Core practical 7: Preparation of copper sulfate

2.42 Core practical: Prepare a sample of pure, dry hydrated copper(II) sulfate crystals starting from copper(II) oxide

Links to the specification content

1.4	Know what is meant by the terms: solvent, solute, solution, and saturated solution
2.39	Describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an insoluble reactant

Introducing the practical

Students should be aware of the solubility rules of salts and of the reactions of metals and bases with dilute acids. They could then be set the task of predicting the reagents required to prepare copper(II) sulfate.

The dilute sulfuric acid needs to be warmed because the reaction with copper(II) oxide is very slow at room temperature. However, care needs to be taken not to get the acid too hot, and certainly not to boiling point, since the copper(II) oxide powder, and also the acid, may 'spit out' of the container and into the atmosphere. Copper(II) oxide can cause respiratory problems when inhaled and can easily bring on an attack with asthmatics. One suitable way to heat the acid is to place it in a boiling tube and heat in a water bath.

The copper(II) oxide is added, with stirring, to the acid a spatula-measure at a time. Each measure should be given time to completely react (i.e. completely disappear) before the next is added. Addition should finish when the oxide stops disappearing.

The mixture is then filtered and crystals obtained from the filtrate by crystallisation.

Crystallisation involves partial evaporation of the copper(II) sulfate solution to produce a hot, saturated solution. This solution is then cooled for crystals to form. The crystals are then removed by filtration and dried using filter paper or blotting paper. They can be dried in a **warm** oven, but not by direct heating with Bunsen flame since the crystals would dehydrate.

Leaving the filtrate for the water to fully evaporate is not suitable, since any water soluble impurities in the original copper(II) oxide will also crystallise and contaminate the copper(II) sulfate.

Preparation of copper sulfate

Questions you could ask to enhance learning and focus your students on important aspects of the practical:

Skills that are covered in each practical:

- Measuring the volume of sulfuric acid
- Safe use of a Bunsen burner for warming the sulfuric acid
- Safe use of a water bath or electric heater for evaporating some of the water from the copper sulfate solution
- Safe use of filtration to separate unreacted copper(II) oxide from copper(II) sulfate solution
- Safe use of evaporation to evaporate some of the water from the copper(II) sulfate solution
- Safe use and handling of sulfuric acid, copper(II) oxide and copper(II) sulfate

Questions

Many different salts can be prepared from acids.

(a) The table shows the reactants used in two salt preparations.

Complete the table to show the name of the salt formed and the other product(s) in each case. **(4)**

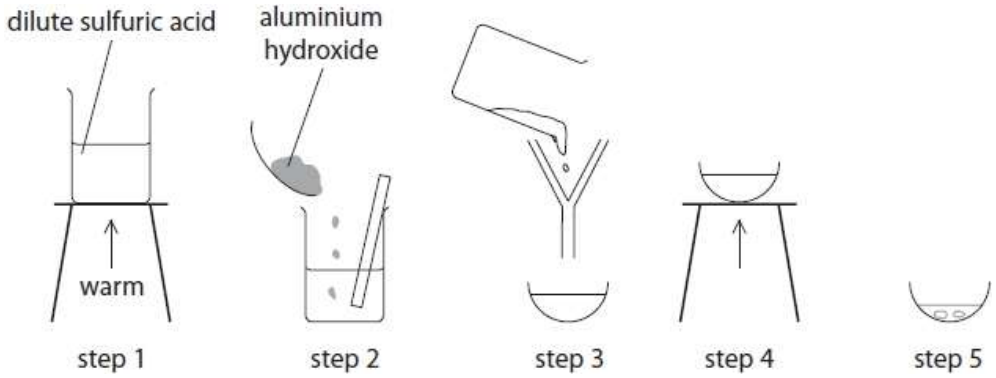
Reactants	Name of salt formed	Other product(s)
zinc + hydrochloric acid		
calcium carbonate + nitric acid		

(b) A student uses the reaction between aluminium hydroxide and dilute sulfuric acid to prepare a pure, dry sample of aluminium sulfate crystals.

The equation for the reaction used to prepare this salt is

$2Al(OH)_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O$

The diagram shows the steps in the student's method.



(i) State **two** ways to make sure that all the acid is reacted in step 2. **(2)**

1

_____

_____

2

_____

_____

(ii) State the purpose of filtration in step 3. **(1)**

_____

_____

(iii) In step 5, the basin is left to cool to room temperature to allow crystals of aluminium sulfate to form.

State **one** method of drying these crystals. **(1)**

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(Total for question = 8 marks)

Mark Scheme

Question number	Answer	Mark
(a)	1 mark for each box completed correctly Reactants: (zinc + hydrochloric acid) / (calcium carbonate + nitric acid) Name of salt formed: zinc chloride / calcium nitrate Other product(s): hydrogen / water + carbon dioxide	4

Question number	Answer	Mark
(b)(i)	• Use excess aluminium hydroxide (1) • Stir (thoroughly) (1)	2

Question number	Answer	Mark
(b)(ii)	To remove unreacted aluminium hydroxide/solid	1

Question number	Answer	Mark
(b)(iii)	Any one of: • leave in a warm place (1) • use filter paper or paper towel (1)	1