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Cambridge Checkpoint Science

Workbook 9

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Introduction

What is this workbook for?

This workbook will help you to develop your knowledge and skills in science.

As you work carefully through it, you should find that you get gradually better and better at doing things such as:

- using your knowledge to work out the answers to questions, rather than just remembering the answers
- planning experiments, recording results, drawing graphs and making conclusions.

How is the workbook organised?

The workbook exercises are arranged in the same order as the topics in your coursebook.

Each exercise has the same number as a topic in the coursebook.

There is not always an exercise for each topic. For example, there is an exercise for each of topics 1.1, 1.2, 1.3, 1.4, 1.6 and 1.7. There is no specific exercise for topic 1.5.

The exercises will help you to develop the skills you need to do well in science.

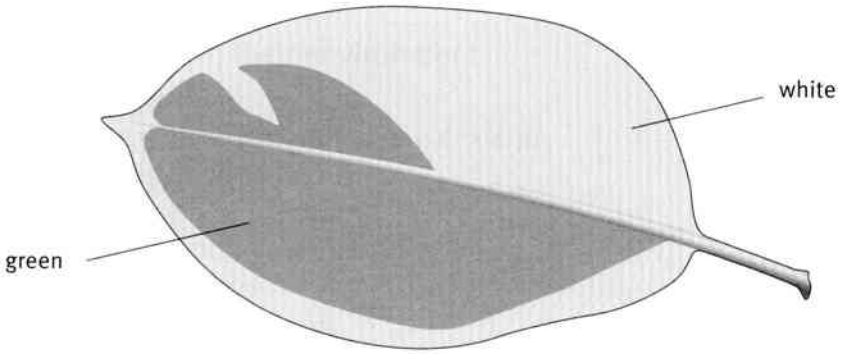
The exercises are not quite the same as the questions that you will meet in the Progression Tests or your Checkpoint examination. This is because the exercises are to help you to get better at doing particular things, rather than testing how well you can do them.

Contents

Exercise 1.1 Variegated leaves

You'll find this exercise easier to do if you have tried Activity 1.1 first, because you need to understand how to test a leaf for starch. You will also need to think about making predictions and use your scientific knowledge.

Haytham found a plant that had leaves with some green areas and some white areas. Leaves like this are called variegated leaves.



He decided to test one of the leaves for starch. He made this prediction:

The green parts of the leaf will contain starch, but the white parts will not.

1 What is the substance that makes leaves green?

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2 Explain why Haytham's prediction is likely to be correct.

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3 First, Haytham put the leaf into boiling water, and left it there for 5 minutes. Explain why he did this.

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4 Next, he took the leaf out of the water and put it into some hot alcohol.

Explain why he did this.

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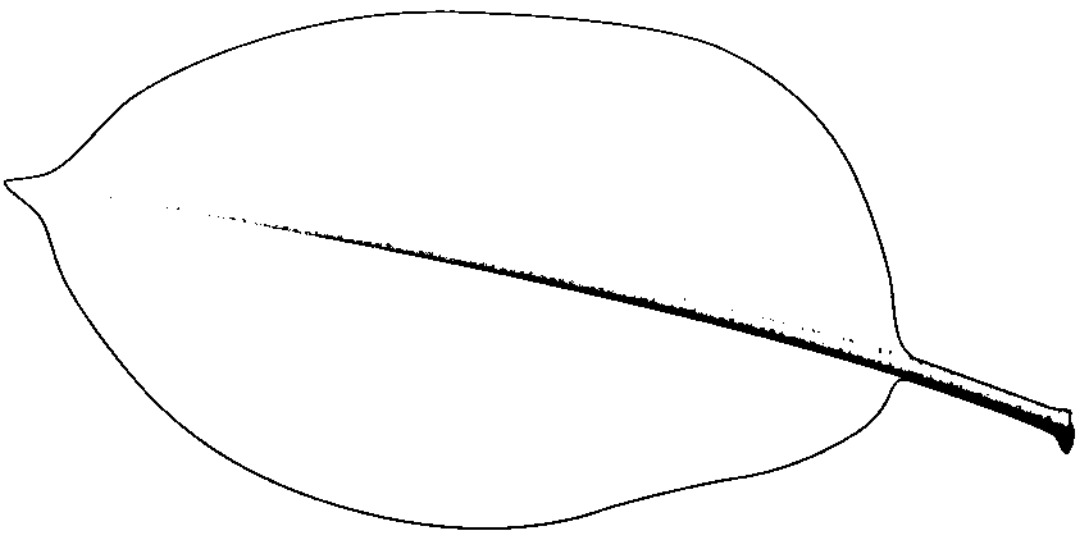
5 Lastly, Haytham dipped the leaf into water and spread it out on a white tile. The leaf looked white. He added iodine solution to the leaf. Some parts of the leaf went orange-brown, and some went blue-black.

On the diagram below, shade in the parts of the leaf that would go blue-black, if Haytham's prediction was correct.



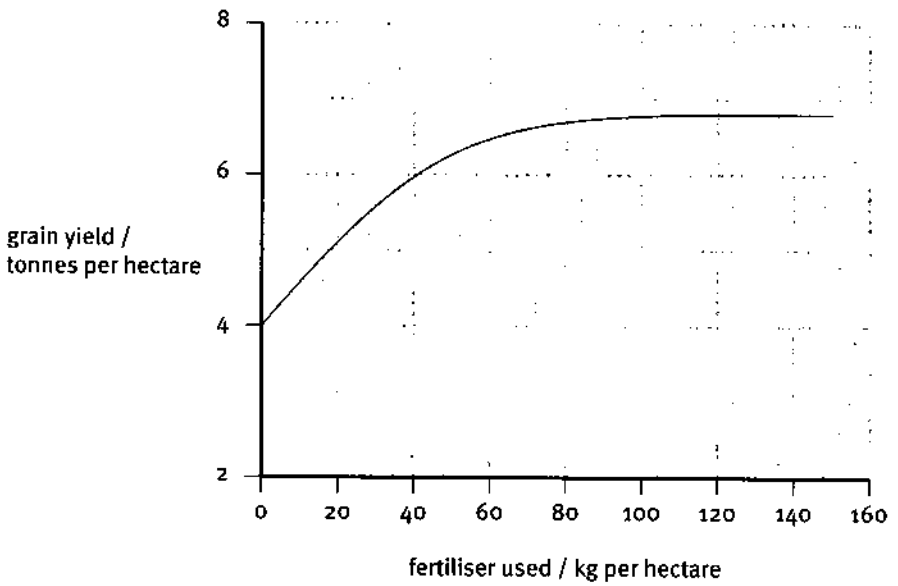
6 What substance causes the iodine to turn blue-black?

