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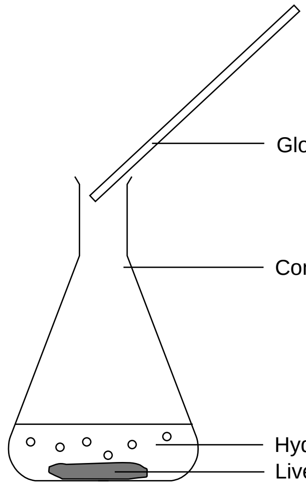
Testing for enzymes

Introduction

Enzymes are biological catalysts, they increase the speed of a chemical reaction. They are large protein molecules and these enzymes are very specific to certain reactions. Hydrogen peroxide decomposes slowly in light to produce oxygen and water. There is an enzyme called catalase that can speed up (catalyse) this reaction.



What to record

What do you see? What gas is produced, and which enzyme source makes the most effective catalyst?

What to do

1. Using a measuring cylinder, put 25 cm^3 of hydrogen peroxide solution into a conical flask.
2. Add a small piece of liver.
3. Test the gas given off with a glowing splint.
4. Dispose of this mixture, including the liver, into a bucket, and put another 25 cm^3 of hydrogen peroxide solution in the flask.
5. Add a small piece of potato.
6. Test the gas given off with a glowing splint.
7. Repeat this experiment with a piece of celery instead of potato.

Safety

Wear eye protection.

Questions

1. Which gas is produced in this reaction?
2. What is the test for this gas?
3. Which enzyme source produces the fastest reaction (liver, potato or celery)?
4. Write a word equation for this reaction.
5. How could the rate of gas production be measured?

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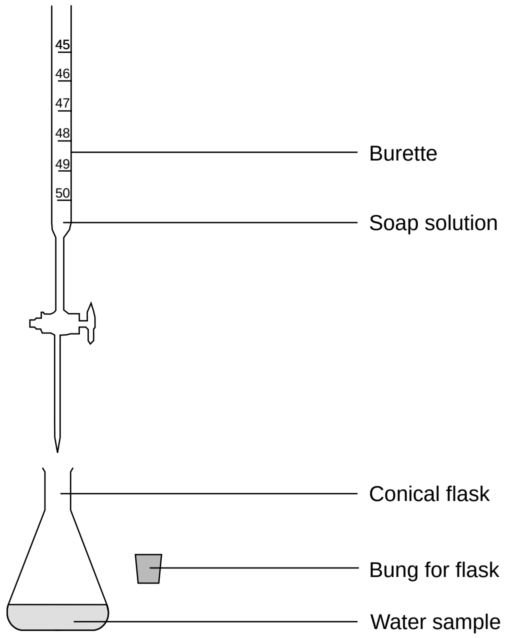
Testing water hardness

Introduction

Tap water in some parts of the country is very pure and is said to be ‘soft’. It easily makes a lather with soap. Water from other parts may contain various dissolved impurities and is described as ‘hard’ water. Temporary hardness may be removed by boiling, but permanent hardness survives the boiling process.

In this practical activity, water hardness can be measured by finding out the volume of soap solution required to form a permanent lather with a known volume of water.



What to record

Record the volume of soap needed to produce a permanent lather with each type of water. Note any difference between the appearance of the samples after the addition of soap solution.

Water type	**Volume of soap required a to produce permanent lather /cm^3**
Rainwater	
Seawater	
Temporary hard water	
Seawater, boiled then cooled (permanent hard water)	
Temporary hard water, boiled then cooled	

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What to do

1. Collect a conical flask and bung. Check the bung is a good fit.
2. Measure 10 cm^3 of water sample into a conical flask using a measuring cylinder.
3. Using the burette add 1 cm^3 of soap solution to the water. Stopper the flask and shake vigorously. If no lather is produced, add another 1 cm^3 of soap solution. Continue in this way until a permanent lather (one that lasts for 30 seconds) is obtained. Record the volume of soap solution needed to produce a permanent lather.
4. Repeat this procedure for the other water samples.

Safety

Wear eye protection.

Questions

1. Is the rainwater hard or soft?
2. Is seawater hard or soft?
3. Does seawater contain temporary hardness, permanent hardness or both?

