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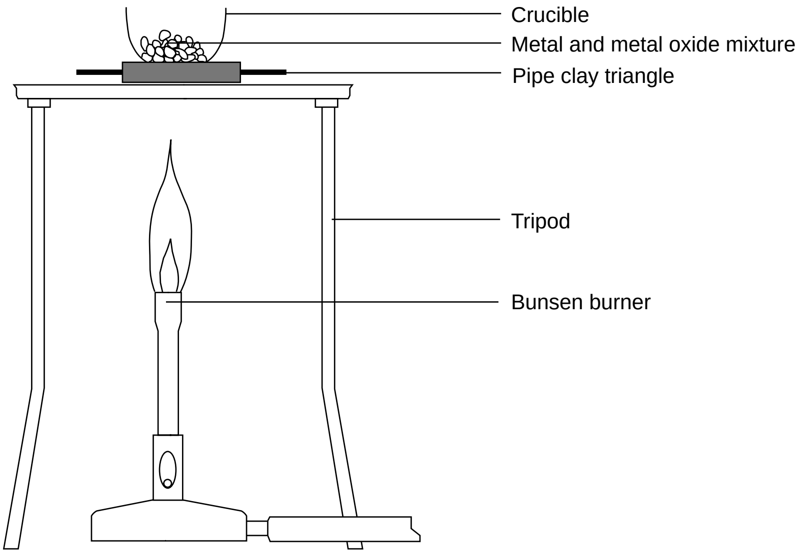
Competition for oxygen

Introduction

This experiment involves the reaction of a metal with the oxide of another metal. When reactions like these occur, the two metals compete for the oxygen. The more reactive metal finishes up with the oxygen (as a metal oxide). If the more reactive metal starts as the oxide then no reaction takes place.



What to record

Decide whether a reaction takes place in each case.

What to do

1. Set up the apparatus as shown in the diagram.
2. Place one spatula measure of one of the reaction mixtures into the crucible.
3. Heat the mixture gently at first and then more strongly. Watch carefully to see what happens but do not lean over the crucible.
4. Allow the mixture to cool. Look for evidence that a reaction has taken place.
5. Use your observations to decide which of the two metals has ‘won’ the competition for oxygen – which is more reactive?
6. Choose another mixture and repeat the experiment.

Safety

Wear eye protection. Do not lean over the crucible.

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Questions

1. Complete the following table.

Reaction mixture	Does this mixture react?
Magnesium oxide and iron	
Lead oxide and iron	
Lead oxide and zinc	
Iron oxide and zinc	

2. Write word equations for any reactions that occur.

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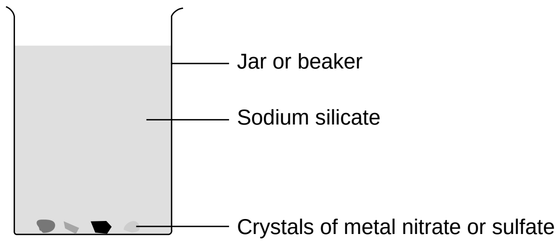
Making a crystal garden

Introduction

The formation of molten silicates in the Earth's mantle involves the formation of silicon dioxide and its subsequent reaction at high temperatures with metal oxides. In this experiment coloured silicates are formed in the laboratory.



What to record

What is observed.

What to do

1. Pour sodium silicate solution (**Irritant**) into a glass jar to a depth of 3 cm. Add hot water to this solution, stirring well during the addition. The final depth of liquid required is about 12 cm. Stirring should continue until no separate silicate layer is visible.
2. Allow the solution to stand until the liquid is quite still.
3. Use forceps to drop a few crystals into the liquid, try and choose different colours. Ensure that the crystals do not fall close to each other.
4. Cover the jar and leave overnight.

Safety

Wear eye protection.

Questions

1. Why are the silicate crystals different colours?
2. Why could silicates not be formed in the laboratory in exactly the same way as they are formed in the Earth's mantle?

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Extracting metal with charcoal

Introduction

This extraction experiment consists of two competition reactions. A metal oxide is reacted with charcoal. If the charcoal (carbon) is more reactive it will remove the oxygen from the metal oxide and leave a trace of metal in the reaction vessel. Start with an oxide of lead, then observe what happens to an oxide of copper.