.....

Exercise 1.2 Fertilisers

Results from experiments can often be used to help people make decisions. In this exercise, you will use data in a graph to work out how and why a farmer should use nitrate-containing fertilisers.

Wheat is an important cereal crop in many parts of the World. An experiment was carried out on a farm to find out how adding different amounts of nitrate-containing fertiliser affected the amount of grain that the farmer got from his wheat crop. The graph shows the results.



1 What yield of grain did the farmer get if he did not add any fertiliser to the field?

.....

2 How much fertiliser should the farmer add to the field to get a 50% increase in yield? Show how you work out your answer.

.....

3 The farmer decided that there was no need to add more than about 60 kg of fertiliser per hectare. Explain how the results of the experiment support his decision. (Remember that fertiliser is expensive.)

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4 Explain why the yield of grain increases when nitrate-containing fertiliser is added.

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5 Suggest why the results of this experiment might be different if it was repeated in a different place.

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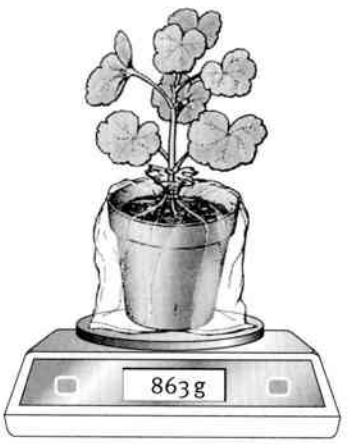
Exercise 1.3 How temperature affects water loss

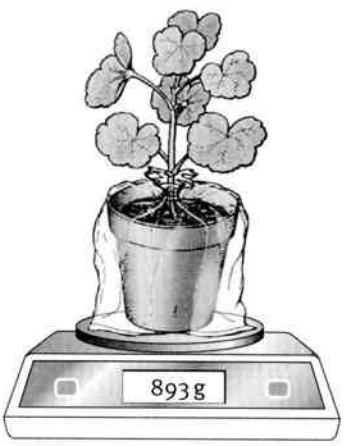
This exercise gives you practice in constructing results tables, drawing line graphs and dealing with anomalous results. You'll also do some calculations, and use your knowledge to try to explain patterns in results.

Fernanda set up an experiment to investigate how temperature affects the rate of water loss from plants. The diagrams show what she did.

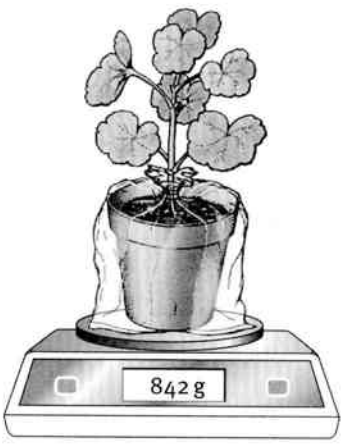
Plant **A** kept at 4 °C



Plant **A** kept at 20 °C



Plant **A** kept at 30 °C



Fernanda read the mass, in grammes, of each plant and pot each day for 8 days. These are the results that she wrote down:

Plant A: 863, 854, 845, 837, 829, 822, 814, 807

Plant B: 893, 873, 856, 837, 861, 792, 779, 761

Plant C: 842, 810, 780, 748, 714, 682, 650, 618

1 Explain why Fernanda covered the pot and soil of each plant with a plastic bag.

.....

.....

.....

2 Draw a results table, and fill in Fernanda's results.

3 Fernanda decided that one of her results was anomalous. Draw a circle around the anomalous result in your results table.

4 Draw line graphs to display Fernanda's results on the grid on the next page.

Put time on the x-axis, and mass of plant and pot on the y-axis. You do not need to start at 0 on the y-axis.

Draw a separate line for each plant. What should you do about the anomalous result?

5 Fernanda calculated the mean loss of mass per day for plant **A** like this:

mass on day 1 = 863 g

mass on day 8 = 807 g

therefore loss of mass over 7 days was 863 − 807 = 56 g

therefore the mean loss of mass per day was 56 ÷ 7 = 8 g per day.

In the space below, calculate the mean loss of mass per day for plant **B** and plant **C**.

6 Use your knowledge of plants and water to suggest an explanation for Fernanda's results.

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Exercise 1.4 Comparing two flowers

In this exercise, you will need to look very carefully at two flowers. Once you have identified all the different parts, you will record your observations in a table.

1 Collect two flowers. Your teacher may give you the flowers, or you may be able to find two different flowers yourself.

2 Study each flower carefully. Try to find each of the following parts:
- petals – the coloured parts, perhaps with guidelines on them
- sepals – a circle of structures outside the petals
- anthers – the parts that make pollen; they are on the end of the stamens
- stigma – the part that catches pollen
- ovary – the part near the base of the flower which contains ovules.

3 Complete the table on the next page to compare the two flowers. There is space for you to add the names of the flowers if you know them.

The first two rows have been started for you. It is up to you to decide what to put in the remaining rows.

Feature	**Flower A**	**Flower B** .....
Number of petals		
Colour of petals		

Exercise 1.6 Flowers and reproduction

The paragraphs in this exercise tell the story of how flowers eventually produce seeds. Choosing the right words to complete the sentences will make you think hard about what happens, and will give you practice in using the terms correctly.

Complete the sentences below using the words from the list. You may use each word once, more than once or not at all.

anthers	**embryo**	**gametes**	**nectar**
organs	**ovule**	**petals**	**scent**
seed	**stigma**	**style**	**tissues**

Flowers are ..... that are involved in sexual reproduction. Many flowers have both male and female parts.

The male parts of the flower are the ....., where pollen grains are produced. The pollen grains contain the male ..... .

