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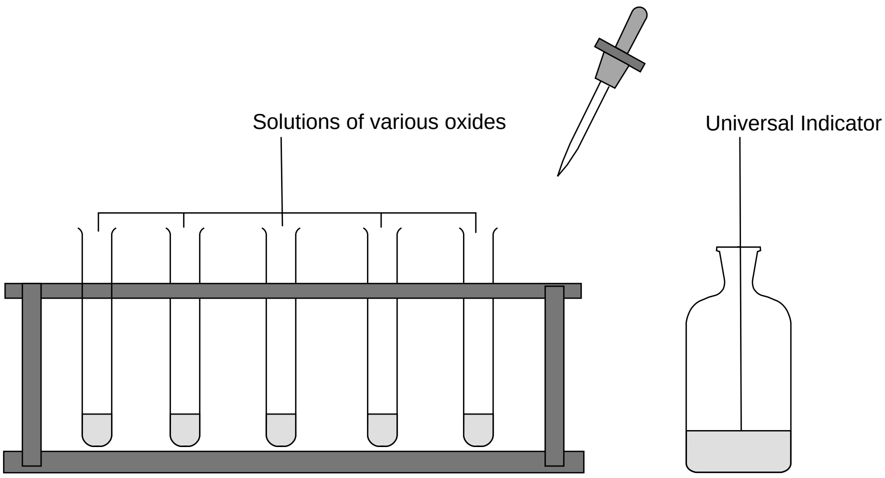
Testing the pH of oxides

Introduction

In this experiment the pH of various oxides is tested.



What to record

Name of oxide	Colour of Universal Indicator	pH value	Acid, alkali or neutral
Nitrogen oxide			
Sodium oxide			
Potassium oxide			
Phosphorus(V) oxide			
Calcium oxide			

What to do

1. Using separate test-tubes, collect a sample (about 2 cm^3) of each oxide in water.
2. Add three drops of Universal Indicator solution to each sample.
3. Record the results in a table showing the oxide, the colour of the Universal Indicator, the pH and whether the oxide is acidic, alkaline or neutral in water.

Safety

Wear eye protection

Questions

1. Which compounds in the table are metal oxides?
2. Comment on your results for the metal oxides?
3. Some metal oxides do not react with water. Predict the pH of these compounds.

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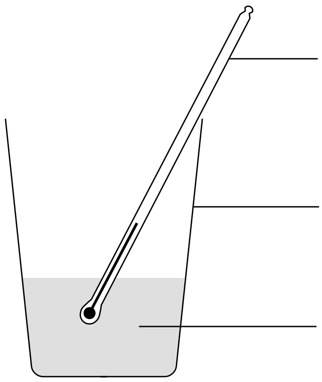
Exothermic or endothermic?

Introduction

Some reactions give out heat and others take in heat. In exothermic reactions the temperature goes up, in endothermic reactions the temperature goes down. In this experiment, various reactions are examined. Temperatures are measured to decide whether a particular reaction is exothermic or endothermic.



What to record

Complete the table

Reaction	Temperature before mixing/°C	Temperature. after mixing/°C	Exothermic or endothermic
Sodium hydroxide solution + dilute hydrochloric acid			
Sodium hydrogen carbonate solution + citric acid			
copper(II) sulfate solution + magnesium powder			
Dilute sulfuric acid + magnesium ribbon			

What to do

1. Use the apparatus as shown.
2. Put 10 cm^3 of sodium hydroxide solution in the beaker, record the temperature then add 10 cm^3 of dilute hydrochloric acid, stirring with the thermometer. Record the maximum or minimum temperature.
3. Repeat the procedure for the following reactions: (*a*) sodium hydrogen carbonate solution and citric acid; (*b*) copper(II) sulfate solution and magnesium powder; and (*c*) dilute sulfuric acid and magnesium ribbon.

Safety

Wear eye protection. Some of the solutions are irritant.

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Questions

1. The first reaction is between an acid and an alkali, what do we call this type of reaction?
2. Which gas is given off when sodium hydrogen carbonate reacts with citric acid?
3. Which type of reaction takes place between copper(II) sulfate and magnesium?
4. Which reactions are exothermic and which are endothermic?
5. Describe in terms of bond breaking and bond making, why some reactions are exothermic and some are endothermic.