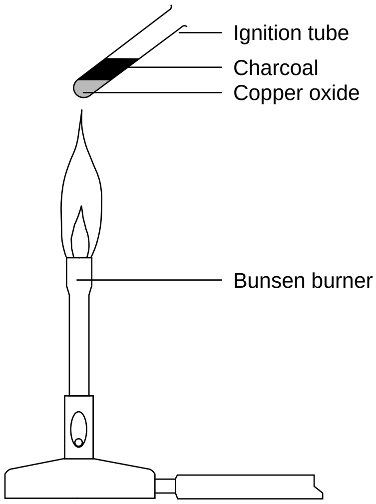
What to do

Lead oxide

1. Add one spatula of lead oxide (**Toxic**) to the ignition tube.
2. Add one spatula of charcoal powder.
3. Mix this mixture using an unfolded paper clip.
4. Strongly heat this mixture for five minutes in the Bunsen burner flame.
5. Allow to cool.
6. Tip the mixture onto a heatproof mat.

Copper oxide

1. Add one spatula of copper oxide (**Harmful**) to the ignition tube.
2. Carefully add one spatula of charcoal powder on top without any mixing.
3. Strongly heat these two layers for five minutes in the Bunsen burner flame.
4. Allow to cool and then look closely at the ignition tube where the powders meet.



Safety

Wear eye protection.

Questions

1. Why should the mixture be cool before it is tipped out of the ignition tube at the end?
2. What happens to the carbon if it takes oxygen from the metal oxide?
3. Write the equation for the reaction of lead oxide.
4. Which element is oxidised and which is reduced in this reaction?

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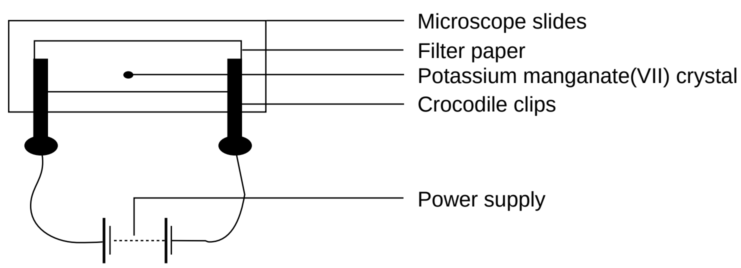
The migration of ions

Introduction

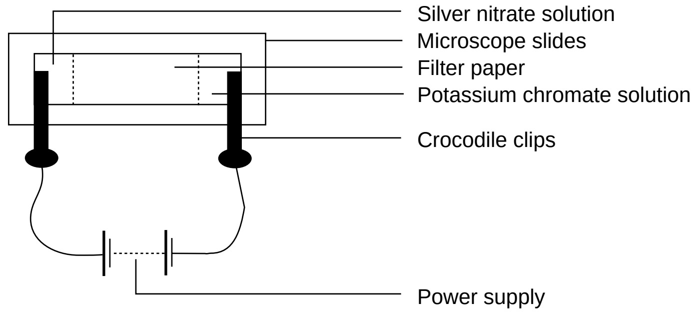
In an electrolysis experiment, the ions migrate towards electrodes of opposite charge. In the first part of this experiment the migration of manganate ions is observed.

In the second part of this experiment, silver and chromate ions meet as they migrate towards opposite electrodes. Silver chromate, an insoluble red compound is formed.

Part 1



Part 2



What to record

Draw a diagram to show the filter paper at the end of both experiments. Mark the ends of the paper with a + or – to show which terminal of the power supply each end is connected to.

What to do

Part 1

1. Cut a piece of filter paper slightly smaller than a microscope slide. Draw a faint pencil line across the middle.
2. Moisten the filter paper with tap water. Fasten the paper to the slide with crocodile clips.
3. Use forceps to put a small crystal of potassium manganate(VII) in the centre of the paper.
4. Connect the clips to a power supply set at not more than 20 V DC. Switch on and wait about ten minutes.

Part 2

1. Cut a piece of filter paper slightly smaller than a microscope slide. Draw a faint pencil line across the middle.
2. Moisten the paper with tap water. Fasten the paper to the slide with crocodile clips.

3. At the end of the paper where the positive electrode will be placed, moisten the paper with silver nitrate solution. (**Will stain fingers**)
4. At the end of the paper where the negative electrode will be placed, moisten the paper with potassium chromate solution. (**Toxic**).
5. Connect the clips to a power supply set at no more than 20 V DC. Switch on and wait about 10 min, or until you see a change.

Safety

Wear eye protection.

Questions

1. Potassium manganate (VII) consists of two ions - potassium ions and manganate (VII) ions. One of these ions is coloured. Which is it likely to be?
2. From the direction of movement, what does this indicate about the charge on the manganate ion?
3. What is happening in the second experiment?
4. The formula of silver nitrate is $AgNO_3$ and potassium chromate is K_2CrO_4. Write the ionic formula equation for the reaction.

