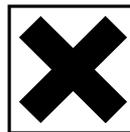# The preparation of tetraamminecopper(II) sulphate-1-water

Aims

You are going to make crystals of a complex salt, tetraamminecopper(II) sulphate-1-water, using copper(II) sulphate, concentrated ammonia and ethanol.

This is the equation for the reaction: $CuSO_4 \cdot 5H_2O + 4NH_3 \rightarrow Cu(NH_3)_4SO_4 \cdot H_2O + 4H_2O$

Methods

1. Prepare these items:
   - a hot water bath in a 100cm^3 beaker (use hot water from a kettle)
   - 6cm^3 of ethanol in a 50cm^3 beaker (use a graduated pipette)

2. Weigh between 1.4g and 1.6g of copper(II) sulphate using a ±0.1g balance.
   Weigh a test tube using a ±0.01g balance and record its mass.
   Add your copper(II) sulphate to the test tube, re-weigh using the ±0.01g balance and record its mass.

3. Add 4cm^3 of water using a graduated pipette and place the test tube in the water bath.
   Stir gently to dissolve the copper(II) sulphate.

4. Remove the test tube of copper(II) sulphate solution from the water bath.
   Do the next step in the fume cupboard while wearing gloves.
   Add, with stirring, 2cm^3 of concentrated ammonia solution to the copper(II) sulphate solution.

5. Pour the contents of the test tube into the beaker of ethanol, mix, then cool the mixture.

6. Using a Buchner funnel and flask, filter the crystals.
   Wash out your test tube with **cold** ethanol and add the washings to the Buchner funnel.
   Finally, rinse the crystals with **cold** ethanol.

7. Carefully scrape the crystals off the filter paper and onto a fresh piece of filter paper.
   Cover the crystals with a second piece of filter paper and pat to dry the crystals.

   Note that, to get the crystals completed dry, you may need to repeatedly move the crystals to dry parts of the filter paper.

8. Weigh a sample bottle and record its mass using a ±0.01g balance.
   Carefully transfer your crystals to the sample bottle. Re-weigh the sample bottle and record its mass.

Analysis

1. Calculate the relative formula masses of $CuSO_4 \cdot 5H_2O$ and $Cu(NH_3)_4SO_4 \cdot H_2O$.

2. Calculate the amount of copper(II) sulphate you used. Use your answer to calculate the theoretical yield (mass) of tetraamminecopper(II) sulphate-1-water your reaction should have produced.

3. Use your recorded masses to calculate the mass of copper(II) sulphate and the actual yield of product.

4. Calculate the % yield you obtained: $\text{\% yield} = \dfrac{\text{actual yield of product}}{\text{theoretical yield of product}} \times 100$

Evaluation

Comment on your % yield, and explain any loss or gain in mass compared with the theoretical yield.

The preparation of tetraamminecopper(II) sulphate-1-water

Technicians' Notes

Per class:

copper(II) sulphate-5-water, $CuSO_4.5H_2O$
3 x 1dp balances
1 x 2dp balance
2 x kettles
250cm^3 ethanol
50cm^3 concentrated ammonia
crushed ice
filter paper to fit Buchner funnels
additional filter paper for drying purposes
Buchner funnels and flasks
water pumps

Per student:

1 x sample bottle with stopper
1 x test tube
1 x 50cm^3 beaker
1 x 100cm^3 beaker
1 x 10cm^3 graduated pipette
1 x pipette filler
1 x spatula
1 x stirring rod
1 x pair of gloves