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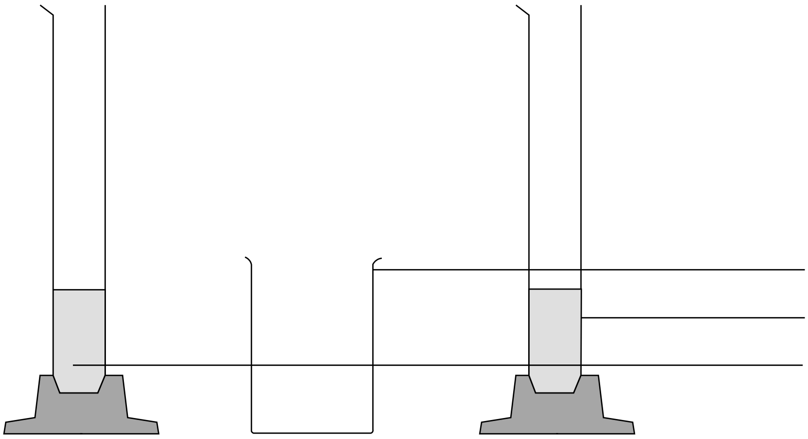
A chemical test for water

Introduction

Some chemicals change colour when water is added to them. Some coloured chemicals owe their colour to the water molecules that are associated with them. Cobalt(II) chloride is one colour when dry and another colour when damp. In this experiment these colours are identified.



What to do

1. Add 4 cm^3 of cobalt(II) chloride solution to a small beaker.
2. Add 4 cm^3 of salt solution.
3. Dip half of the filter paper into the solution, using tongs.
4. Boil a beaker of water and carefully lift the beaker off the tripod onto the bench.
5. Allow the paper to dry. Wrap it around the beaker of hot water to speed up drying.
6. Observe differences in colour between the wet and the dry cobalt(II) chloride paper.
7. Place the dry cobalt(II) chloride paper near an open window on a humid day and observe what happens.

Safety

Wear eye protection.

Avoid contact with the cobalt(II) chloride paper and the cobalt(II) chloride solution. Cobalt(II) chloride is toxic.

Questions

1. For what other purposes might the sodium chloride be on the paper, in addition to supplying more chloride ions?
2. How many times can the cobalt(II) chloride paper cycle between colours?
3. Suggest a practical application for the cobalt(II) chloride paper.

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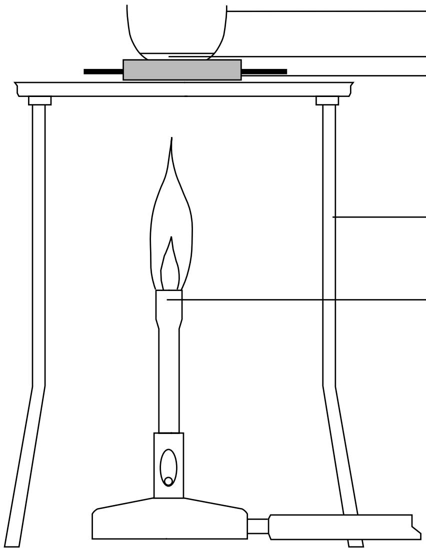
Forming glass

Introduction

The aim of this experiment is first to make some glass and secondly to make some coloured glass by adding other compounds to the molten glass mixture.



What to record

Record the colour of the glass produced when a speck of a particular oxide is added.

What to do

1. Weigh 6.5 g of lead(II) oxide, 3.5 g of boric acid and 0.5 g of zinc oxide. Mix thoroughly in the boiling tube.
2. Pour the mixture into a crucible and place it on a pipe clay triangle.
3. Heat strongly until it becomes molten and runny. Using tongs pour one or two drops of the molten glass onto your heatproof mat.
4. Allow the beads to cool for 5 min and then examine them.
5. Using an unfolded paper clip pick up a tiny amount of transition metal oxide and drop it into the remaining molten mixture. Stir in the powder using the paper clip.

Do not add too much powder or you will produce a very dark piece of glass.

Safety

Wear eye protection. Care must be taken with the lead(II) oxide, as it is toxic. Avoid raising the dust. Some of the other chemicals are harmful.

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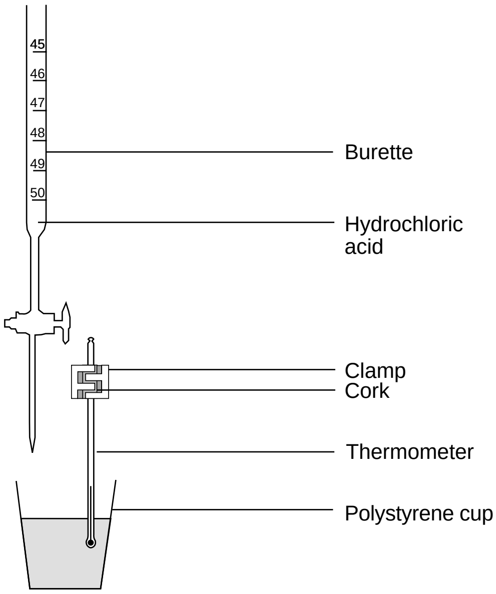
Thermometric titration

Introduction

The aim of this experiment is to measure the maximum temperature reached during the reaction between hydrochloric acid and sodium hydroxide solution. The solutions of acid and alkali do not have the same concentration. The volumes that have reacted at the highest temperature reached, represent the ‘end point’ of the titration.