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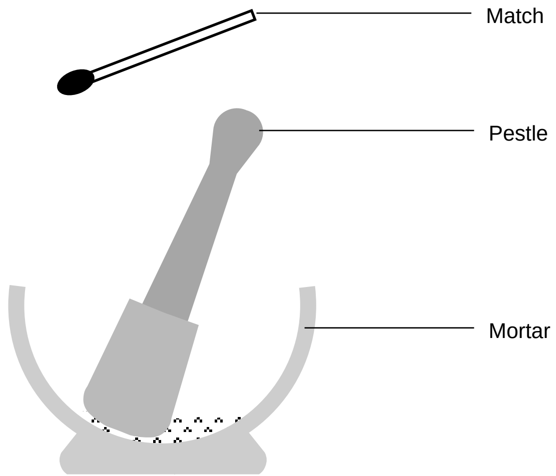
The reduction of iron oxide by carbon

Introduction

Metals high in the reactivity series will reduce the oxides of those lower in the series. The oxides of metals between zinc and copper in the reactivity series can be reduced by carbon. In this experiment, sodium carbonate is used to fuse the reactants in intimate contact.



What to do

1. Char the point of a used match, moisten it with a drop of water and rub on some sodium carbonate crystals.
2. Rub the point in some powdered iron(III) oxide (Fe_2O_3) and heat in a blue Bunsen burner flame until the point glows strongly.
3. Allow to cool.
4. Crush the charred head in a mortar and pestle then run a magnet through the pieces.

Safety

Wear eye protection.

Questions

1. What does 'reduction' mean?
2. Carbon does not reduce aluminium oxide. Where would carbon be placed in this reactivity series?
   Potassium
   Sodium
   Calcium
   Magnesium
   Aluminium
   Zinc
   Iron
   Lead
   Copper

What other information would you need to determine carbon's exact place?

3. Explain why calcium oxide cannot be reduced using carbon.

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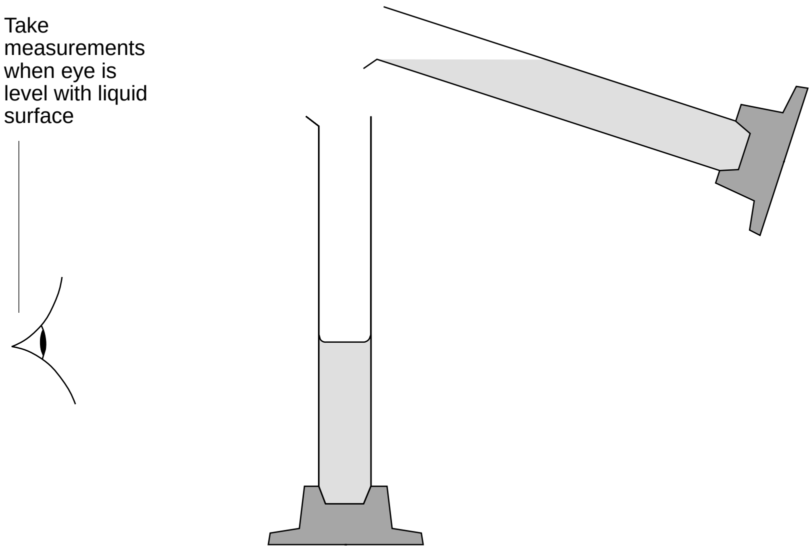
Experiments with particles

Introduction

When materials are added together, they may acquire new properties. When a solid and a liquid are mixed, the solid may or may not dissolve. When two liquids are mixed they may become one liquid or stay separate. These experiments provide an opportunity to predict and then observe what happens.



What to record

Activity 1

Volume of peas/cm^3	Volume of sand/cm^3	Combined volume/cm^3

Activity 2

Volume of alcohol/cm^3	Volume of water/cm^3	Combined volume /cm^3

Activity 3

Initial volume of water/cm^3	Final volume of salt solution/cm^3

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What to do

Activity 1

1. Add approximately 25 cm^3 of dried peas and 25 cm^3 of sand to separate measuring cylinders. Accurately measure and record the volumes.
2. The contents of one cylinder is added to the other and shaken until the two substances are mixed together.
3. Place the measuring cylinder on the bench and gently shake from side to side to allow the mixture to settle.
4. Read the combined volume.