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Water expands when it freezes

Introduction

Water expands when it freezes. Most liquids contract when they freeze so this property of water is unusual. This property is clearly shown in this experiment. This process is used to explain how ice can break rocks apart.

What to record

What happens.

What to do

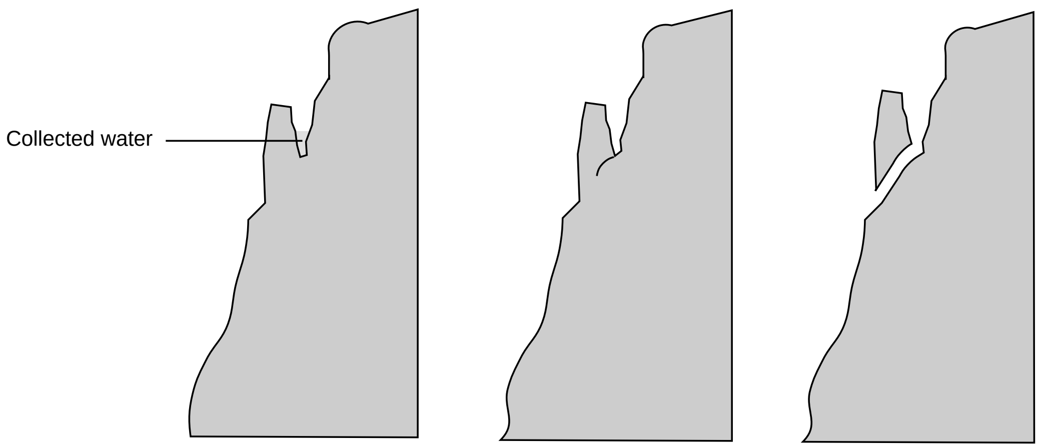
1. Fill a screw top bottle right up to the top with water.
2. Screw on the top tightly.
3. Tie the sealed bottle in a clear plastic bag.
4. Leave overnight in a freezer.

Safety

Care when removing frozen bottle from freezer.

Questions

1. Use what happened to explain why water pipes sometimes burst in winter.
2. What happens when your milk freezes on the doorstep in winter?
3. Use this knowledge to add captions to the diagram that explain how rocks crack.



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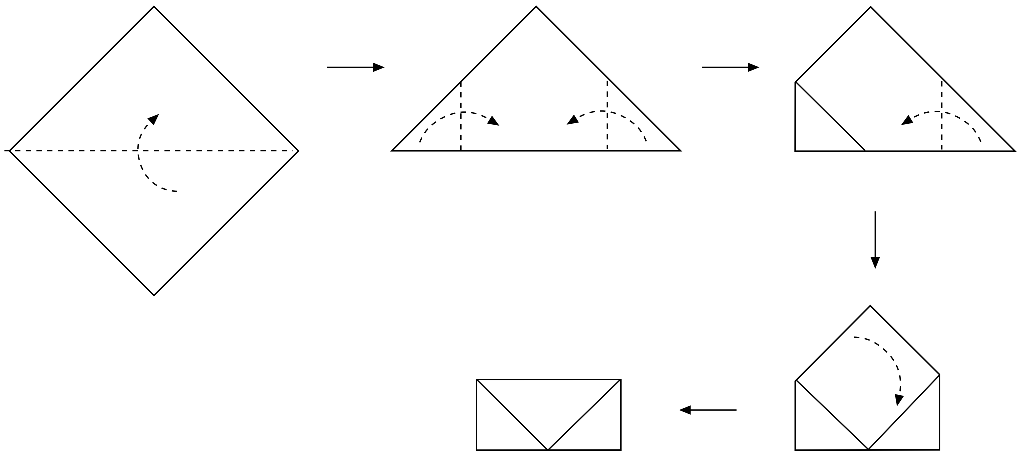
The chemical properties of the transition metals – the copper envelope

Introduction

Transition metals are situated between Groups 2 and 3 of the Periodic Table. They have important uses. One well-known transition metal is copper. Transition metals have similar reactions and properties.

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg

This is the sequence of folds to produce the copper envelope.



What to do

1. Fold a square of copper foil into an envelope as shown in the diagram. Care – sharp corners.
2. Hold the envelope in tongs.
3. Heat strongly in a Bunsen burner flame for 5 min.
4. Place the copper envelope on the heatproof mat to cool. Care – hot.
5. When the envelope is cool enough to hold; open it up and compare the inside with the outside.