What to record

Record your results in a table.

Volume of acid added/cm^3	Temperature/ °C

What to do

1. Using a measuring cylinder, place 15 cm^3 of sodium hydroxide (**Corrosive**) into the polystyrene cup and measure the temperature.
2. Using the burette add a small portion (3–5 cm^3) of dilute hydrochloric acid to the solution in the polystyrene cup. Swirl the solution and measure the highest temperature reached.
3. Immediately add a second small portion of the dilute hydrochloric acid, swirl and again measure the highest temperature.
4. Continue in this way until there are enough readings to decide the highest temperature for the experiment.

Safety

Wear eye protection.

Questions

1. What is the highest temperature reached in this reaction?
2. Draw a graph of your results.

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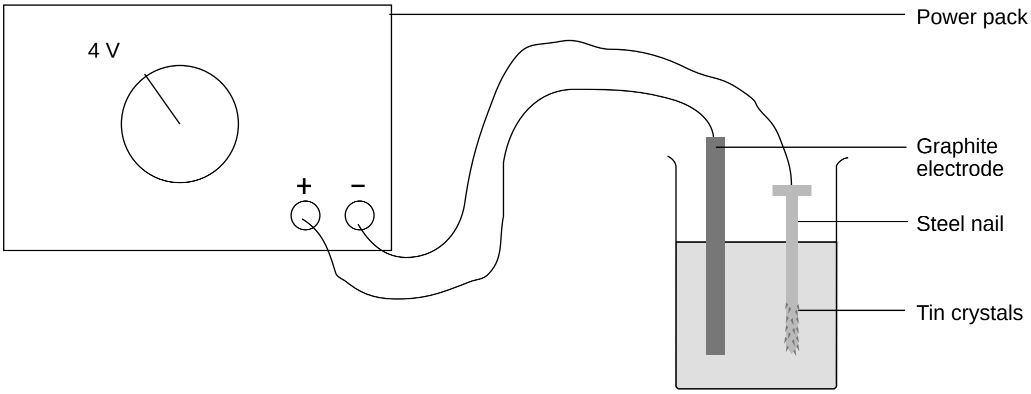
The formation of metal crystals

Introduction

Metal crystals can be grown using several methods – *eg* displacing one metal by another from a salt solution, by cooling a liquefied metal and by electrolysing a salt solution. This experiment illustrates the electrolysis of tin(II) chloride solution.



What to record

What was done and what was observed.

Note your observations at each electrode.

What to do

1. Set up an electrolysis experiment as shown in the diagram.
2. Ensure the nail is connected as the cathode (-ve terminal) and the carbon rod as the anode (+ve terminal).
3. Set the voltage to 4 V
4. Observe the formation of tin crystals on the nail cathode.

Safety

Wear eye protection. Do not inhale the fumes produced. Do not electrolyse for too long. The tin(II) chloride is dissolved in strong acid (**Irritant solution**).

Questions

1. What is the product formed at the carbon anode?
2. Give one common household use of steel electroplated with tin.
3. Write an ionic equation for the reaction at the cathode.

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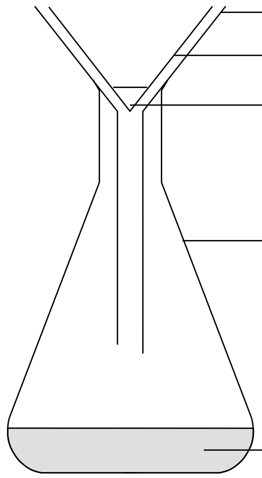
Formation of a salt which is insoluble in water

Introduction

When solutions of two soluble salts are mixed, a solid may form. The solid is called a precipitate, and the reaction is called a precipitation reaction. Precipitation reactions are used to make insoluble salts.



What to record

What was done and what was observed.