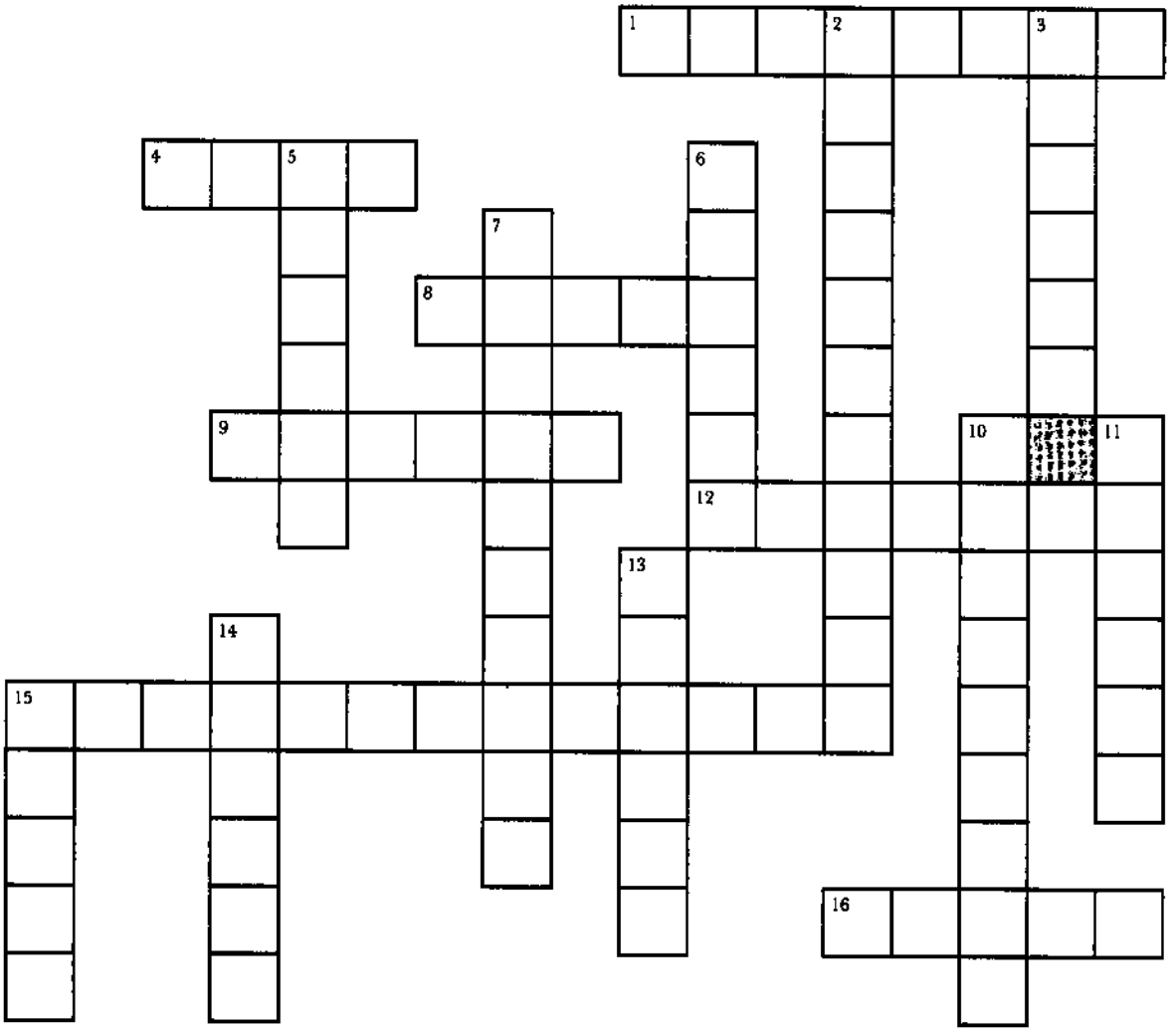
The stigma, style and ovaries are the female parts of the flower. Each ovary contains at least one ....., which contains the female gametes.

Pollination is the transfer of pollen grains from the ..... to a ..... . This is often done by insects, which are attracted to the flower by its brightly coloured ..... or by its ..... . The flower often produces a sugary fluid called ....., which insects like to eat. As the insects push into the flower to get this sweet fluid, they accidentally pick up pollen grains from the ..... . When they visit another flower, they may rub some of the pollen grains onto the ..... .

After pollination, a tube grows out of a pollen grain. The tube grows down, through the ....., to an ovule. The male ..... travel down the tube. When a male gamete fuses with a female gamete inside an ....., a zygote is produced. The zygote eventually becomes an ..... . The ovule becomes a ..... .

Exercise 1.7 Crossword

This crossword puzzle uses words from all of the topics that you have covered in this Unit. It's a good way of practising using all of the terms correctly.



