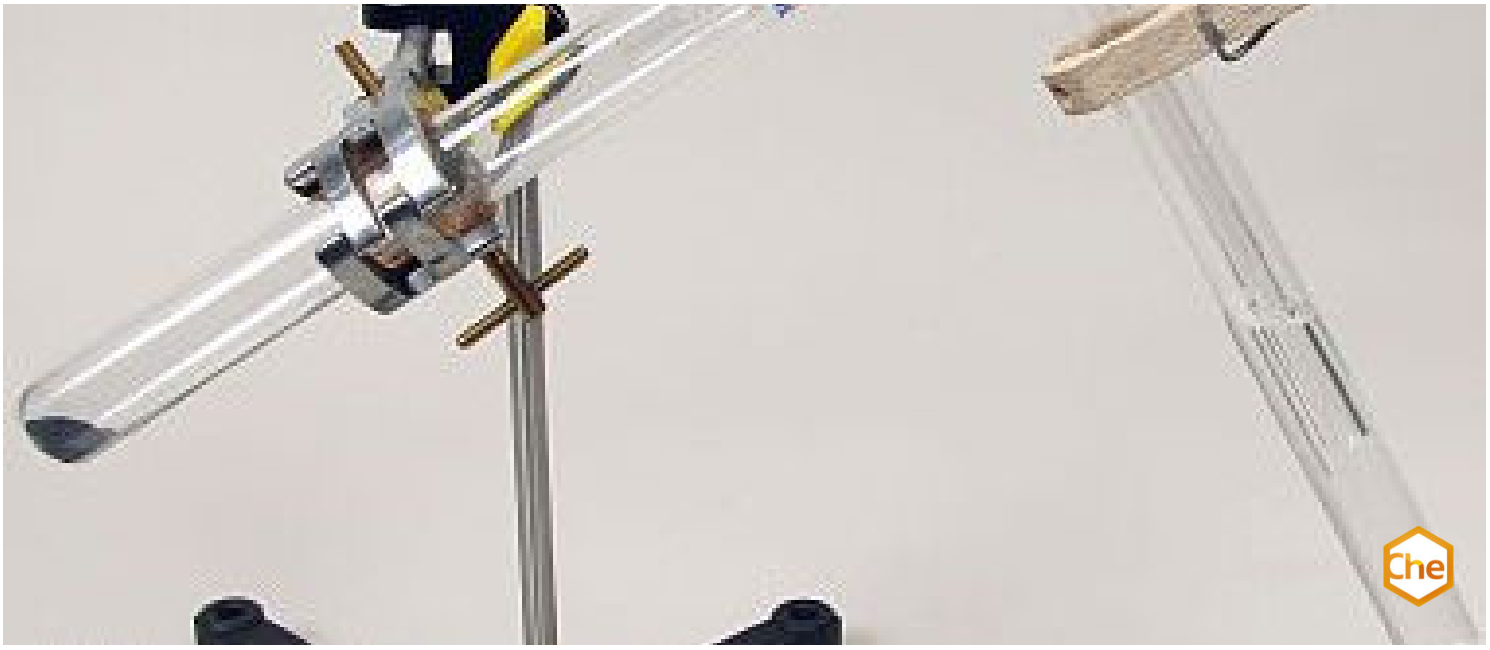
Reduction of copper oxide



In this student experiment, reduction (as a reversal process of oxidation) is investigated using the example of the reduction of copper oxide to copper. It can be seen that many oxides (formed by a thermal reaction of atmospheric oxygen with an element) cannot be thermally decomposed in a simple way, but can be returned to the corresponding element with the help of reducing agents (e.g. carbon).