Safety

Wear eye protection.

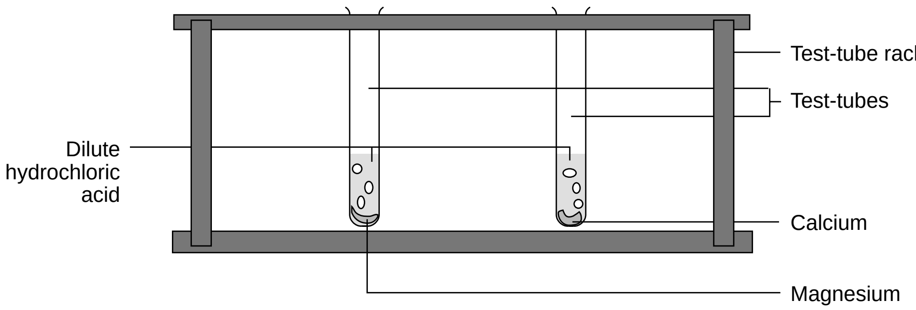
Questions

1. Does the copper burst into flames like magnesium?
2. What does the copper look like after it has cooled?
3. Which gas in the air has copper reacted with?
4. What is the black coating on the surface called?
5. What is the appearance of the inside of the envelope and why is this?

The reactivity of Group 2 metals

Introduction

Metals in Group 2 of the Periodic Table are less reactive than those in Group 1. This experiment indicates the relative reactivity of elements within the group.



What to do

1. Fill two test-tubes a quarter full with dilute hydrochloric acid.
2. Into one test-tube drop a small piece of magnesium.
3. Into the other, drop a small piece of calcium.
4. Compare the reactivity of the two metals.
5. Drop another bit of magnesium into the first test-tube and put your thumb over the end.
6. When the pressure can be felt, take your thumb off and test the gas with a lighted splint.
7. Record what happens.

Safety

Wear eye protection.

Questions

1. Which is the more reactive, magnesium or calcium?
2. Write word equations for these reactions.
3. Write formula equations for these reactions.

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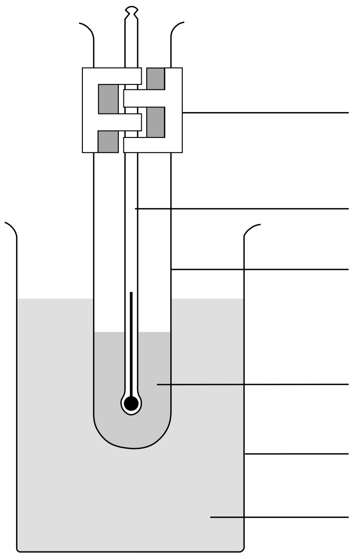
Melting and freezing

Introduction

In this experiment, a solid turns into a liquid and then the liquid turns into a solid. The energy changes are examined.



What to record

Complete the table.

Time/min	Temperature/°C

What to do

1. Fill a 250 cm^3 beaker with about 150 cm^3 tap water.
2. Heat it on a tripod and gauze until the water just starts to boil.
3. Set up the apparatus as shown in the diagram and start the timer.
4. Try and maintain the temperature of the water. It should be just boiling but not boiling vigorously.
5. Record the temperature every minute as the stearic acid heats up, until it reaches about 70 °C. Show in your table the temperature where the solid starts to melt.
6. Use the clamp stand to lift the tube from the hot water. Record the temperature every minute as the stearic acid cools down until it reaches about 50 °C. Note the temperature in your table when the first signs of solid formation are observed.
7. Plot a line graph of your results. Put time along the bottom and temperature up the side. Label your graph to show where stearic acid is a solid, a liquid or present in both states.

Safety

Wear eye protection.