Across

1 To spread out; fruits help seeds to do this.

4 A structure containing an embryo plant; it forms from an ovule after fertilisation.

8 The part of a flower that is often brightly coloured and attracts insects to it.

9 The cell that is formed when a male gamete and a female gamete fuse together.

12 A mineral salt that plants need to make proteins and grow well.

15 The fusion of a male gamete with a female gamete.

16 A structure found inside the ovary of a flower, which contains the female gamete.

Down

2 The transfer of pollen from an anther to a stigma.

3 A type of insoluble carbohydrate, often stored in leaves and other parts of plants.

5 A very young organism, for example a developing plant while it is still inside the seed.

6 Powdery grains that contain the male gametes of plants.

7 A substance containing mineral salts that is added to the soil to help plants to grow better.

10 A mineral salt that is used by plants to make chlorophyll.

11 A sweet, sugary fluid produced by flowers to attract insects.

13 Male parts of a flower, in which pollen is produced.

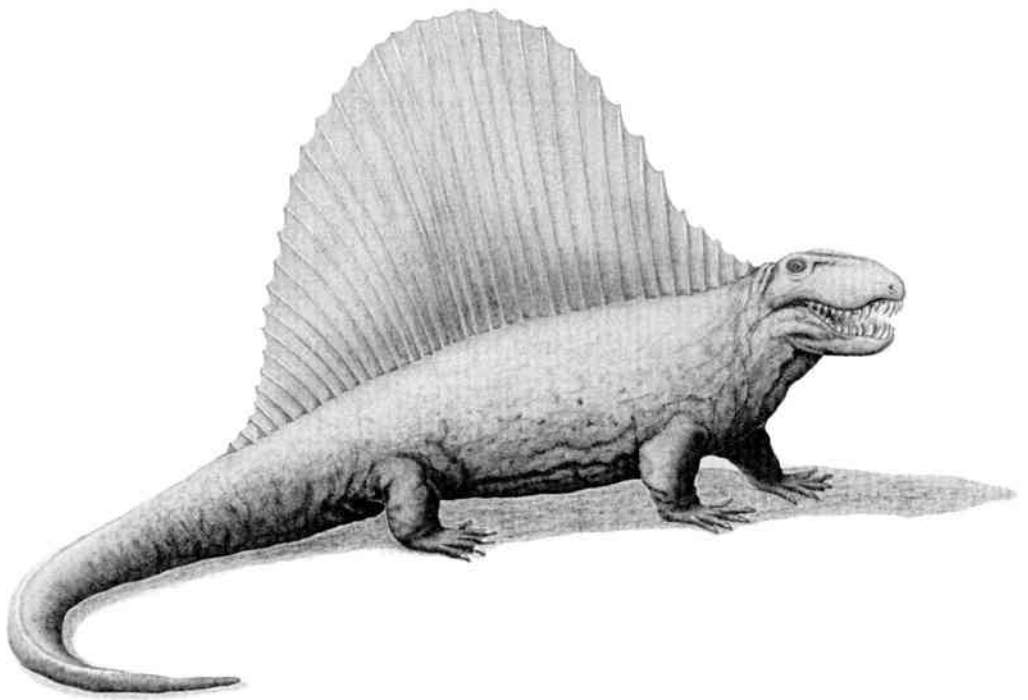
14 The part of a flower that receives pollen grains.

15 A structure containing seeds, which develops from an ovary after fertilisation.

Exercise 2.2 Dinosaur adaptations

We can find out something about the adaptations of extinct organisms by studying their fossils. This exercise asks you to think about how a dinosaur was adapted to survive in its habitat. It will also help you to remember some of the work that you did about rocks in Stage 7.

Dimetrodon was a dinosaur that lived about 280 million years ago. Its habitat was warm, low-lying wetland areas. The drawing shows what we think a *Dimetrodon* may have looked like.



1 Describe **one** adaptation, visible in the drawing, that suggests that *Dimetrodon* was a carnivore.

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.....

2 Fossil skulls of *Dimetrodon* show that it had large, strong bones in its head for the attachment of its jaw muscles. Suggest how this adaptation could help it to survive.

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3 No-one really knows why *Dimetrodon* had a huge 'sail'. Scientists think that it could have helped to warm the dinosaur up, so that it could begin to be active early in the morning.

Suggest how a *Dimetrodon* would have to behave, in order to use its sail to warm its body.

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4 Fossils of *Dimetrodon* have been found in North America and Germany.

a What is a fossil? Describe how fossils are formed.

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b What kind of rocks contain fossils?

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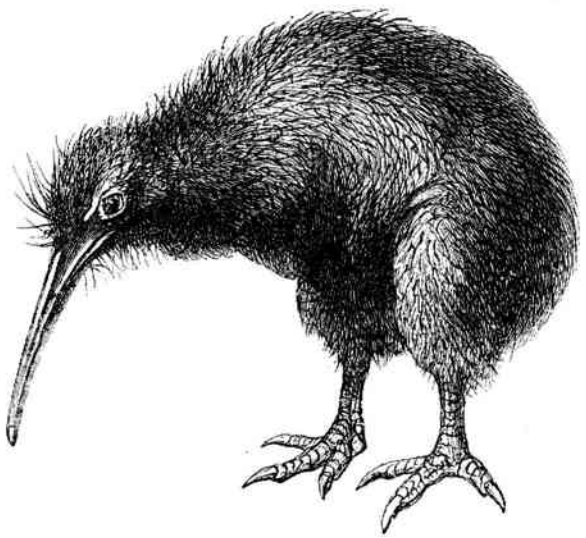
Exercise 2.3 An ecology investigation in New Zealand

It is often very difficult to find answers to questions about organisms in their environment. In this exercise, you will think about why it is sometimes helpful to use data from secondary sources, rather than from first-hand experience. You will also try to interpret results and think about how further investigations could be carried out.

Kiwis are flightless birds that live only in New Zealand. The number of kiwis is decreasing, especially in forests on the mainland.



A group of scientists wanted to find out if the eating of kiwi eggs by predators is causing this decrease. Several surveys and experiments about this had been done by other researchers. These researchers had found kiwi nests and recorded what happened to the eggs that were laid in them.

The scientists did not do any new experiments themselves. Instead, they collected together all the results from these earlier experiments. Their results are shown in the table.

Total number of eggs that were recorded	**100**
Number that hatched	33
Number that were definitely eaten by predators	2
Number that disappeared	8
Number that were smashed but not eaten	11
Number that went rotten	16
Number that were deserted by the parents	28
Number that were buried	2

1 Suggest why the scientists decided to use results that other researchers had found, rather than try to collect new data themselves. (You may be able to think of several reasons.)

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2 What percentage of eggs was definitely eaten by predators?

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3 Could any of the other losses of eggs have been caused by predators? Explain your answer.

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4 Suggest how the scientists could collect more data to find out if the eating of kiwi eggs by predators is an important reason for the decrease in kiwi numbers.

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Exercise 2.4 Constructing a food web

In this exercise, you will use information to construct a food web. It's a good idea to identify the producers first, and put them at the bottom of the web. Then build up carefully from there. Remember to make all the arrows point in the correct direction.

Here is the information about some of the organisms that live on grassy plains in Africa.

- Giraffes and impala (a kind of antelope) eat the leaves from acacia trees.
- Locusts and grass rats eat grass.
- Wild dogs, cheetahs and lions are predators of all of the vertebrate herbivores.
- Many kinds of birds eat locusts.
- Eagles eat birds.

1 In the space below, construct a food web for this habitat.

2 Draw a green circle around each producer in your food web.

3 Draw a blue circle around each herbivore in your food web.

4 Draw a red circle around each carnivore in your food web.

Exercise 2.5 Decomposition of a dead rat

Most people don't like thinking about what happens to dead bodies, but it is an important part of biology. In this exercise, you will practise finding information in a written passage, and combining this information and your own knowledge to answer questions.

Read the passage, and then answer the questions that follow.

A cat killed a rat, but did not eat it. The rat's body lay on the ground.

As soon as the rat died, bacteria already present in its body began to break down its tissues and cells. They produced smelly gases.

Blowflies detected the gases and flew towards the rat's body. They laid eggs on it. The eggs hatched into maggots (fly larvae).

The maggots produced enzymes that digested the large molecules that made up the rat's body. Smaller molecules were produced. They were absorbed into the maggots' bodies, helping them to grow. Eventually, only the rat's skeleton remained.

