Your teacher may watch to see if you can…

- follow instructions
- make accurate measurements.

Aim

To find the volume of hydrochloric acid needed to neutralise 25.0 cm^3 of 0.10 mol dm^{-3} sodium hydroxide solution.

Apparatus

- eye protection
- burette and stand
- funnel
- pipette and filler
- conical flask
- white tile
- wash bottle of distilled or deionised water
- methyl orange indicator
- 0.10 mol dm^{-3} sodium hydroxide solution
- hydrochloric acid of unknown concentration

⚠ Safety

Eye protection must be worn.

Use a pipette filler.

Method

A Place a funnel in the top of the burette, then rinse and fill the burette with the dilute hydrochloric acid.

B Fill the jet below the tap by running some acid out of the burette, then remove the funnel from the top of the burette. Record the initial reading on the burette.

C Following instructions from your teacher, use the pipette filler to rinse and fill the pipette to the 25.0 cm^3 mark with the sodium hydroxide solution.

D Empty the sodium hydroxide solution from the pipette into a conical flask.

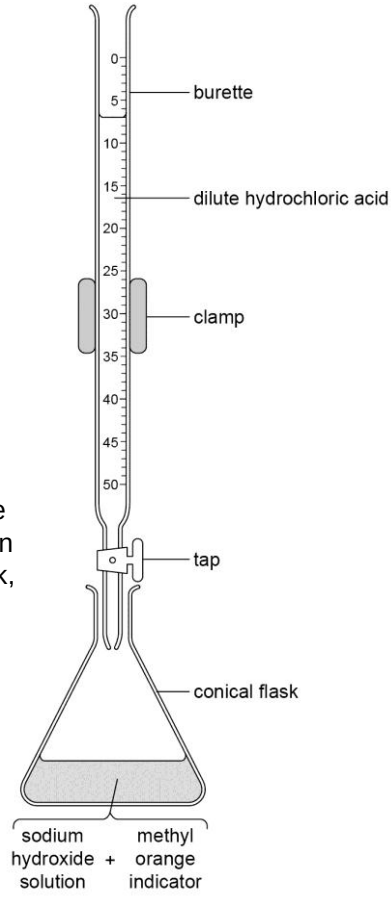
E Add a few drops of methyl orange to the conical flask until the solution is yellow, then place the flask on a white tile under the burette.

F Add the hydrochloric acid to the sodium hydroxide solution in small portions while swirling the conical flask.

G Stop adding the hydrochloric acid when the indicator turns a peach/orange colour. Record the burette reading. This is the rough titration to give you an approximate volume of hydrochloric acid needed. If the indicator turns pink, you have added too much hydrochloric acid.

H Repeat steps **A**–**E** (except for rinsing the burette and pipette). Add hydrochloric acid to the sodium hydroxide until you have used 1 cm^3 less than in the rough titration. Use a wash bottle of distilled/deionised water to rinse the tip of the burette with a little water to make sure no hydrochloric acid is left there. Then add hydrochloric acid drop by drop until the solution in the flask is peach/orange. Record the burette reading.

I Repeat step **H** until you have two concordant results within 0.2 cm^3 of each other.



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1 Repeat the titration using 25.0 cm^3 of sodium hydroxide solution and the mean volume of hydrochloric acid, but do not add any indicator.

2 Pour the sodium chloride solution into an evaporating basin and heat it until crystals start to form. Take care – it starts to spit hot salt if it boils completely dry.

3 Leave the basin until it is cool and the rest of the water has evaporated. You will be left with pure, dry crystals of sodium chloride.

Name _____ **Class** _____ **Date** _____

Recording your results

1 Record your results in the table.

Burette reading	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Final reading (cm^3)					
Initial reading (cm^3)					
Volume added (cm^3)					

Considering your results/conclusions

2 Calculate the mean of the concordant results (results that are within 0.2 cm^3 of each other).

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3 Calculate the number of moles of sodium hydroxide in 25.0 cm^3 of 0.10 mol dm^{-3} sodium hydroxide solution. Use the formula:

number of moles of solute = volume of solution (dm^3) × concentration (mol dm^{-3})

Remember to convert the volume in cm^3 to dm^3 by dividing by 1000.

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4 The equation for the reaction between hydrochloric acid and sodium hydroxide is:

$$HCl + NaOH \rightarrow NaCl + H_2O$$

Work out the number of moles of hydrochloric acid that reacted with the number of moles of sodium hydroxide you calculated in question **3**.

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5 Use the formula in question **3**, the mean volume of hydrochloric acid and your answer to question **4** to calculate the concentration of hydrochloric acid in mol dm^{-3}. Remember to convert the volume in cm^3 to dm^3.

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