48. Titration of sodium hydroxide with hydrochloric acid

Topic
Acids and alkalis, neutralisation, formation of a soluble salt.

Timing
45 min.

Description
Students find the amount of acid required to neutralise 25 cm$^3$ of sodium hydroxide. These volumes are reacted and sodium chloride is then crystallised.

Apparatus and equipment (per group)
- 250 cm$^3$ Conical flask
- 50 cm$^3$ or 100 cm$^3$ Burette
- Burette stand
- One 25 cm$^3$ or larger measuring cylinder.

Chemicals (per group)
- Hydrochloric acid 1 mol dm$^{-3}$
- Sodium hydroxide 1 mol dm$^{-3}$ (Corrosive)
- Methyl orange.

Teaching tips
Demonstrate how to fill a burette and run out to the zero mark.

With older groups, a pH sensor in the flask can monitor the pH change as the alkali is neutralised. Get the computer recording the pH sensor and allow the acid to drip at a steady rate as you swirl the flask. Data logging software will show the readings as a ‘classic’ strong acid-strong base titration curve where pH is on the y-axis and time (as a rough measure of the volume) is on the x-axis.

Background theory
Acids and alkali, salts.

Safety
Wear eye protection.

Answers
1. Salt.
2. Hydrochloric acid + sodium hydroxide $\rightarrow$ sodium chloride + water
3. HCl + NaOH $\rightarrow$ NaCl + H$_2$O
4. The original solution contained methyl orange.
Titration of sodium hydroxide with hydrochloric acid

Introduction

In this experiment sodium hydroxide is neutralised with hydrochloric acid to produce the soluble salt sodium chloride. This is then concentrated and crystallised in a crystallising dish.

What to record

What was done and what was observed.

What to do

1. Add 25 cm$^3$ of sodium hydroxide solution (Corrosive) to a conical flask using a measuring cylinder and add a couple of drops of methyl orange indicator.
2. Fill the burette with hydrochloric acid and run through to the zero mark (use a funnel to fill the burette and a beaker to collect the excess acid).
3. Add the hydrochloric acid to the sodium hydroxide solution in small volumes swirling after each addition. Continue until the solution turns red and record this reading on the burette.
4. Carefully add this volume of fresh hydrochloric acid to another 25 cm$^3$ of sodium hydroxide solution to produce a neutral solution.
5. Reduce to about half the volume using an evaporating dish on a gauze over a Bunsen burner flame.
6. Leave to evaporate in a crystallising dish to produce a white crystalline solid.
Safety

Wear eye protection.

Questions

1. What is the everyday name for sodium chloride?
2. This reaction is a specific example of the general reaction:
   Acid + alkali → salt + water.
   Write a word equation for this specific reaction.
3. Write a formula equation for this reaction.
4. Why must you use another 25 cm$^3$ of sodium hydroxide solution to make pure sodium chloride?