The maggots changed into adult blowflies and flew away. Birds and lizards ate some of the blowflies.

1 Name **one** predator mentioned in the passage.

.....

2 Name **two** decomposers mentioned in the passage.

.....

3 Explain why the flies only found the rat's body after bacteria had begun to break it down.

.....

.....

4 Explain how an atom that was once part of the rat's body could become part of a bird's body.

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5 Use the example described in the passage to explain why decomposers are important.

.....

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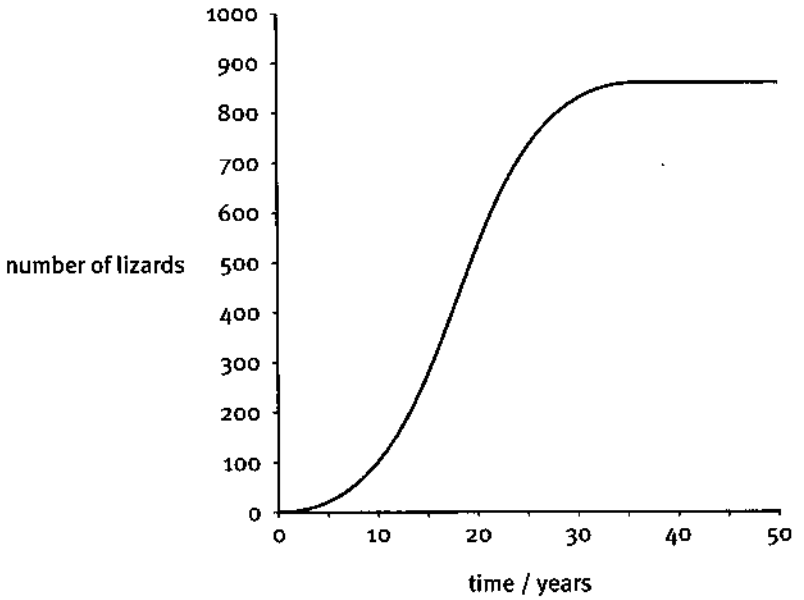
Exercise 2.6 Lizard population on an island

In this exercise, you will practise using your scientific knowledge and understanding to explain a pattern shown on a graph. You will need to think about the factors that affect the sizes of populations.

Four lizards – two males and two females – were put onto an island where no lizards were present. The lizards ate flies and other small insects. There were buzzards and eagles on the island, which could eat lizards.

The graph shows what happened to the population of lizards over the next fifty years.



1 Explain the meaning of the term **population.**

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2 What was the maximum population of lizards on the island?

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3 Suggest why the lizard population increased during the first 35 years.

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4 Suggest why the lizard population eventually stopped increasing.

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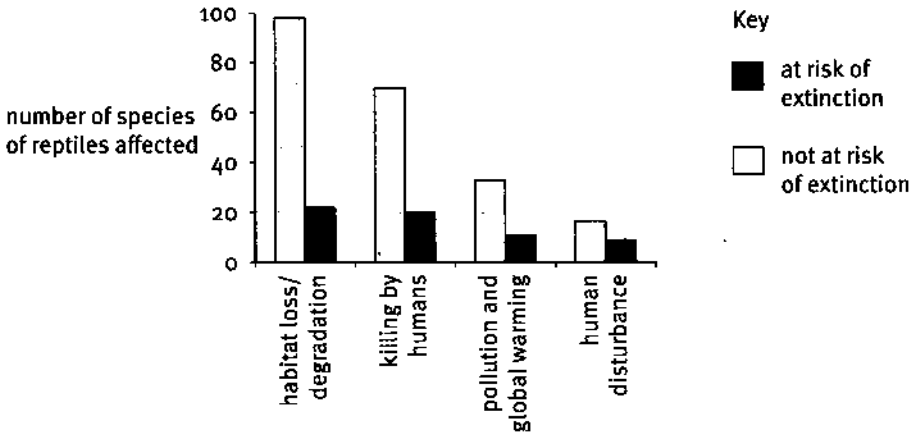
Exercise 2.8 Endangered species

This exercise will help you to check that you know the meaning of some important words, and can read information from a bar chart.

If the numbers of a species become very low, then the species is at risk of becoming extinct. The species is said to be threatened or endangered.

The bar chart shows the number of species of reptiles that are affected by four different factors in Europe.



1 Explain the meaning of these words.

species

.....

.....

extinct

.....

.....

reptile

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.....

2 Which factor affects the most reptile species in Europe?

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3 Which factor threatens the most species of reptiles with extinction?

.....

4 Explain why the factor in your answer to question **3** could cause some species of reptiles to become extinct.

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5 Explain what is meant by **global warming**, and what is thought to be causing it.

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6 Suggest why climate change (global warming) could cause some species of reptiles to become extinct.

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Exercise 2.9 The Ramsar Convention

This exercise is about how countries can work together to conserve important habitats. You will have to think about how much you can trust the information provided. You will also need to think about the problems that countries might have in conserving habitats.

The Ramsar Convention is an international agreement to try to save the World's wetlands.

A meeting of representatives from all of the nations belonging to the Ramsar Convention took place in Romania in July 2012. Before the meeting, the countries were asked several questions. Here are five of the questions. (The questions have been slightly simplified from the ones that the countries were asked to answer.)

1 Has the country identified and listed all of its wetlands?

2 Is there a national policy for conserving wetlands?

3 Is all the planned management of wetlands based on scientific research?

4 Have programmes started to restore damaged wetlands?

5 Have actions been taken to encourage the conservation and wise use of wetlands?

The table shows the answers given by seven countries in Asia.

key: ✔ = yes

✘ = no

☆ = not done yet, but planned or in progress

blank = question not answered

Country	Q1	Q2	Q3	Q4	Q5
China	✔	✔	✔	✔	✔
Indonesia	✔	✔	✔	✔	✔
Japan	✔	✔	☆	✔	✔
Mongolia	✔	✔		✘	✔
Pakistan	✔	✔	☆	✔	☆
Sri Lanka	☆	✔	☆	✔	☆
Thailand	✔	✔	✘	✔	✘

1 Explain why the information given in the table may not be completely reliable.

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2 a To which question did the smallest number of countries answer 'yes'?

.....

b Suggest why many countries could not answer 'yes' to this question.

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3 All of the countries that have joined the Ramsar Convention agree that it is important to conserve wetlands.

