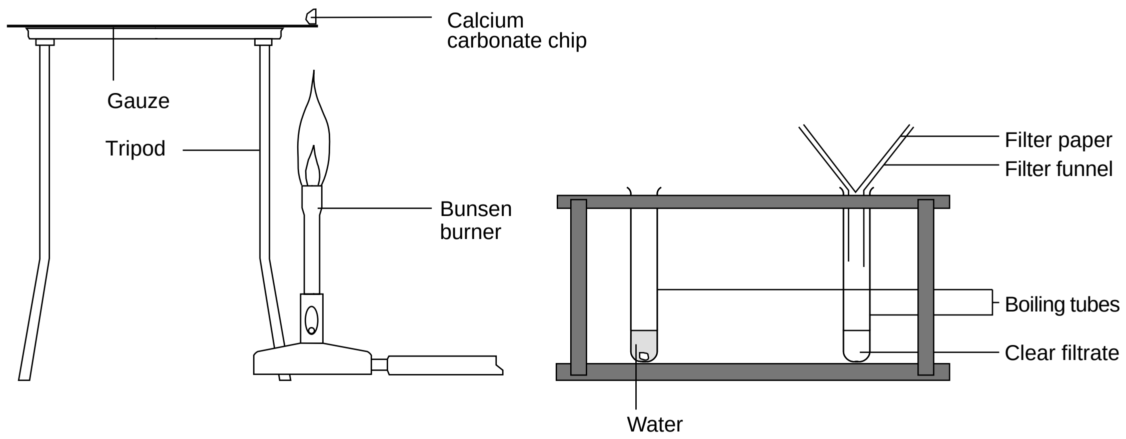
RS•C

Reactions with calcium carbonate

Introduction

Limestone and chalk are mainly calcium carbonate. In this experiment, calcium carbonate is heated to form calcium oxide. This is reacted with a few drops of water, and the resulting calcium hydroxide is dissolved in water. Carbon dioxide is bubbled through the water and the milky suspension of calcium carbonate characteristic of limewater and carbon dioxide is observed.



What to record

Observe what happens at each stage. Complete the table.

Method	**Observation**
Heat for 10 mins	
Add 2–3 drops of water	
Blow bubbles through solution	
Add Universal Indicator	

What to do

1. Set the chip of calcium carbonate, $CaCO_3$, on a gauze. If your gauze has a coated circle use the edge where there is no coating. Heat strongly for 10 minutes.
2. Let the chip cool and use tongs to move to a boiling tube. Add 2–3 drops of water with a dropper.
3. Add about 10 cm^3 more water to the solid. Then filter half the mixture into the other boiling tube.
4. Gently blow a few bubbles through the filtrate.
5. Test the remaining half with Universal Indicator solution.

Safety

Wear eye protection. Take care not to suck the limewater into your mouth.

RS•C

Questions

Write word equations for the reactions that occur at the following stages.

1. Calcium carbonate is heated.
2. Water is added to the product.
3. Carbon dioxide is bubbled through limewater.

Write formula equations for the reactions that occur at these stages.

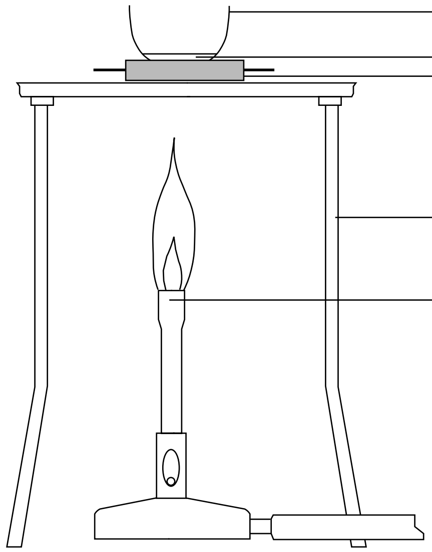
4. Calcium carbonate is heated.
5. Water is added to the product.
6. Carbon dioxide is bubbled through limewater.

RS•C

To find the formula of hydrated copper(II) sulfate

Introduction

In this experiment, the water of crystallisation is removed from hydrated copper(II) sulfate. The mass of water is found by weighing before and after heating. This information is used to find *x* in the formula: $CuSO_4.xH_2O$.



