ OR $\frac{1.10}{16.1} \times 100$

percentage difference in concentration = 7.33 OR 6.83 % [1]

[Total: 12]