Explain why wetland conservation is important.

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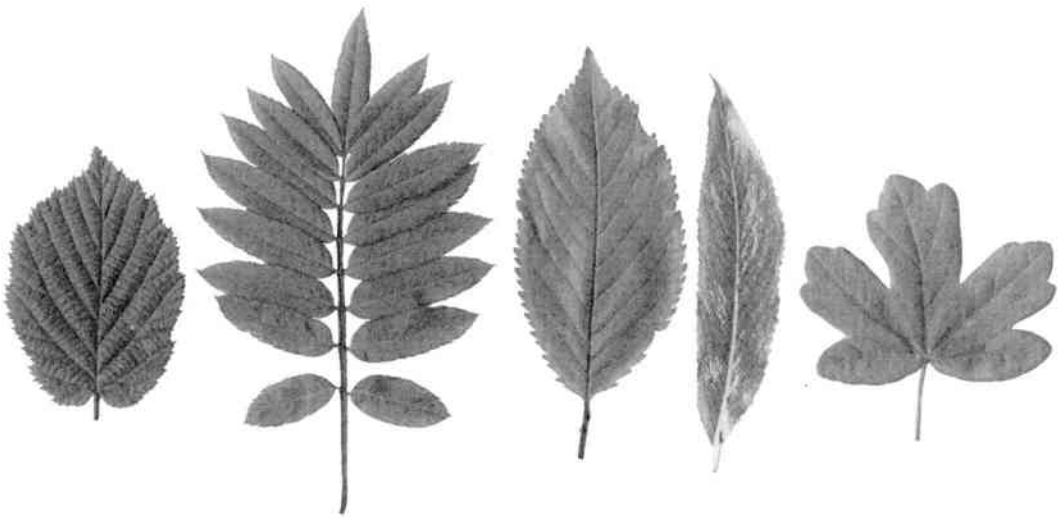
Unit 3 Variation and inheritance

Exercise 3.1 A key for identifying leaves

In this exercise, you will use a key to identify from which species of tree each of these five leaves have been collected.

The photographs show five leaves.



A B C D E

1 Use the key to identify leaf A.

1	**a**	leaf is made up of many small leaflets	**rowan**
	b	leaf is not made up of small leaflets	go to 2
2	**a**	leaf is oval	go to 3
	b	leaf is not oval and has five lobes	**maple**
3	**a**	leaf is at least twice as long as it is wide	go to 4
	b	leaf is less than twice as long as it is wide	**hazel**
4	**a**	leaf has shiny surface	**willow**
		leaf has dull surface	**cherry**

Leaf A is .....

2 Write down the statements, in order, that led you to your answer.

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3 Now identify each of the other leaves. Write down the statements, in order, that lead you to each answer.

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Exercise 3.2 Variation in finger length

This exercise will improve your ability to record results and to display them as a frequency diagram. You'll also need to remember how to calculate a mean.

Felipe measured the length of the middle finger on the left hand of every person in his class. He made his measurements in centimetres (cm).

These are the results that he wrote down.

9.5	7.0	8.4	7.3	10.1	9.6	8.9	7.6	9.1	8.3
9.4	8.0	7.2	8.1	8.8	8.3	7.5	7.9	8.6	8.8

1 How many people were there in Felipe's class? .....

2 Calculate the mean finger length of all the people in Felipe's class. Show how you worked out your answer.

..... cm

3 Felipe sorted his results into different ranges. He recorded them in a results table.

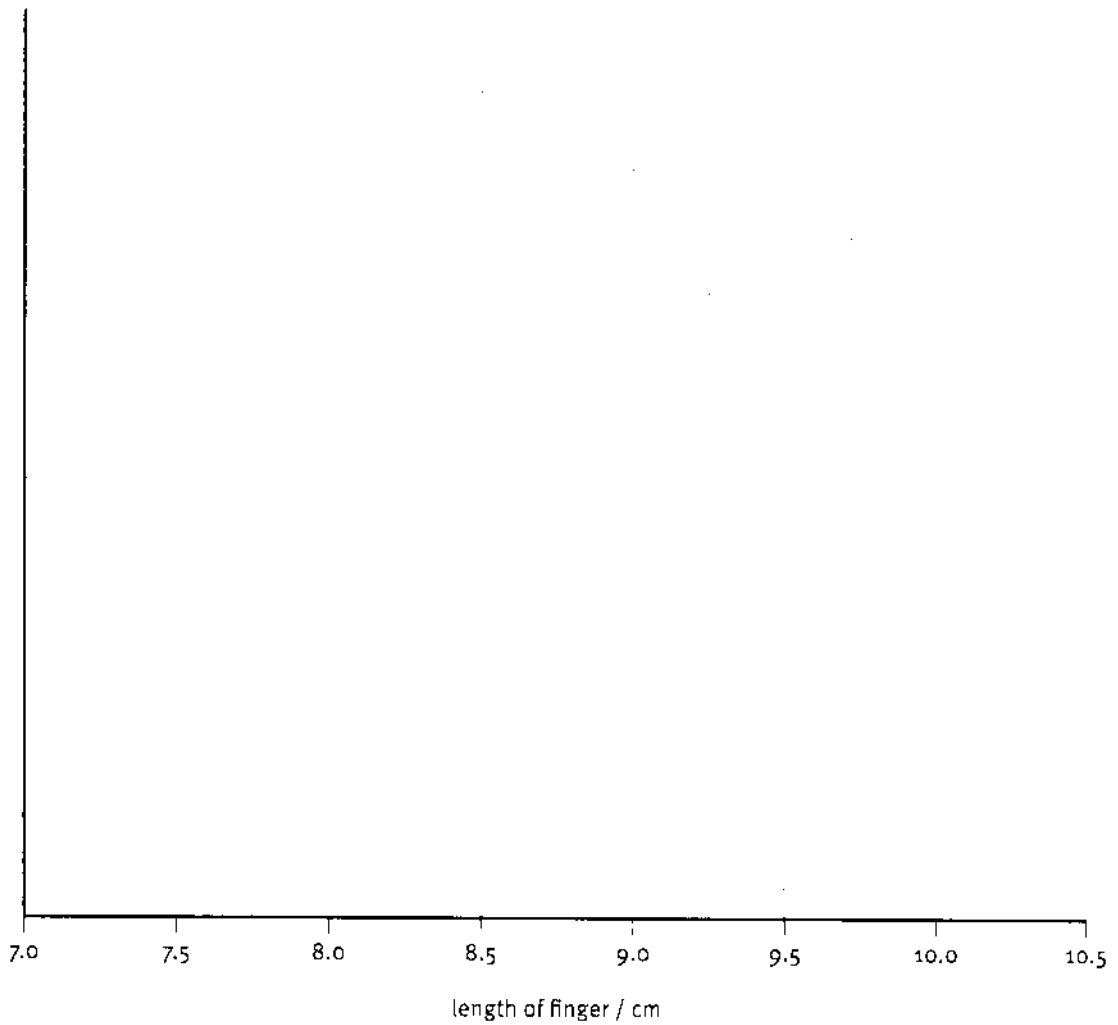
Complete Felipe's results table.

