39 Which item of apparatus is used to measure 13.7 cm^3 of dilute hydrochloric acid?

A a balance

B a burette

C a conical flask

D a volumetric pipette

2 A student investigates the reaction between dilute hydrochloric acid and aqueous sodium hydroxide.

The student does five experiments.

Experiment 1

- Fill a burette with aqueous sodium hydroxide.
- Run some of the aqueous sodium hydroxide out of the burette so that the level of the aqueous sodium hydroxide is on the burette scale.
- Record the initial burette reading.
- Use a volumetric pipette to add 25.0 cm^3 of dilute hydrochloric acid to a conical flask.
- Stand the conical flask on a white tile.
- Add five drops of thymolphthalein indicator to the conical flask.
- Slowly add aqueous sodium hydroxide from the burette to the conical flask, while swirling the flask, until the solution just changes colour. This is the end-point.
- Record the final burette reading.

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Refill the burette with aqueous sodium hydroxide.
- Run some of the aqueous sodium hydroxide out of the burette so that the level of the aqueous sodium hydroxide is on the burette scale.
- Record the initial burette reading.
- Use the volumetric pipette to add 25.0 cm^3 of dilute hydrochloric acid to the conical flask.
- Add 0.25 g of sodium hydrogencarbonate to the conical flask and swirl the flask.
- Stand the conical flask on the white tile.
- Add five drops of thymolphthalein indicator to the conical flask.
- Slowly add aqueous sodium hydroxide from the burette to the conical flask, while swirling the flask, until the solution just changes colour. This is the end-point.
- Record the final burette reading.

Experiment 3

- Repeat Experiment 2 using 0.50 g of sodium hydrogencarbonate instead of 0.25 g.

Experiment 4

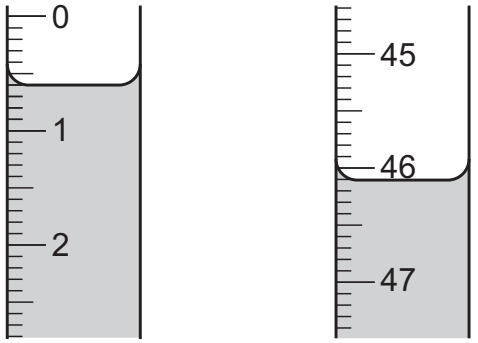
- Repeat Experiment 2 using 1.00 g of sodium hydrogencarbonate instead of 0.25 g.

Experiment 5

- Repeat Experiment 2 using 1.50 g of sodium hydrogencarbonate instead of 0.25 g.

(a) Use the information in the descriptions of Experiments 1 to 5 and the burette diagrams in Fig. 2.1 and Fig. 2.2 to complete Table 2.1.

Experiment 1

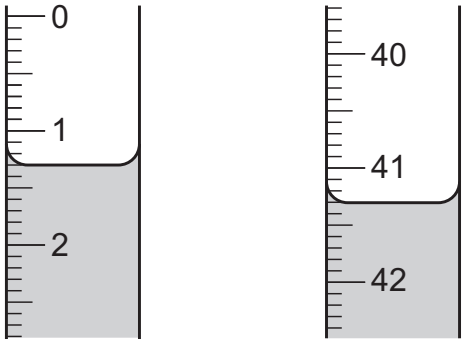


initial burette reading

final burette reading

Fig. 2.1

Experiment 2



initial burette reading

final burette reading

Fig. 2.2

Table 2.1

	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
volume of dilute hydrochloric acid / cm^3					
mass of sodium hydrogencarbonate / g	0.00	0.25	0.50	1.00	1.50
final burette reading / cm^3			36.0	24.1	13.5
initial burette reading / cm^3			1.4	0.3	0.5
volume of aqueous sodium hydroxide added to reach the end-point / cm^3					13.0

[5]

(b) Complete a suitable scale on the *y*-axis and plot the results from Experiments 1 to 5 in Table 2.1 on Fig. 2.3. Draw a straight line of best fit.