What to record

Complete the table.

Relative atomic mass H=1, O=16, S=32, Cu=64

It is necessary to calculate the relative molecular mass of H_2O and $CuSO_4$.

What to do

1. Find the mass of your crucible.
2. Place 2–3 spatulas of blue copper(II) sulfate in the crucible and weigh.
3. Heat until the powder has gone completely white, but do not heat so strongly that it starts to blacken.
4. Allow to cool then reweigh.

(*a*) Mass of crucible	–	g
(*b*) Mass of crucible + blue copper(II) sulfate	–	g
(*c*) Mass of crucible + white copper(II) sulfate	–	g
(*d*) Mass of blue copper(II) sulfate	(*b*-*a*)	g
(*e*) Mass of white copper(II) sulfate	(*c*-*a*)	g
(*f*) Mass of water	(*d*-*e*)	
(*g*) Moles of white copper(II) sulfate	*e*/RMM ($CuSO_4$)	
(*h*) Moles of water	*f*/RMM(H_2O)	
(*I*) Moles of water/Moles copper(II) sulfate	*h*/*g*	
(*j*) Formula of hydrated copper(II) sulfate.	–	

Safety

Wear eye protection.

Question

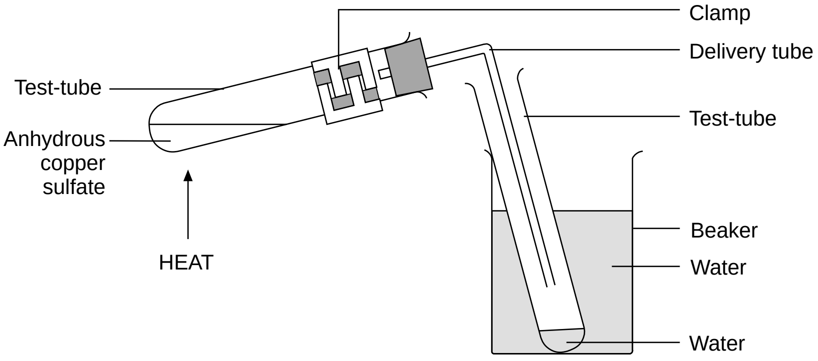
1. What is the formula of hydrated copper(II) sulfate?

RS•C

Heating copper(II) sulfate

Introduction

In this experiment the water of crystallisation is removed from hydrated blue copper(II) sulfate. After cooling the anhydrous copper(II) sulfate formed is then rehydrated with the same water.



What to record

Record any observations when the water was poured back onto the white copper(II) sulfate.

What to do

1. Set up the apparatus as shown.
2. Heat the blue copper(II) sulfate until it has turned white.
3. Act quickly to prevent suck back. Lift the clamp stand so that the delivery tube does not reach into the water in the test-tube.
4. Allow the anhydrous copper(II) sulfate to cool.
5. Hold the tube containing anhydrous copper(II) sulfate in one hand and pour the condensed water onto the powder.

Safety

Wear eye protection.

Questions

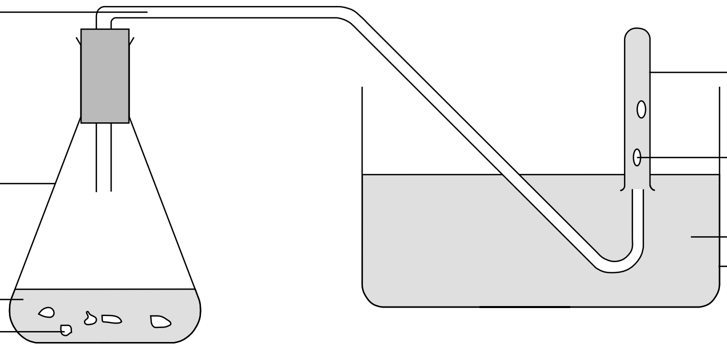
1. Why is one test-tube placed in a beaker of cold water?
2. What do the following words mean (*a*) hydrated, (*b*) anhydrous, (*c*) product, (*d*) condensed and (*e*) reaction?
3. The reaction
   Hydrated copper(II) sulfate + heat $\rightleftharpoons$ anhydrous copper(II) sulfate + water
   is called a reversible reaction. Why?
4. Anhydrous copper(II) sulfate could be used as a fuel for heating ('just add water to get the heat'). Explain why it would not be a very economical fuel.