Chemistry > Inorganic chemistry > Acids, bases, salts

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/633b29fbbdf6080003a94203

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Teacher information

Application

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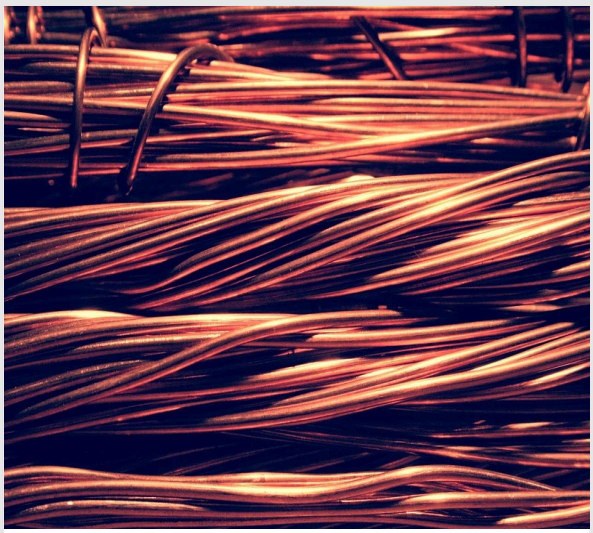

Copper wire

Oxidation means reaction with oxygen. It is the removal of oxygen from an oxide.

In this experiment, the reduction of copper oxide with carbon is carried out.

If a mixture of copper oxide and carbon is heated, a colourless gas escapes which clouds a clear lime water solution or a clear barite solution. The turbidity is evidence of the gas carbon dioxide. You can see that a reddish substance is produced, namely copper.

Carbon is a reducing agent here and is itself oxidised to carbon dioxide. Carbon removes the oxygen from the copper oxide.

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Other teacher information (1/2)

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Prior knowledge

A reduction is a chemical reaction in which one or more electrons are accepted by a particle.

A reduction always occurs together with the oxidation of the particle that supplied the electrons and which is called the reducing agent.

Principle

In this experiment, the students investigate reduction as a reversal process of oxidation using the reduction of copper oxide as an example.

It can be determined that oxides that have been formed by a thermal reaction of atmospheric oxygen with an element can be reduced to the corresponding element with the help of reducing agents.

Other teacher information (2/2)

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Learning objective

Many oxides cannot be thermally decomposed in a simple way.

These oxides can be returned to the element with the help of reducing agents.

Tasks

- The students extract copper from copper oxide.
- They investigate suitable reducing agents to split oxides.

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Safety instructions

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- Acids cause severe burns.
- Use protective goggles/gloves!
- The general instructions for safe experimentation in science lessons apply to this experiment.
- For H and P phrases, please refer to the safety data sheet of the respective chemical.

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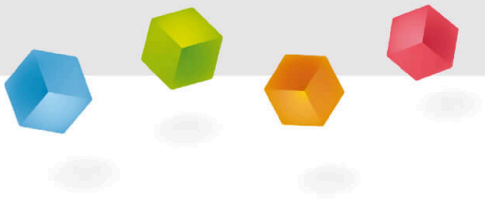

Student information

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Motivation

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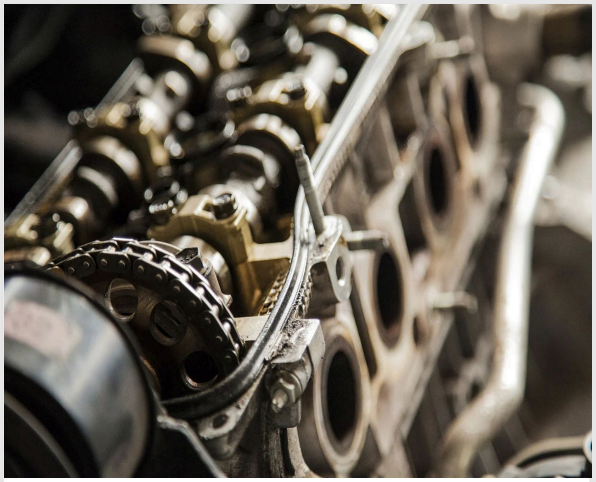

Metals are necessary everywhere, even in cars

Metals are very important for industry. Whether in cars or mobile phones, different metals are used everywhere.

However, metals very rarely occur in nature in pure form. Most are combined with other substances and exist, for example, as metal oxides (combined with oxygen).

To use the metals, they have to be separated from these substances. There are different methods.

For this experiment, the reduction of metal oxides by reducing agents such as carbon is very important.

Tasks

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Carbon is a

- Reducing agent
- Oxidising agent

How can the element be recovered from an oxide?

- Carry out the experiment to extract copper from copper oxide.
- Note down your observations and answer the questions in the report.