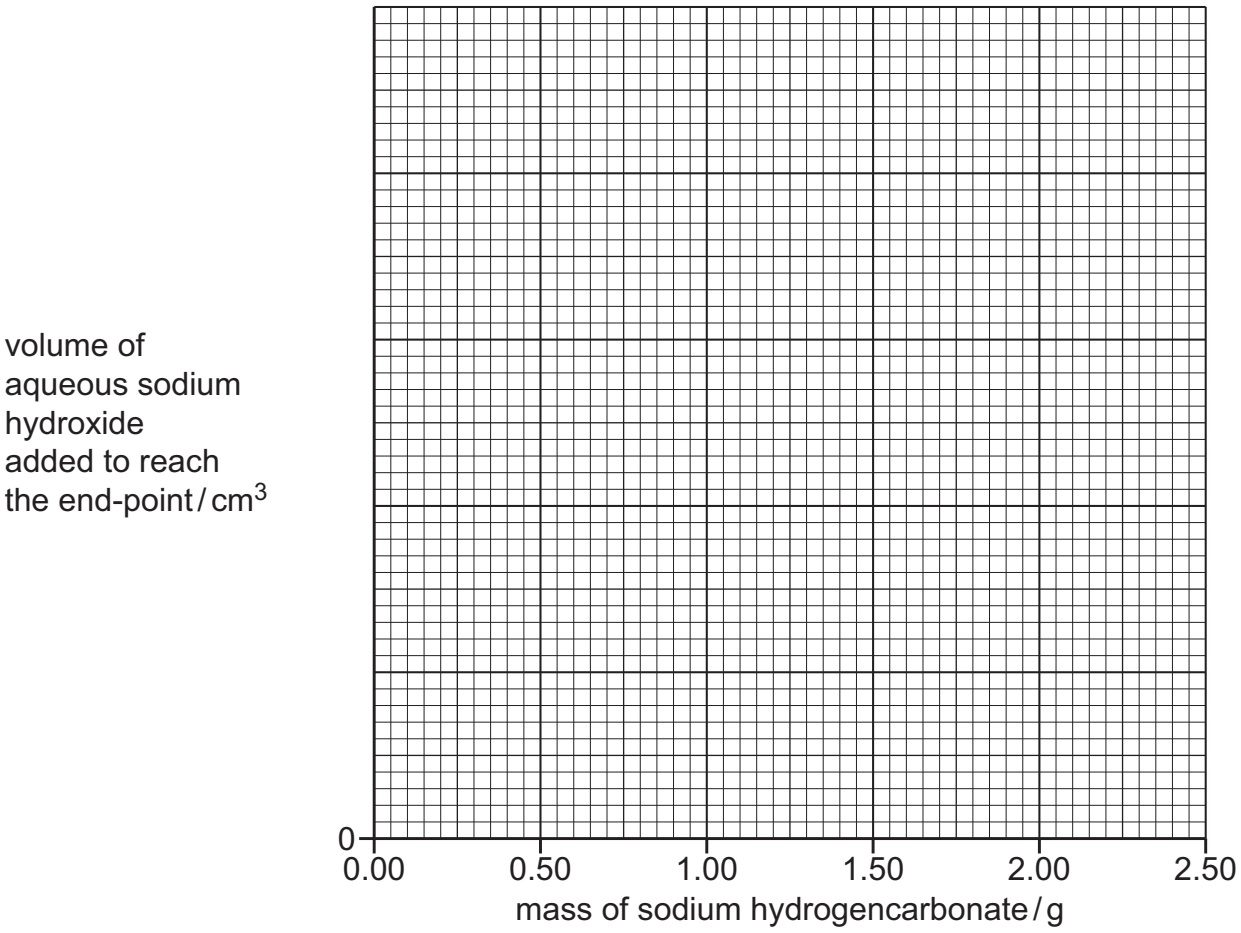


Fig. 2.3

[4]

(c) The sodium hydrogencarbonate added in Experiments 2 to 5 neutralises some of the dilute hydrochloric acid in the conical flask. The sodium hydroxide used in the titration neutralises the remaining dilute hydrochloric acid.

Extrapolate the line on your graph in Fig. 2.3 and deduce the mass of sodium hydrogencarbonate needed to neutralise **all** of the dilute hydrochloric acid in the conical flask.

Show clearly **on Fig. 2.3** how you worked out your answer.

mass of sodium hydrogencarbonate = ...

[3]

(d) **(i)** Explain why a volumetric pipette is used rather than a measuring cylinder to measure the volume of dilute hydrochloric acid used in each experiment.

.....

..... [1]

(ii) Explain why it is **not** possible to use a volumetric pipette instead of the burette to measure the volume of aqueous sodium hydroxide added in each experiment.

.....

..... [1]

(e) The conical flask is placed on a white tile to make the colour change of the indicator at the end-point more visible.

Explain why universal indicator is **not** a suitable indicator for this titration.

.....

.....

.....

..... [2]

(f) Draw a line **on Fig. 2.3** to show the results you would expect if the investigation was repeated using aqueous sodium hydroxide with twice the concentration.

Label your line **F**. [2]

[Total: 18]

2 A student investigates the reaction between acidic solution **B** and two different solutions of aqueous sodium hydroxide, solution **C** and solution **D**, using two different indicators.

The student does two experiments.