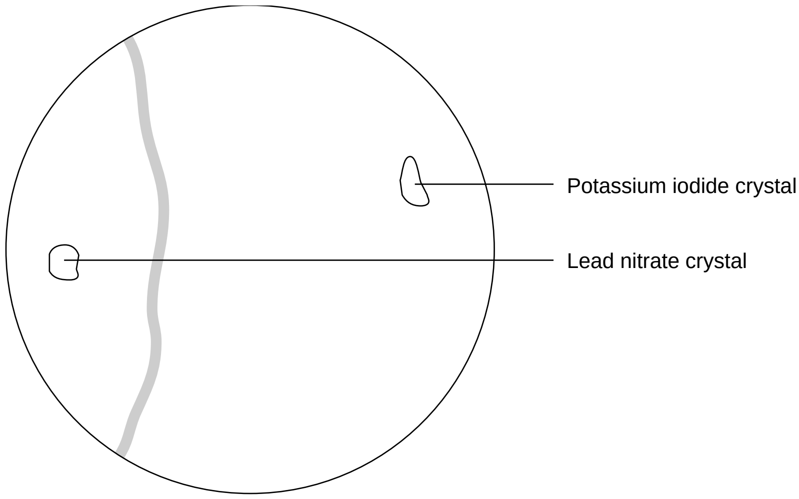
Questions

1. What is the melting point of stearic acid?
2. What is the freezing point of stearic acid?
3. Why are there flat sections on your graph? Explain this in terms of the forces between particles.

Diffusion in liquids

Introduction

Diffusion occurs in liquids but more slowly than in gases. The particles are not as free to move about. This experiment illustrates diffusion in a liquid.



What to do

1. Fill a petri dish with deionised water.
2. Use forceps to drop crystals of lead nitrate and potassium iodide on opposite sides of the dish.
3. The solid crystals form solutions that react. Observe what happens.
4. Watch diffusion occurring, as a yellow solid slowly forms between the two crystals.

Safety

Wear eye protection.

Questions

1. Write a word equation for the reaction.
2. Write a formula equation for the reaction.
3. How can this diffusion process be explained?
4. With crystals of lead nitrate and potassium iodide in water, the yellow solid forms closer to the lead nitrate crystal. Which reactant diffuses faster, the lead ion or the iodide ion? Why?

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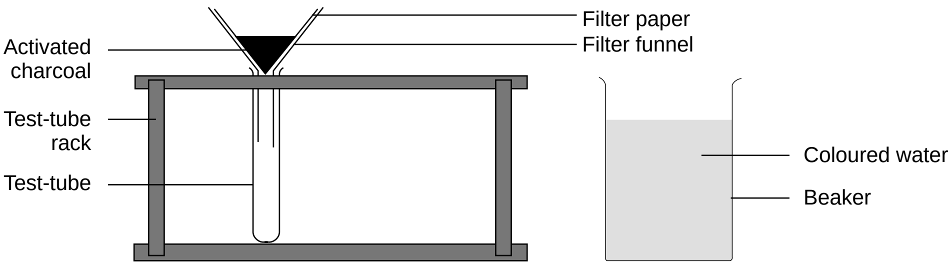
Chemical filtration

Introduction

In this experiment, carbon that has undergone special treatment to make it into decolourising carbon is shown to remove colour and odour from various solutions. This form of carbon is sometimes called activated charcoal. This method is used to remove objectionable taste and odours from drinking water.



What to do

1. Fold a piece of filter paper, place it in a funnel, and put the stem of the funnel into a test-tube in a test-tube rack.
2. Add about five spatulas of decolourising carbon to the funnel
3. Add one drop of ink or food colour to 100 cm^3 of water in a beaker.
4. Carefully pour some of the coloured water onto the charcoal in the filter paper.
5. Prepare another filter paper with the same amount of carbon. This time filter a solution made by adding two or three crystals of potassium manganate(VII) to 100 cm^3 of water.
6. Repeat the activity, this time filter sauerkraut juice, dill pickle juice or vinegar.

Safety

Wear eye protection.

Questions

1. Describe the material before and after filtration in each of the three activities.
2. How does carbon remove colour and odour?
3. How could this process be used to provide pure water for drinking?

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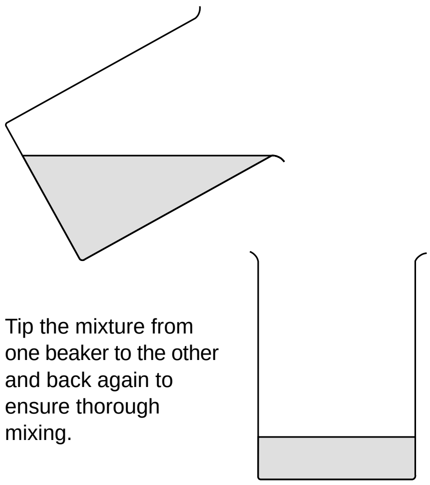
Rate of reaction – the effect of concentration and temperature

Introduction

In this experiment, two colourless solutions are mixed to make a solution which becomes dark blue. Changing the concentration or temperature of the solutions changes the time required for the blue colour to develop.