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Boss head	02043-00	1
4	Porcelain dish, 75ml, d = 80 mm	32516-00	1
5	Test tube,180x20 mm, PN19	MAU-17080101	1
6	Glass tubes,right-angled	MAU-10030701	1
7	Test tube, 180x18 mm,100pcs	37658-10	1
8	Test tube rack f. 6 tubes, wood	37685-10	1
9	Universal clamp	37715-01	1
10	Test tube brush w. wool tip,d20mm	38762-00	1
11	Test tube holder, up to d 22mm	38823-00	1
12	Rubber stopper, d = 22/17 mm, 1 hole	39255-01	1
13	Protecting glasses, clear glass	39316-00	1
14	Spatula, powder, steel, l=150mm	47560-00	1
15	Glycerol, 250 ml	30084-25	1
16	Charcoal powder 250 g	30087-25	1
17	Copper-II oxide,powder 100 g	30125-10	1
18	Butane burner with cartridge, 220 g	32180-00	1
19	Calcium hydroxide solution 1000ml	31458-70	1

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Set-up (1/3)

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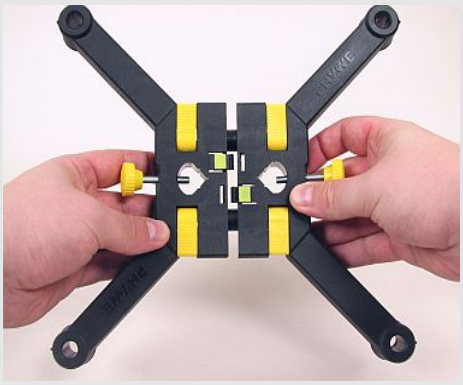
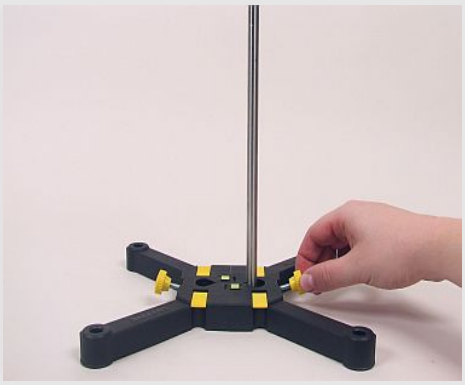
Assemble a tripod as shown in the picture below. Put the two halves of the tripod base together. Position a tripod rod in the tripod base and attach a socket to the tripod rod.

Place the tripod stably on the worktop





Set-up (2/3)

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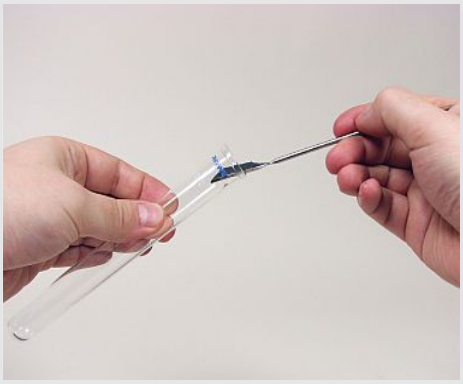
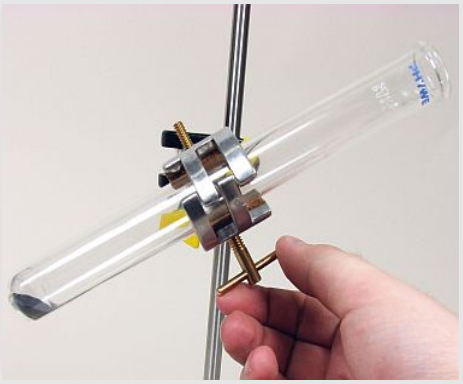
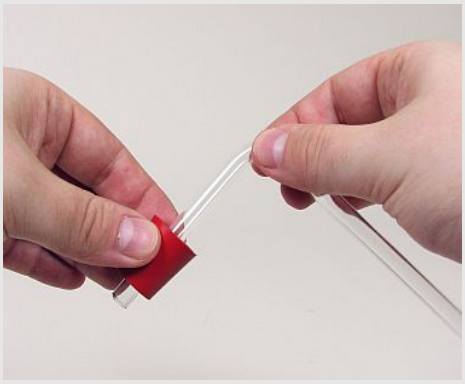
Fill a spatula of prepared copper oxide/carbon powder mixture into a test tube. Insert a clamp into the sleeve and fix the test tube with the clamp. Put a drop of glycerine on the short end of the angle tube and carefully twist it into the hole of the rubber stopper. Now put the rubber stopper on the test tube.







