








## Objectives

- C0.3** Write balanced equations, including the use of the state symbols (s), (l), (g) and (aq).
- C3.9** Recall that a base is any substance that reacts with an acid to form a salt and water only.
- C3.11b** Explain the general reactions of aqueous solutions of acids with metal oxides to produce salts.
- C3.13** Describe a neutralisation reaction as a reaction between an acid and a base.
- C3.15** Explain why, if soluble salts are prepared from an acid and an insoluble reactant:
- excess of the reactant is added
  - the excess reactant is removed
  - the solution remaining is only salt and water.
- C3.17** *Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide, including the use of a water bath.*

## Maths requirements

- 1c** Use ratios, fractions and percentages.

## Learning outcomes

-  **SC3.9** Describe how a base reacts in a neutralisation reaction.
-  **SC3.11** Describe what happens when an acid reacts with a metal oxide.
-  **SC3.11** Write word equations for the reactions of acids and metal oxides.
-  **SC3.11** Write symbol equations for the reactions of acids and metal oxides.
-  **SC3.13** Explain what happens during a neutralisation reaction.
-  **SC3.15** Describe the steps involved in preparing a soluble salt from an acid and an insoluble reactant.
-  **SC3.15** Explain why
- an excess of insoluble reactant is used when preparing a soluble salt
  - the excess reactant is removed when preparing a soluble salt
  - the remaining solution contains only a salt and water, when preparing a soluble salt from an acid and an insoluble reactant.

## Exploring

### 1. Preparing a soluble salt – Core Practical

Students work in groups following the instructions on Students' sheet CP3 (Preparation of Copper Sulfate). In this case the salt is hydrated copper sulfate. Briefly discuss the steps involved in the preparation of the salt before the students start the investigation. Students should understand why:

- an excess of copper oxide has to be added
- the excess has to be removed
- only the salt and water are present in the solution after filtration.

There are different ways of carrying out this practical. For example, the experiment could be carried out in a boiling tube and step B could be done by placing the boiling tube in a beaker of water over a Bunsen burner.

To produce the largest and best-formed crystals of copper sulfate, the final solution should be kept dust free and allowed to evaporate as slowly and evenly as possible.

**Support:** Some students will need help with the word and symbol equations.

**Stretch:** Ask students to find out why certain salts could *not* be prepared by this method. For example, sodium sulfate cannot be made this way as sodium oxide is soluble and the excess could not be separated. Calcium sulfate could not be formed this way as it is insoluble in water and could not be separated from the metal oxide.

#### Expected results

Copper oxide and sulfuric acid form a soluble salt, copper sulfate. Students should be able to prepare a dry pure sample of copper sulfate crystals, which are blue in colour and diamond shaped.

#### Safety

Eye protection should be worn throughout this experiment.

#### Course resources

Chem Students' sheet CP3

#### Equipment (per group)

eye protection, 100 cm<sup>3</sup> conical flask, 100 cm<sup>3</sup> beaker, Bunsen burner, gauze, tripod stand, heat mat, Petri dish or watch glass, 100 cm<sup>3</sup> measuring cylinder, evaporating basin, spatula, stirring rod, filter funnel, filter paper, tongs, water bath (set at 50 °C), 1 mol dm<sup>-3</sup> sulfuric acid, copper(II) oxide