Activity 2

1. Add approximately 25 cm^3 of ethanol (**Highly flammable**) and 25 cm^3 of water to separate measuring cylinders. Accurately measure and record the volumes.
2. The contents of one cylinder is added to the other and shaken from side to side for 15–30 seconds until the two substances are mixed together and then left to stand for one minute.
3. Read the combined volume.

Activity 3

1. To the measuring cylinder add approximately 75 cm^3 of water. Accurately measure and record the volume.
2. Spatulas of salt should then be added one at a time until the salt begins to be left at the bottom of the cylinder, despite continued stirring.
3. The volume reading on the side of the cylinder should again be recorded.

Safety

Wear eye protection.

Questions

1. What is the similarity between the first two activities?
2. What is an explanation for the result in the last activity?

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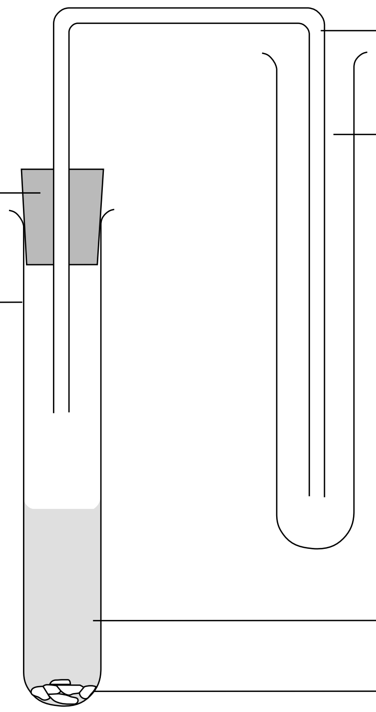
Particles in motion?

Introduction

These two activities suggest that particles in a gas are in motion.



What to do

1. Set up the apparatus as shown in the diagram.
2. Put a spatula measure of calcium carbonate into the first test-tube.
3. Add 10 cm^3 of hydrochloric acid and quickly replace the bung and delivery tube. Ensure the delivery tube reaches almost to the bottom of the second test-tube.
4. Allow the gas to pass into the second test-tube for about one minute, then remove the delivery tube and cork the test-tube.
5. Hold the test-tube upside down over a similar test-tube containing air.
6. Remove the cork and place the tubes mouth to mouth.
7. After 5 min, cork both tubes and test the contents for carbon dioxide (swirl a little limewater round in the test-tube). Write down what happens in both tubes.
8. Repeat this experiment but this time at step 5 hold the test-tube of air upside down over a test-tube of carbon dioxide.

Safety

Wear eye protection.

Questions

1. Which of the four test-tubes contained carbon dioxide at the end of the experiment?
2. Is air or carbon dioxide more dense?
3. Does this experiment support the idea that the particles of a gas are in motion? Give your reasons.

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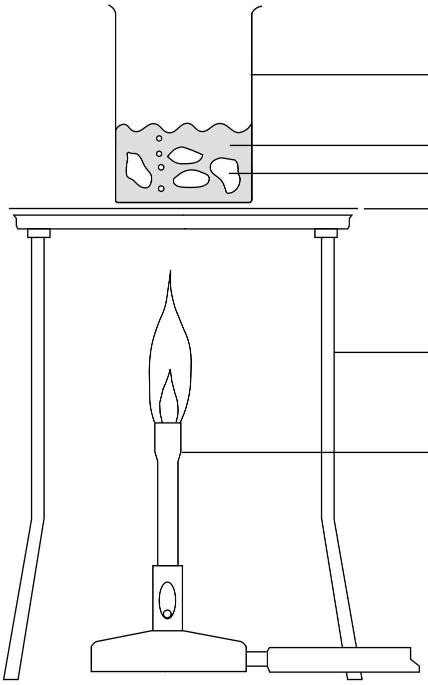
Making a pH indicator

Introduction

A pH indicator is a substance that has a different colour when added to acid or alkali. In this experiment a pH indicator is made from red cabbage.



What to record

Record the colour of the cabbage indicator in the three solutions.

What to do

1. Boil about 100 cm^3 of tap water in a beaker.
2. Add three to four pieces of red cabbage to the boiling water.
3. Boil for about 5 min. The water should have turned blue or green.
4. Turn off the Bunsen burner and allow the beaker to cool for a few minutes.
5. Place three test-tubes in a rack. Half fill one with alkali, one with acid and one with deionised water.
6. Decant approximately 2–3 cm height of cabbage solution into each test-tube.

Safety

Wear eye protection.