RS•C

The oxidation of hydrogen

Introduction

In this experiment hydrogen is burnt with some air. The aim of the experiment is to find out how much air is needed to burn hydrogen most efficiently.



What to record

How loud/shrill is the pop for each mixture.

What to do

1. Mark one test-tube where it is a quarter full. Mark one at half full, another at three quarters full.
2. Set up the equipment as shown – a few drops of copper(II) sulfate speeds up the hydrogen production.
3. Using the mark as a guide, fill one test-tube a quarter, one a half, one three quarters and another completely full of water.
4. Invert the quarter filled tube in the trough to collect the hydrogen by displacing the water.
5. Put a bung in the test-tube.
6. Repeat this with the tubes half full, three quarters full and completely full of water.
7. Keep the 4 test tubes in the test-tube rack and clear away the hydrogen generator.
8. Using a lighted splint, carry out the 'pop' test on each of the tubes.

Safety

Wear eye protection.

Questions

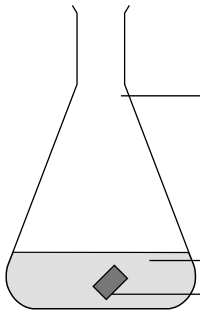
1. Which mixture of hydrogen and air gives the most powerful explosion?
2. The formula of the product is H_2O, what is the ideal mixture of hydrogen and oxygen?
3. If the air is one-fifth oxygen calculate the ideal mixture of hydrogen to air?

RS•C

Investigating the reactivity of aluminium

Introduction

This experiment illustrates the displacement of copper from copper(II) sulfate solution using aluminium foil.



What to record

Write yes or no.

Observations	Before the sodium chloride is added	After the sodium chloride is added
Bubbles observed		
Colour changes		
Temperature change		
Copper observed		

What to do

1. Measure approximately 20 cm^3 of copper(II) sulfate solution into the conical flask.
2. Add a square of aluminium foil.
3. Look for signs of a reaction.
4. Add a spatula of sodium chloride and stir to dissolve.
5. Observe any changes. If nothing happens, add more sodium chloride. Has displacement of copper from copper(II) sulfate occurred?

Safety

Wear eye protection

Questions

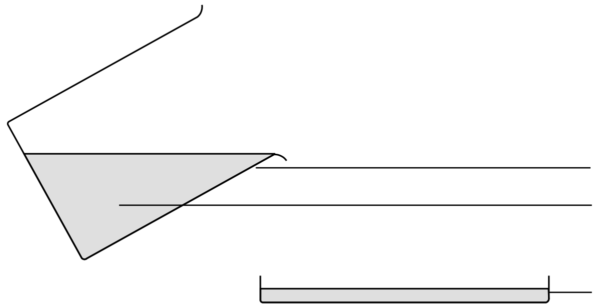
1. Before the sodium chloride is added, does any reaction occur?
2. After adding sodium chloride, does the aluminium appear more or less reactive?
3. How does the salt affect this change?

RS•C

An oscillating reaction

Introduction

Several solutions are mixed in a petri dish. After about 5 min, the colour of the solution oscillates between red and blue.



What to do

1. Prepare the oscillating solution as follows: Place 6 cm^3 of solution A in a small beaker using a measuring cylinder.
2. Add 0.5 cm^3 of solution B using a syringe.
3. Add 1.0 cm^3 of solution C using a syringe. A brown colour appears. When it disappears, add 1.0 cm^3 of ferroin using a syringe.
4. Add 1 drop of Photoflo using the dropper pipette.
5. Add enough of this solution in the beaker to a petri dish to half-fill it.
6. Wait for oscillations to begin.

Safety

Wear eye protection. Solutions may be irritant.

