Edexcel Chemistry GCSE

CP 5: Carry out an accurate acid-alkali titration, using burette, pipette and a suitable indicator

Notes

Acid-Alkali Titration

Aim

To carry out an accurate acid-alkali titration using a burette, pipette and a suitable indicator.

Equipment list

- 50 cm^3 burette
- 25 cm^3 pipette with pipette filler
- 250 cm^3 conical flask
- 100 cm^3 beaker
- Funnel
- White tile
- Burette clamp and stand

Chemicals required

- Phenolphthalein indicator
- 0.4 mol/dm^3 hydrochloric acid
- Sodium hydroxide solution (unknown concentration)
- Deionised water

Method

1. Add exactly 25 cm^3 of sodium hydroxide to a conical flask using a pipette and pipette filler. Add a few drops of phenolphthalein indicator to the conical flask then place the conical flask on a white tile.
2. Setup the burette in the clamp and stand. Close the tap and use a funnel to pour about 10 cm^3 of hydrochloric acid into the burette.
3. Place a beaker under the burette and open the tap, allowing the tip of the burette to fill with acid and displace any air bubbles.
4. Close the tap before the burette empties then use a funnel to fill the burette with acid. Record the initial burette reading to the nearest 0.05 cm^3.
5. Place the burette above the conical flask. Carry out a rough trial titration, adding the acid 1-2 cm^3 at a time, swirling the conical flask constantly.
6. Close the burette tap as soon as the solution decolourises. Record the final burette volume and calculate the volume of acid that has been added from the burette.
7. Rinse the conical flask with deionised water then add 25 cm^3 of sodium hydroxide. Refill the burette if necessary and record the initial volume of acid in the burette.
8. Using the rough titre as guidance, add the acid to the conical flask until within about 4 cm^3 of the rough titre volume. Add the acid drop by drop after this, swirling constantly until the endpoint is reached. Record the final burette reading and use this value to calculate the titre volume.
9. Repeat steps 7 and 8 until concordant titres are obtained (results within 0.1 cm^3).
10. Use the concordant results to calculate the mean titre.

Key points

- The equation for this reaction is:
  $HCl + NaOH \rightarrow NaCl + H_2O$
- The white tile is used to make the colour change of the indicator easier to see so the end point can be identified.
- The conical flask is swirled to ensure all the reactants are mixed together throughout the experiment. This ensures an accurate end point is obtained.
- The rough titre must not be used to calculate the mean as it is not accurate enough.
- The indicator phenolphthalein is colourless in acids and pink in alkalis.
- When reading the volume of acid in the burette, it should be read at eye level from the bottom of the meniscus (the curve of the liquid).
- The end point is the point at which the indicator first changes colour.

Diagram

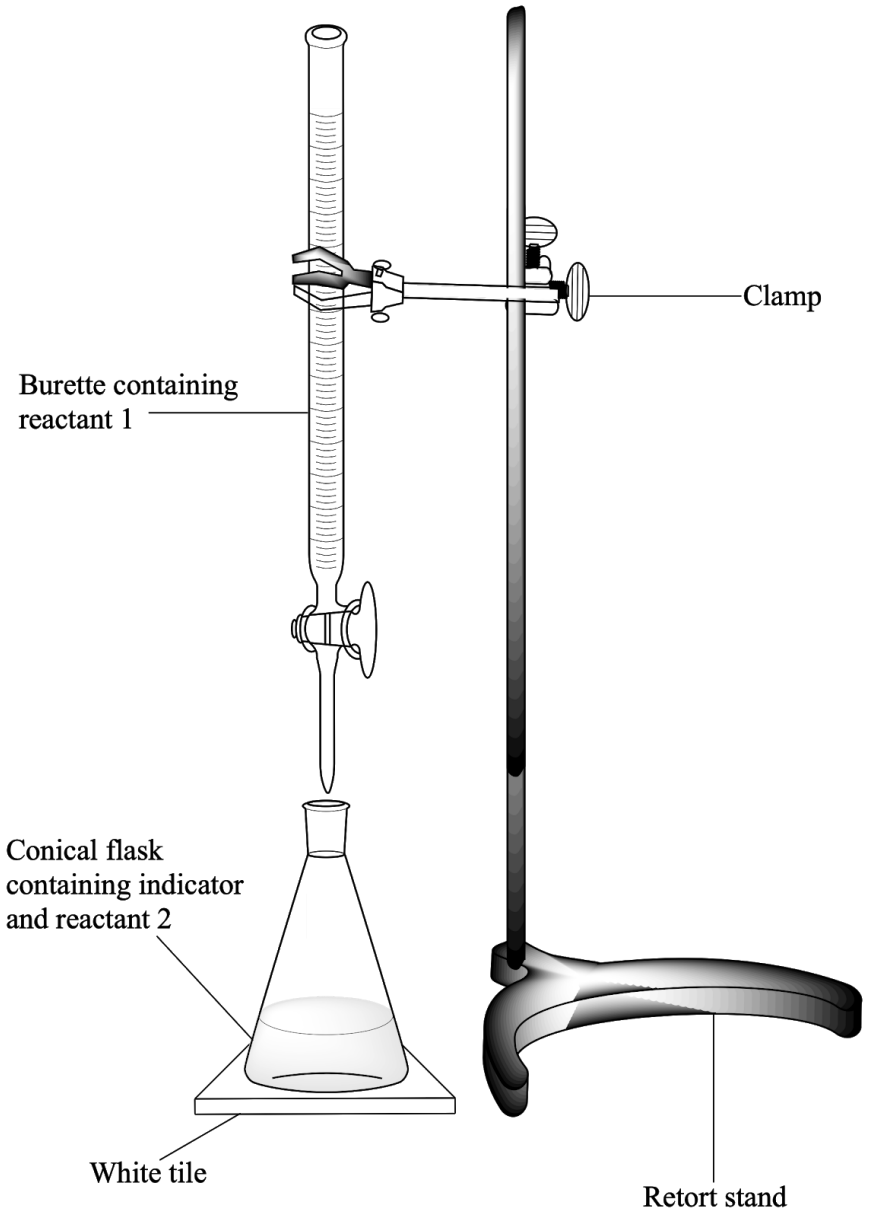

Figure 1: Experiment setup

Safety precautions

- Safety goggles must be worn at all times.
- Fill the burette below eye level to prevent chemicals splashing into someone's face. This can be achieved by placing the burette on the floor when it is being filled.
- Sodium hydroxide is an irritant so avoid contact with the skin. If the skin comes into contact, wash immediately.
- Hydrochloric acid is corrosive. Although a low concentration is being used in this experiment, treat with the same precautions as sodium hydroxide.
- Take care when using fragile glassware like the burette and pipette. Clear up any broken glass immediately.

Analysis of Results

The results from each titre can be recorded in a table similar to the one below. More columns may be added until 2 concordant results are obtained:

	Rough titre	**Titre 1**	**Titre 2**	**Titre 3**
Initial burette volume (cm^3)	e.g. 27.30			
Final burette volume (cm^3)	e.g. 4.25			
Titre (cm^3)	e.g. 23.05			

To determine the concentration of the sodium hydroxide used:

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

From the equation above it is easy to identify that hydrochloric acid and sodium hydroxide react in a 1:1 ratio. Therefore to find the concentration of alkali:

1. Find the moles of HCl used by multiplying the mean titre of HCl (in dm^3) by the concentration. The 1:1 ratio can be used to find the number of moles of NaOH that reacted (this will be the same as the number of moles of HCl).
2. Divide the moles of NaOH by the volume used (dm^3).
3. This value is the concentration of NaOH. Round it to 3 significant figures.