Oxford Cambridge and RSA

AS Level Chemistry A

H032/01 Breadth in chemistry

Question Set 19

1. A student carries out a titration to determine the concentration of some hydrochloric acid.

The student titrates the hydrochloric acid against a standard solution of sodium carbonate, Na_2CO_3. The equation is shown below.

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

- The student prepares 0.150 mol dm^{-3} Na_2CO_3 in a 250.0 cm^3 volumetric flask.
- The hydrochloric acid is added to a 50.0 cm^3 burette.
- The student pipettes the $Na_2CO_3(aq)$ using a 25.0 cm^3 pipette.

(a) The student's burette readings are shown in the table.
The rough titre has been omitted.

(i) Complete the table by adding the titres to the table. **[1]**

Final reading / cm^3	24.60	48.45	34.30
Initial reading / cm^3	0.40	24.60	10.00
Titre / cm^3	24.20	23.85	24.30

(ii) Calculate the mean titre of HCl, to the nearest 0.05 cm^3, that the student should use for analysing the results.

[1]

(b) Calculate the concentration, in mol dm^{-3}, of the hydrochloric acid.

Give your answer to **3** significant figures.

[3]

(c) In the titrations, the student measured volumes with a pipette and a burette.

- The pipette had an uncertainty of ± 0.04 cm^3 in the volume measured.
- The burette had an uncertainty of ± 0.05 cm^3 in the volume measured.

Determine whether the volume measured by the pipette or the volume measured by the burette has the greater percentage uncertainty. **[2]**

Total Marks for Question Set 19: 7

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(ii) Calculate the mean titre of HCl, to the nearest 0.05 cm^3, that the student should use for analysing the results. **[1]**

(1) a) ii) $\frac{24.20 + 24.30}{2} = 24.25\ cm^3$

(b) Calculate the concentration, in mol dm^{-3}, of the hydrochloric acid. **[3]**

Give your answer to **3** significant figures.

iii) moles $Na_2CO_3 = 0.15 \times 0.025$
$= 0.00375$

moles $HCl = 0.00375 \times 2 = 0.0075$

concentration $HCl = \frac{\text{moles}}{\text{volume}} = \frac{0.0075}{0.02425} = 0.309278$
$= 0.309\ mol\,dm^{-3}$

(c) In the titrations, the student measured volumes with a pipette and a burette.

- The pipette had an uncertainty of ±0.04 cm^3 in the volume measured.
- The burette had an uncertainty of ±0.05 cm^3 in the volume measured.

Determine whether the volume measured by the pipette or the volume measured by the burette has the greater percentage uncertainty. **[2]**

c) pipette : $100 \times \left(\frac{0.04}{25.0}\right) = 1.6 \times 10^{-3}$
$= 0.16\%$

burette : $\frac{0.05 \times 2}{24.25} \times 100 = 0.41\%$

∴ the % uncertainty for the burette is greater than for the pipette.

Total Marks for Question Set 19: 7