Length of finger / cm	**7.0–7.4**	**7.5–7.9**	**8.0–8.4**	**8.5–8.9**	**9.0–9.4**	**9.5–9.9**	**10.0–10.4**
Tally							
Number of people							

4 Complete the frequency diagram to show Felipe's results.

Write a heading for the vertical axis.

- Decide what will be the largest number you need on the vertical axis. Then label the scale on this axis.
- Draw a bar for each range of finger lengths. The bars should touch one another, with no spaces in between them.



Exercise 3.3 Merino sheep

This exercise is about a real experiment that was done to find out how farmers could get the best quality wool from their sheep. You will need to look carefully at all the information, and use it to make conclusions. You should also think about designing good experiments.

In Australia, Merino sheep are kept for their wool. The best quality wool has especially thin fibres.

An experiment was carried out to find out whether genes, the environment or both have an effect on the thickness of the fibres.

Two groups of 20 sheep were used. Group A had wool with thin fibres. They came from a breeding herd that always produced sheep with thin fibres.

Group B had wool with thicker fibres. They came from a breeding herd that always produced sheep with thicker fibres.

In the experiment, 10 sheep from Group A were kept in a hot, dry part of Australia. The other 10 sheep from Group A were kept in a cooler, wetter part.

The same was done with the sheep from Group B.

After two years in these environments, the diameters of a sample of wool fibres from each group of sheep were measured and the mean diameters were calculated. The results are shown in the table.

Mean diameter of fibres in micrometres	**In a hot, dry environment**		**In a cool, wet environment**	
	Group A	Group B	Group A	Group B
	18.55	20.72	16.82	19.06

1 There are 1000 micrometres in 1 mm. Suggest how the researchers could measure the diameter of the fibres.

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2 What evidence did the researchers have, before they began their experiment, that suggested that genes affect the diameter of wool fibres?

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3 Explain how the results of the experiment confirm the idea that genes affect the diameter of wool fibres.

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4 Explain how the results of the experiment confirm the idea that the environment affects the diameter of wool fibres.

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5 Do you think that the researchers' experiment was designed well? Suggest how they could improve it.

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Exercise 3.5 Breeding a new variety of flower

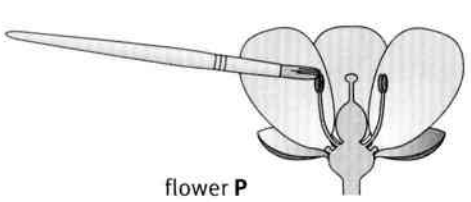
This exercise will help you to remember how plants reproduce, which you learnt about in Stage **8**. You will use what you have learnt about selective breeding to think about how a plant breeder could carry out this process.

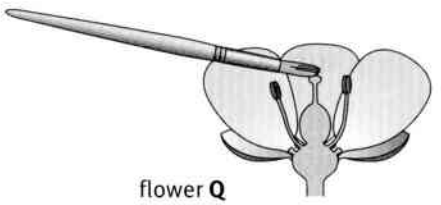
Nur grows and sells flowers. She has plants that produce very attractive flowers, but most of them do not have a strong scent.

She decides to try to breed some plants that produce flowers with a stronger scent.

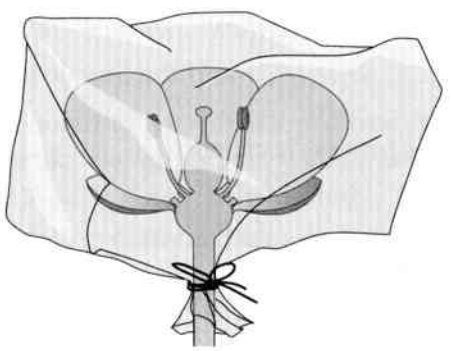
First, Nur tests all of her plants, and chooses the two that have flowers with the strongest scents.

Then she takes pollen from a flower on one of these plants (flower **P**), and brushes it onto a stigma on the second plant (flower **Q**).


flower **P**


flower **Q**

Nur covers flower **Q** with a plastic bag, to stop bees bringing any more pollen to it.



She leaves the flower for several weeks, until its seeds have developed. Then she collects the seeds and sows them.

When the seeds germinate, Nur lets all the new plants grow and flower. Then she smells them all, and repeats steps 1 to 4. She does this again and again, for many years.

1 Name the part of the flower from which Nur collects pollen.

.....

2 Explain why it is important to stop bees from bringing more pollen to flower Q.

.....

.....

.....

3 The first set of seeds that Nur sowed contained genes from both flower P and flower Q.

Complete these sentences to explain why. Use words from the list. You can use each word once, more than once, or not at all.

chromosomes	**cytoplasm**	**female**	**fertilisation**
genes	**male**	**ovule**	**P**
pollination	**proteins**	**Q**	**stigma**
tails	**tubes**		

The pollen that Nur takes from flower P contains the ..... gametes.

The pollen grains grow ....., down to the ..... of flower Q.

The nuclei of the male gamete of plant ..... and the female gamete of plant ..... fuse together. This process is called ..... .

The nuclei of the male gametes and female gametes each contain ....., which are made up of many ..... . The zygote that is formed has a mixture of characteristics from P and Q.

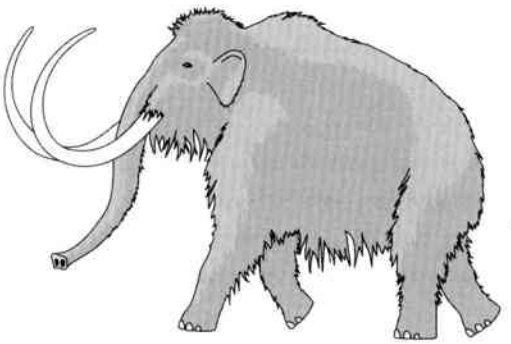
4 What is the name of the process that Nur used to breed her new, strongly scented plant variety?