Questions

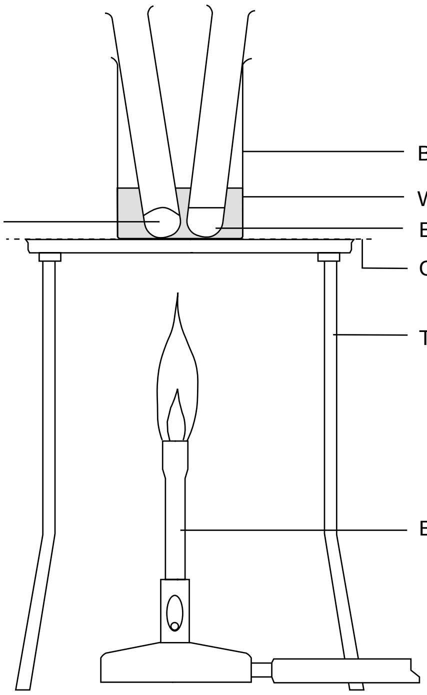
1. What is the role of ferroin in this reaction?
2. What is a surfactant or surface-active agent?

RS•C

Chocolate and egg

Introduction

This experiment shows some changes that happen when different substances are heated.



What to record

Make a table of your observations.

Substance	What happens on heating	What happens on cooling

What to do

1. Set up the equipment as shown in the diagram.
2. Heat the boiling tubes in the beaker of water. The water in the beaker should boil.
3. Watch what happens to the substances in the tubes as they are heated.
4. Turn off the Bunsen burner and use the test-tube holder to transfer the tubes to the rack to cool.
5. Watch what happens to the substances in the tubes as they cool.

Safety

Wear eye protection. Do not taste foods in a laboratory. The food or the apparatus may be contaminated.

Questions

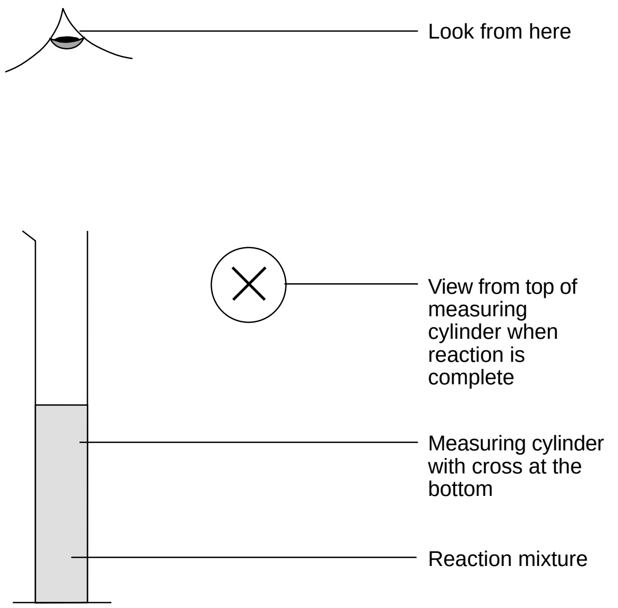
1. Which of these changes is reversible? This is called a physical change.
2. Which of these changes produces a new substance? This is called a chemical change.
3. Give one more example of a physical and a chemical change.

RS•C

Catalysis

Introduction

In this experiment the speed of a reaction is measured. Various metals in solution are tested as possible catalysts.



What to record

Complete the following table.

	No Catalyst	Nickel(II) Sulfate	Copper(II) sulfate	Iron(II) sulfate	Cobalt(II) chloride
Time (s)					

What to do

1. Draw a cross on a piece of scrap paper and put it underneath the measuring cylinder so it can be seen when looking down the cylinder from the top.
2. Using a 50 cm^3 measuring cylinder measure 50 cm^3 of iron(III) nitrate solution.
3. Using a 100 cm^3 measuring cylinder measure 50 cm^3 of sodium thiosulfate solution.
4. Pour the iron(III) nitrate solution into the sodium thiosulfate solution and start the timer.
5. Look through the reaction mixture from above until the cross can first be seen. Stop the timer and record the time.
6. Repeat this experiment but add one drop of catalyst to the iron(III) nitrate solution before mixing. Test the various catalysts and fill in the table.

Safety

Wear eye protection.