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Set-up (3/3)

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The experimental setup should now look like the illustration on the left!

Make sure that the test tube is closed tightly with the stopper.

Take two test tubes and a test tube rack.

Fill a test tube halfway with lime water.

Put a spatula full of copper oxide into the second test test tube.

Place both test tubes in the test tube rack.

Procedure (1/3)

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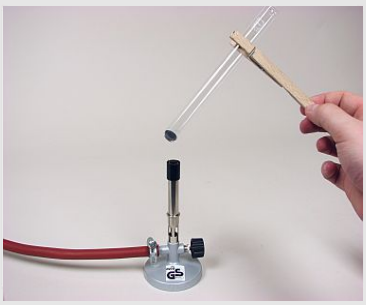

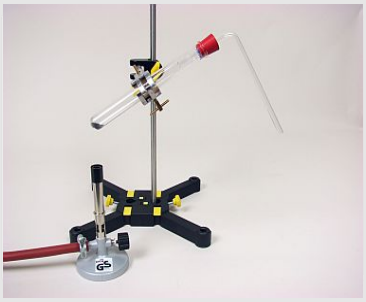

Using a test tube holder, take the test tube filled with copper oxide and heat it over a gas burner to glowing.

Look at the copper oxide before and after heating and put the test tube back into the test tube rack after cooling.

Now heat the test tube that is filled with the copper oxide mixture.

Watch out for rising powder.

Stop heating here and tap the powder back down.

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Procedure (2/3)

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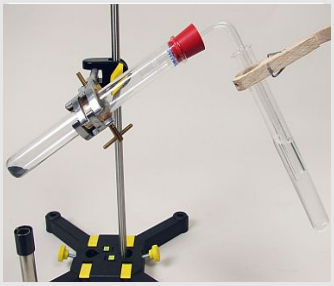
When the reaction starts, immediately extinguish the burner and insert the long end of the angled tube into the test tube with lime water.

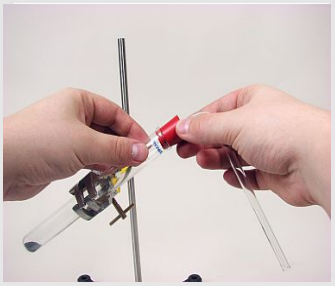
After the reaction is complete, first put back the test tube with the lime water, then let the test tube cool down.

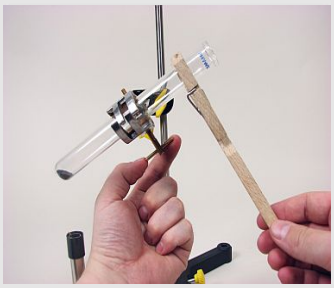
After the test tube has cooled down completely, remove the stopper with the angled tube.

Use the test tube clamp to remove the test tube and pour the contents into the evaporating dish.

See the illustrations on the right.







Procedure (3/3)

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Look closely at the residue in the test tube.

Check the residue with the spatula for firmness and appearance.

Disposal

- Collect copper oxide residues from the test tube in an appropriately labelled container and reuse for similar experiments.
- Dispose of the mixture from the evaporating dish as heavy metal waste.
- Put lime water into the container for acids and alkalis.

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Report

Task 1

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Write down your observations.

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Task 2

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Copper (II) oxide becomes copper

- oxidised.
- reduced.

Give the processes in a word equation !

Copper (II) oxide + _____ → _____ + _____.

Check

Task 3

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What is the opposite of a reducing agent?

The opposite of a reducing agent is an _____. An oxidising agent is a substance that can _____ other substances and is itself _____ in the process. An example of this is _____. Oxygen difluoride and _____ itself are the strongest oxidising agents.

- reduced
- fluorine
- hydrogen peroxide
- oxidise
- oxidising agent

Check

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Slide	Score / Total
Slide 8: Oxidising and reducing agents	0/2
Slide 18: Multiple tasks	0/6
Slide 19: Oxidising agent	0/5

Total 0 / 13

Solutions | Repeat | Export text

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