What to do

1. Mix 25 cm^3 of magnesium sulfate solution and 25 cm^3 of sodium carbonate solution in a conical flask.
2. Filter the mixture to remove the spectator ions.
3. Remove the filter paper with the magnesium carbonate and leave to dry.

Safety

Wear eye protection.

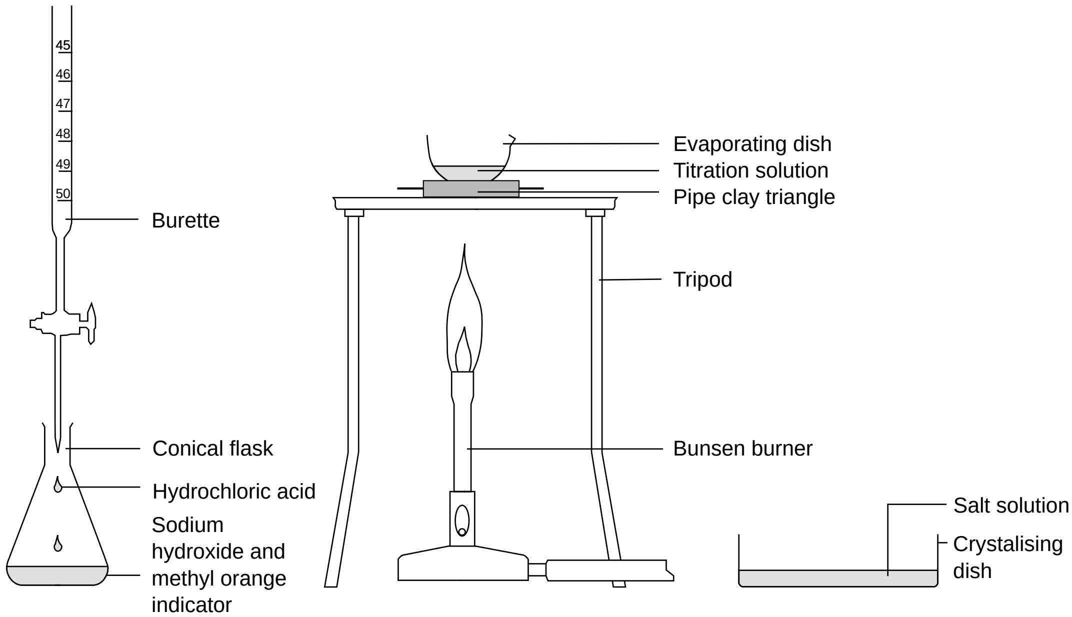
Questions

1. Write a word equation for this reaction.
2. Write a formula equation for this reaction.
3. Write an ionic equation for this reaction.
4. What is meant by spectator ions?

Titration of sodium hydroxide with hydrochloric acid

Introduction

In this experiment sodium hydroxide is neutralised with hydrochloric acid to produce the soluble salt sodium chloride. This is then concentrated and crystallised in a crystallising dish.



What to record

What was done and what was observed.

What to do

1. Add 25 cm^3 of sodium hydroxide solution (**Corrosive**) to a conical flask using a measuring cylinder and add a couple of drops of methyl orange indicator.
2. Fill the burette with hydrochloric acid and run through to the zero mark (use a funnel to fill the burette and a beaker to collect the excess acid).
3. Add the hydrochloric acid to the sodium hydroxide solution in small volumes swirling after each addition. Continue until the solution turns red and record this reading on the burette.
4. Carefully add this volume of fresh hydrochloric acid to another 25 cm^3 of sodium hydroxide solution to produce a neutral solution.
5. Reduce to about half the volume using an evaporating dish on a gauze over a Bunsen burner flame.
6. Leave to evaporate in a crystallising dish to produce a white crystalline solid.

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Safety

Wear eye protection.

Questions

1. What is the everyday name for sodium chloride?
2. This reaction is a specific example of the general reaction:
   Acid + alkali → salt + water.
   Write a word equation for this specific reaction.
3. Write a formula equation for this reaction.
4. Why must you use another 25 cm^3 of sodium hydroxide solution to make *pure* sodium chloride?