Questions

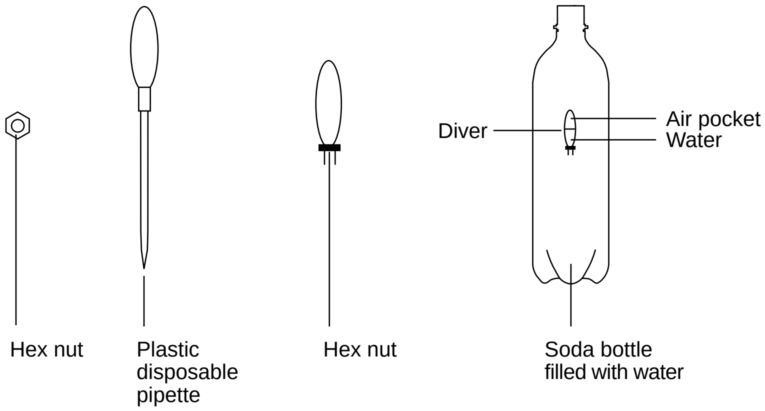
1. Which metal compound is the best catalyst?
2. Why were only very dilute solutions of metal compounds used?
3. A catalyst speeds up a reaction. Suggest one way of slowing down this reaction.

RS•C

A Cartesian diver

Introduction

This is an experiment named after René Descartes (1596–1650). Descartes was a French scientist and philosopher. The Cartesian diver can be used to illustrate the behaviour of gases and liquids when compressed. In this experiment a Cartesian diver is constructed and some of the properties observed.



What to do

1. Screw the hex nut onto the base of the pipette until it is held tightly in place.
2. Cut off all but 1 cm of the pipette stem. (This is the diver.)
3. Place the diver in a beaker of water. Squeeze the bulb of the pipette to force air out and release to allow water up into the diver. Repeat this until the diver is about half full of water.
4. Does the diver still float? If adjusted properly the diver should barely float in the water. If it sinks squeeze a little water out.
5. Carefully transfer the diver to the soda bottle that is full to the brim with water. Take care not to lose water from the diver. Place the cap on the bottle.
6. Use both hands and squeeze the bottle. Watch the diver sink when the bottle is squeezed, or float when pressure is released.

Safety

Wipe up any water spillage.

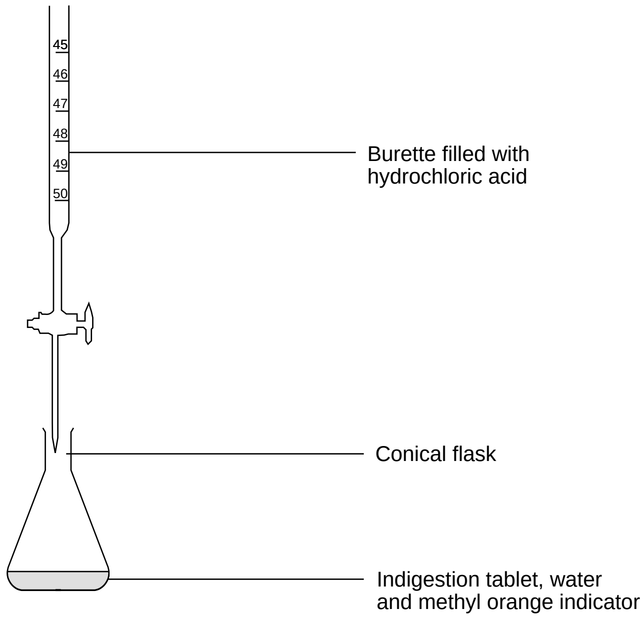
Questions

1. What happens to the air in the diver when the bottle is squeezed?
2. Why does the air behave in this way?
3. Write a sentence that explains how the Cartesian diver works.

Neutralisation of indigestion tablets

Introduction

Indigestion is caused by excess acid in the stomach. The tablets neutralise some of this acid. In this experiment the amount of acid neutralised by one tablet is found. This may be considered a direct measurement of the effectiveness of the tablet.



What to record

Record the volume and concentration of the acid added.

What to do

1. Crush a tablet using a mortar and pestle and carefully transfer it to a conical flask.
2. Add about 25 cm^3 of water and three drops of methyl orange indicator.
3. While slowly swirling the flask, add acid from the burette, 0.5 cm^3 at a time.
4. Continue adding acid in 0.5 cm^3 portions until the liquid goes red and stays red for one minute.
5. Record the volume of acid used.

Safety

Wear eye protection.

Question

1. Samples of various brands of indigestion tablets and the cost of each packet are provided. Describe how this experiment could be used to determine which brand represents the best value.