Experiment 1

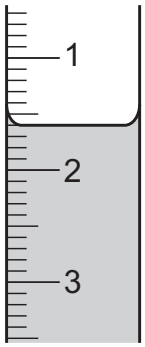
- Rinse a burette with distilled water and then with solution **C**.
- Fill the burette with solution **C**. Run some of solution **C** out of the burette so that the level of the solution is on the burette scale.
- Record the initial burette reading.
- Use a measuring cylinder to pour 25 cm^3 of solution **B** into a conical flask.
- Add five drops of methyl orange indicator **and** five drops of thymolphthalein indicator to the conical flask.
- Stand the conical flask on a white tile.
- Slowly add solution **C** from the burette to the conical flask, while swirling the flask, until the solution changes colour from red to orange. This is the first end-point.
- Record the burette reading at the first end-point.
- Continue to add solution **C** from the burette to the conical flask while swirling the flask. The solution changes colour from orange to yellow.
- Continue to add solution **C**, while swirling the flask, until the solution changes colour from yellow to green. This is the second end-point.
- Record the burette reading at the second end-point.

Experiment 2

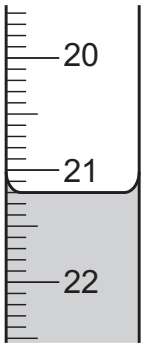
- Empty the conical flask and rinse it with distilled water.
- Repeat Experiment 1 using solution **D** instead of solution **C**.

(a) Use the burette diagrams in Fig. 2.1 and Fig. 2.2 to record the readings for Experiment 1 and Experiment 2 in Table 2.1. Complete Table 2.1.

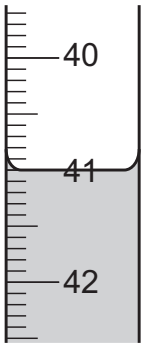
Experiment 1



initial burette reading



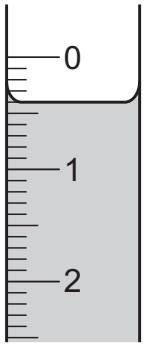
burette reading at first end-point



burette reading at second end-point

Fig. 2.1

Experiment 2



initial burette reading

burette reading at first end-point

burette reading at second end-point

Fig. 2.2

Table 2.1

	Experiment 1 using solution **C**	Experiment 2 using solution **D**
burette reading at first end-point / cm^3		
burette reading at second end-point / cm^3		
initial burette reading / cm^3		
volume added from burette to reach first end-point / cm^3		
total volume added from burette to reach second end-point / cm^3		

[5]

(b) (i) Explain why the conical flask is rinsed with distilled water at the start of Experiment 2.

.....

..... [1]

(ii) At the start of Experiment 1, the burette is rinsed with distilled water and then with solution **C**.

Explain how the volume added from the burette to reach the first end-point would be different if the burette was **not** rinsed with solution **C**.

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.....

.....

..... [2]

(iii) Explain why the conical flask is placed on a white tile during the titration.

.....

..... [1]

(c) Compare the concentration of solution **C** used in Experiment 1 with the concentration of solution **D** used in Experiment 2.

Explain your answer.

.....

.....

.....

..... [3]

(d) (i) Deduce the volume of solution **C** required to reach the **first** end-point if Experiment 1 is repeated using 50 cm^3 of solution **B** instead of 25 cm^3.

volume of solution **C** = ... [2]

(ii) State why using 50 cm^3 of solution **B** would cause a problem when finding the volume of solution **C** needed to reach the **second** end-point in Experiment 1.

.....

..... [1]

(e) A student repeats Experiment 2.

The student warms solution **B** in the conical flask before carrying out the titration.

State the effect, if any, on the volume of solution **D** required to reach the **second** end-point in Experiment 2.

Explain your answer.

effect on volume of solution **D** .....

explanation .....

.....

[2]

(f) State **one** change to the **apparatus** that will improve the accuracy of the results.

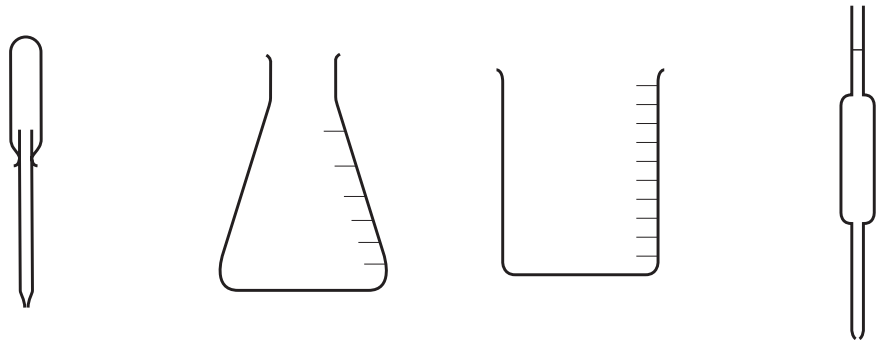
..... [1]

[Total: 18]

IGCSE Chemistry: **s25 21**

38 Which item of apparatus is used to measure 25.0 cm^3 of aqueous sodium hydroxide?

A **B** **C** **D**



IGCSE Chemistry: **s25 22**

38 Which item of apparatus is used to measure exactly 26.3 cm^3 of a liquid?

A **B** **C** **D**