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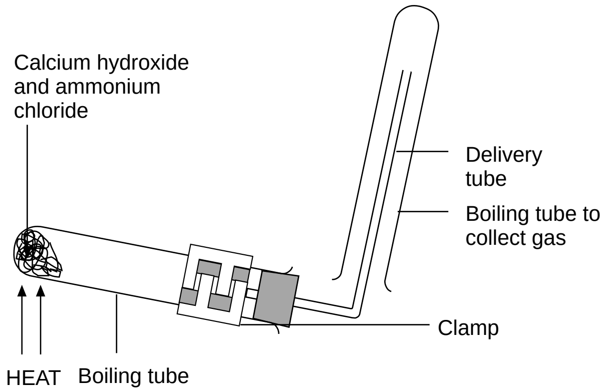
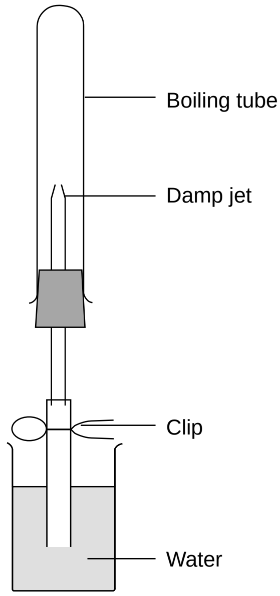
The properties of ammonia

Introduction

In this experiment, ammonia is produced and collected. The gas is tested and the solubility in water is illustrated by the use of a fountain experiment.



(A)



(B)

What to record

Observe what happens at each stage. Record the results in the table.

Test	**Observations**
Heating the mixture	
Lighted splint test	
Damp red litmus paper	
Damp Universal Indicator paper	
Hydrochloric acid bottle stopper	
Opening the clip	

What to do

1. Add two spatulas of calcium hydroxide and two spatulas of ammonium chloride to a boiling tube and mix them.
2. Set up the apparatus as shown in the diagram (A). Warm gently.

3. Test the gas produced with a lighted splint
4. Test the gas with damp red litmus paper
5. Test the gas with damp Universal Indicator paper
6. Test the gas with a stopper from a hydrochloric acid bottle.
7. Fill a dry boiling tube with the gas by heating for several minutes. (The tube *must* be dry.)
8. Fit the tube quickly with a bung carrying a damp glass jet.
9. Set up the apparatus as shown in diagram (B).
10. Open the clip.

Safety

Wear eye protection. Take care not to inhale the ammonia produced. Work in a well ventillated area.

Questions

1. Fill in the missing gaps: Ammonia is a __________ gas with a strong, choking _________. It does not ___________ and puts out a lighted _____________. It is ____ _____ than air. It is _____________ to litmus and Universal Indicator. It is very __________ in water, as shown by the ____________ experiment. It reacts with hydrochloric acid to form ______________ chloride.
2. Complete the following word equations:
   Ammonium chloride + calcium hydroxide → ______ + water + _______

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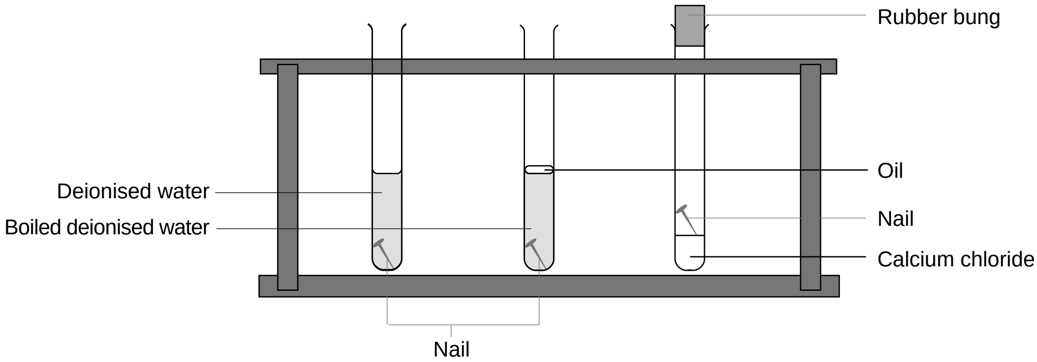
Causes of rusting

Introduction

Rusting of iron and steel is a commonly occurring process with which we are all familiar. This experiment investigates the conditions needed for rusting to occur.



What to record

Observe what happens at each stage. Complete the table.

Tube number	Conditions	Observations when re-examined
1		
2		
3		

What to do

1. Place a clean nail into a test-tube that contains a little deionised water.
2. Place a clean nail into a test-tube that contains a little boiled deionised water. Pour about 1 cm depth of oil onto the surface.
3. Place about 2 cm depth of anhydrous calcium chloride granules into a test-tube, add a nail on top and place a bung on the tube.
4. Leave the tubes for more than three days and then re-examine the nails.

Safety

Wear eye protection.

Questions

1. Explain why the water is boiled, and oil added in tube 2.
2. What conditions are required for rust to form?
3. Suggest another method to prevent rust formation.