Tip the mixture from one beaker to the other and back again to ensure thorough mixing.

What to record

The conditions and the times for reactions to occur.

What to do

1. Place 50 cm^3 of solution A in a 250 cm^3 beaker.
2. Place the same volume of solution B in a second beaker.
3. Mix the two solutions by pouring from one beaker into the other several times.
4. Note the time required for a reaction to occur (formation of blue colour).
5. Repeat, but use solution A that has been diluted to one half the concentration. Note the time for the reaction to occur.
6. Repeat using solution A warmed to 35 °C. Note the time for a reaction to occur.

Safety

Wear eye protection

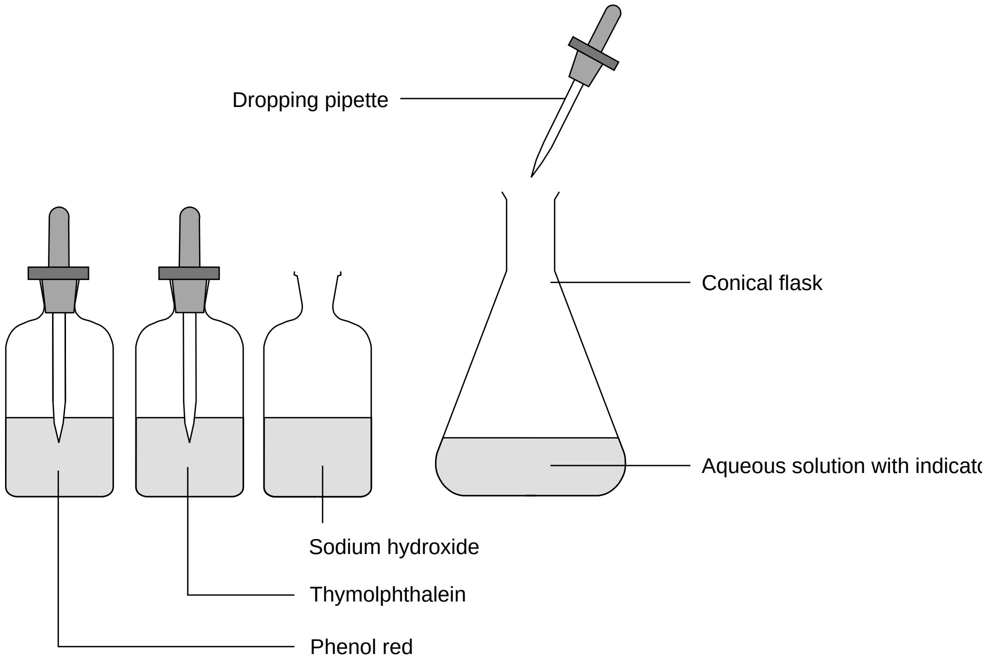
Questions

1. Why does increasing the concentration usually result in an increased rate of reaction?
2. Why does increasing the temperature usually result in an increased rate of reaction?
3. How could this experiment be set up so it took exactly 10 min to turn blue?

Reaction between carbon dioxide and water

Introduction

When carbon dioxide reacts with water a weak acid is formed. Carbon dioxide is present in exhaled breath. Observing a colour change using an acid-base indicator shows the reaction between carbon dioxide and water.



What to do

Activity 1

1. Place about 125 cm^3 of ethanol (**Highly flammable**) in a 250 cm^3 conical flask.
2. Add five or six drops of thymolphthalein indicator to the alcohol.
3. Add just enough dilute sodium hydroxide (**Irritant**) (dropwise) to produce a blue colour.
4. Talk or blow gently into the flask – *ie* add the carbon dioxide.
5. Continue adding the carbon dioxide until a colour change is observed.

Activity 2

1. Place about 125 cm^3 of water in a 250 cm^3 conical flask.
2. Add one or two drops of phenol red to the water.
3. Add two drops of sodium hydroxide solution (**Irritant**) to produce a red solution.
4. Talk or blow gently into the flask – *ie* add carbon dioxide.
5. Continue adding the carbon dioxide until a colour change is observed.

Safety

Wear eye protection.

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Questions

1. Why does the colour change not occur instantly?
2. Why are a few drops of sodium hydroxide solution (NaOH) added before the experiment?