Questions

1. What colour is the cabbage indicator when neutral?
2. What colour is the cabbage indicator when alkali?
3. What colour is the cabbage indicator when acid?

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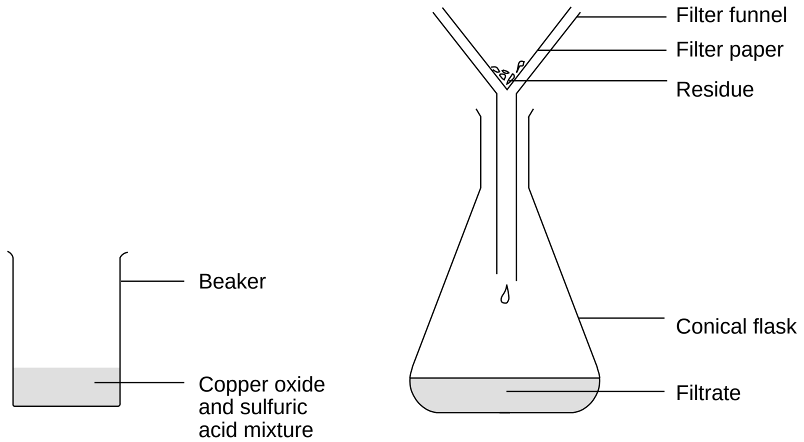
The reaction between a metal oxide and a dilute acid

Introduction

Many metal oxides react with dilute acid. In this experiment copper(II) oxide is reacted with dilute sulfuric acid.



What to do

1. Pour about 20 cm^3 of dilute sulfuric acid into a beaker.
2. Heat on a tripod and gauze using a Bunsen burner until the acid just boils.
3. Add copper(II) oxide to the hot acid, a spatula measure at a time and stir after each addition, continue until no more dissolves.
4. Filter the mixture, while still hot, into a conical flask.

Safety

Wear eye protection.

Questions

1. What is the residue on the filter paper?
2. What does the filtrate contain?
3. Write an equation for the reaction between solid copper(II) oxide and dilute sulfuric acid.
4. How could the solid product be isolated from the filtrate?

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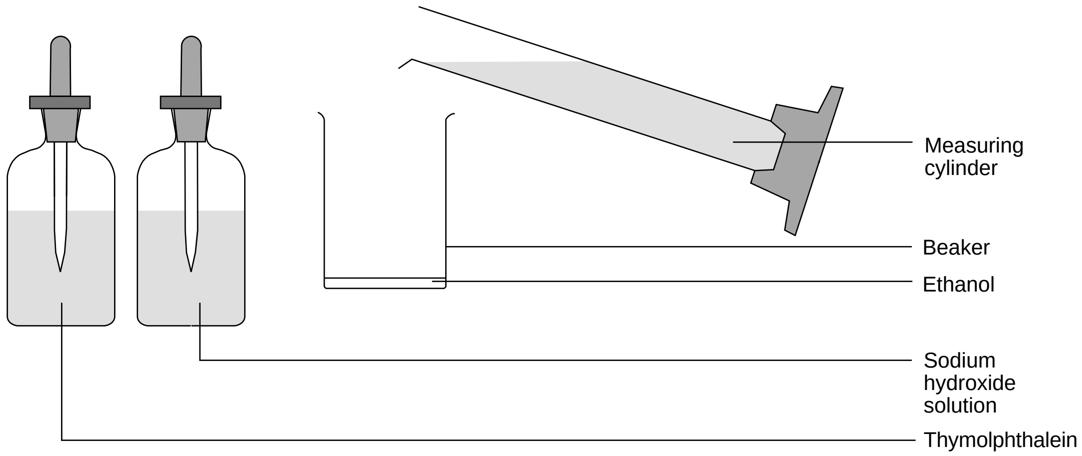
Disappearing ink

Introduction

A blue liquid is made. This liquid is tested on a white page, it leaves a blue ink spot. In a few seconds, the blue spot disappears.



What to do

1. Place 10 cm^3 of ethanol (**Highly flammable**) in a small beaker.
2. Add a few drops of thymolphthalein (**Highly flammable**) indicator solution.
3. Add just enough NaOH solution (**Irritant**), dropwise, to produce a deep blue colour in the solution.
4. Using a small paint brush test the 'disappearing ink' on a white page.

Safety

Wear eye protection. Care with teat pipettes that contain sodium hydroxide.

Questions

The colour change occurs because sodium hydroxide reacts with a gas in the air.

1. Which gas in the air causes this colour change?
2. Write a word equation for the reaction.
3. Write a formula equation for the reaction.