OCR (B) Chemistry GCSE

PAG 6: Titration

(chemistry only)

Notes

Titration of Sodium Hydroxide and Hydrochloric Acid

Aim

To determine the concentration of a sample of sodium hydroxide by carrying out a titration.

Equipment list

- 50 cm^3 burette
- 25 cm^3 pipette
- Pipette filler
- 250 cm^3 conical flask
- 100 cm^3 beaker
- Funnel
- White tile
- Stand
- Burette clamp
- Deionised water

Chemicals required

- Phenolphthalein indicator
- Hydrochloric acid
- Sodium hydroxide solution (unknown concentration)

Method

1. Set up the burette as shown in figure 1.
2. Close the tap on the burette. Using the funnel, 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. Use a funnel to fill the burette with the acid.
5. Using the pipette and pipette filler add 25 cm^3 of sodium hydroxide to a conical flask then add 2-3 drops of phenolphthalein.
6. Record the initial burette reading to 2 decimal places.
7. Carry out a rough trial, adding 1-2 cm^3 of acid at a time to the conical flask. Ensure the mixture is swirled constantly.
8. As soon as the solution in the conical flask decolourises, close the tap on the burette and record the new volume of acid in the burette. Calculate the volume of acid added from the burette.
9. Rinse the conical flask with deionised water and refill with 25 cm^3 of sodium hydroxide. Refill the burette if necessary and record the initial volume of acid in the burette.
10. Using the rough titre as guidance, add the acid to the conical flask 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 calculate the titre volume.
11. Repeat steps 9 and 10 until concordant results are obtained (titres within 0.1 cm^3).
12. Use the concordant results to calculate the mean titre.

Key points

- The equation for the reaction taking place is: $HCl + NaOH \rightarrow NaCl + H_2O$
- The rough titre must not be used when calculating the mean as it is not accurate enough. The mean must be calculated using concordant results.
- The white tile allows the colour change to be seen much easier.
- Phenolphthalein is colourless in acid and turns pink in an alkali.
- To improve the accuracy, deionised water can be used to wash the pipette into the conical flask to ensure all the NaOH reacts.
- 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).

Diagram

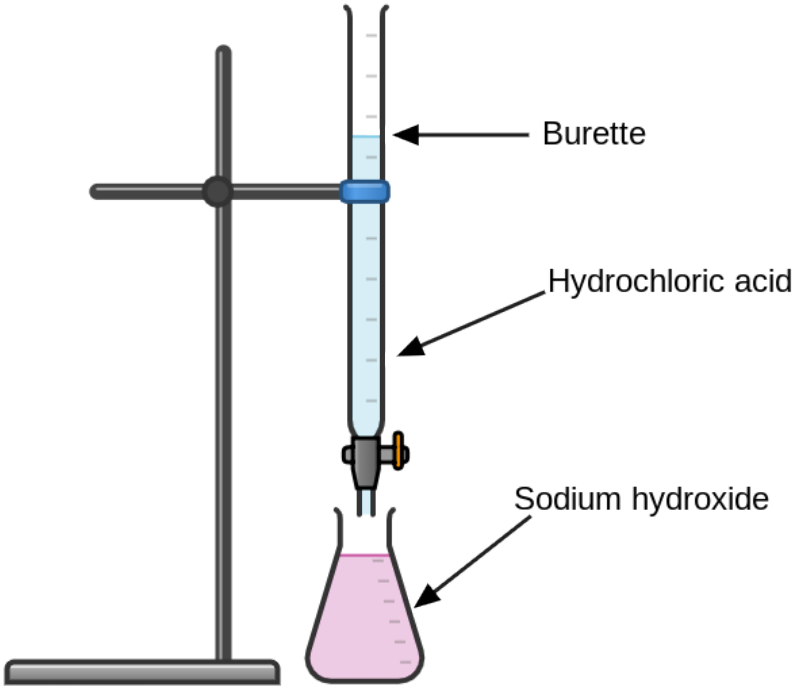

Figure 1 Experiment Setup

Chemix

Safety precautions

- Safety glasses 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. 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.