.....

Exercise 3.6 Woolly mammoths

In this exercise, you will practise using the ideas of natural selection to suggest an explanation for how a species of animal developed. You will need to write your ideas down on rough paper first. Try to put plenty of detail into your answer, and use scientific terms where you can.

Woolly mammoths lived in northern Europe, north America and Siberia. The last woolly mammoth is thought to have died about 4000 years ago.



Woolly mammoths had very long, thick hair, which insulated them in the cold climates in which they lived. They also had huge tusks. Scientists think that they may have used their tusks to clear away snow, to find plants underneath that they could eat.

Woolly mammoths are thought to have developed from steppe mammoths. Steppe mammoths looked rather like elephants. They had less fur and shorter tusks than woolly mammoths. Woolly mammoths probably developed from steppe mammoths when the climate got much colder, during one of the Ice Ages.

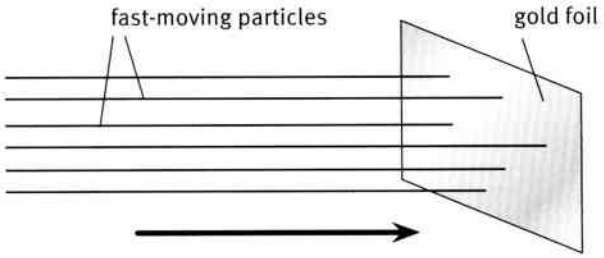
Use the ideas of natural selection to suggest how woolly mammoths may have developed.

Exercise 4.1 The structure of the atom

This exercise will give you practice in labelling the model of the atom. You will also think about one of the experiments that led scientists to use that model.

1 Draw a labelled diagram of an atom.

2 Ernest Rutherford was one of the scientists whose work helped to give us the model of the atom which we use today. Below is a diagram showing his most famous experiment – the gold foil experiment. In this experiment he fired fast-moving particles, smaller than an atom, at a very thin sheet of gold foil.



a Complete the diagram to show what happened to the particles when they hit the gold foil.

b What did the results of Rutherford's experiment tell him about the structure of the atom?

.....

.....

c Name another scientist whose work contributed to the model of the atom we use today.

.....

Exercise 4.2 More about the structure of the atom

This exercise will give you practice in drawing atoms and in working out how many of each type of particle are present in an atom.

1 The element carbon has an atomic number of 6 and a mass number of 12.

a How many protons does carbon have?

.....

b How many electrons does carbon have?

.....

c How many neutrons does carbon have? Show how you work out your answer.

.....

.....

d Draw and label the structure of an atom of carbon.

2 Complete the table below.

Element	Atomic number	Mass number	Protons	Neutrons	Electrons	Electronic structure
beryllium	4	9	4	5	4	2,2
magnesium	12	24				
calcium	20	40				

Exercise 4.4 Trends in groups in the Periodic Table

This exercise will help you to identify trends in groups of the Periodic Table.

1 Explain what is meant by a 'group' in the Periodic Table.

.....

2 This table contains some data about the elements in Group 7 of the Periodic Table. The elements are given in the descending order.

Element	Atomic number	Melting point /°C	Boiling point /°C	Reactivity
fluorine	9	−220	−188	most reactive
chlorine	17	−101	−34	
bromine	35	−7	59	less reactive
iodine	53			
astatine	85			

a What trends can you see in this group of the Periodic Table?

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b Iodine is the fourth element in this group. Would you expect the melting point of iodine to be higher or lower than that of bromine?

.....

c Would you expect iodine to be a solid, a liquid, or a gas at room temperature? Give a reason for your answer.

.....

d Would you expect iodine to have a higher or lower boiling point than astatine? Give a reason for your answer.

.....

e Would you expect astatine to be more or less reactive than iodine?

.....

Exercise 5.2 Exothermic reactions

The first part of this exercise will give you practice in writing word equations. The rest of the exercise will help you to look critically at evidence from an investigation.

1 Write a word equation for burning sulfur in oxygen.

.....

2 Write a word equation for the reaction between magnesium and sulfuric acid.

.....

3 When magnesium ribbon is placed in sulfuric acid, a chemical reaction takes place and heat energy is given off.

Liang and Naranbaatar are planning an investigation into the effect of the length of magnesium ribbon on the increase in temperature. They decide to carry out some preliminary work.

Explain what preliminary work they could do and how this would help them plan their investigation.

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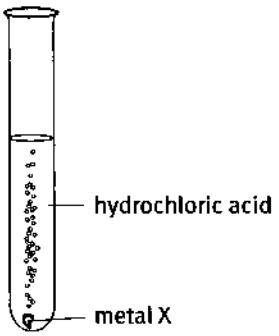
4 Simon and Nirav are carrying out an investigation to find which of the metals X or Y produces the higher temperature in a reaction with hydrochloric acid.

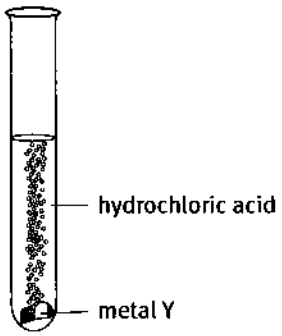
Simon measures out 10 cm^3 of hydrochloric acid in a test tube. He measures the temperature and then places a small piece of metal X into the acid. He sees bubbles of gas given off. When the reaction finishes, he measures the temperature again.

Nirav measures out 10 cm^3 of hydrochloric acid in a test tube. He measures the temperature and then places a piece of metal Y into the acid. He also sees bubbles of gas given off. When the reaction finishes, he measures the temperature again.

Simon's experiment



Nirav's experiment



a Which variable did Simon and Nirav need to change in their experiment?

.....

b Which variable or variables have they kept the same?

.....

c There is one variable that Simon and Nirav changed, but which they should have kept the same. What is this variable?

.....

d In the reaction with metal X, the temperature increased by 2 °C. In the reaction with metal Y the temperature increased by 6 °C.

What conclusions can you draw from these results?

.....

.....

e Suggest how Simon and Nirav could improve their investigation and make their results more reliable.

.....

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Exercise 5.3 Endothermic reactions and processes

This exercise will help you to remember the difference between an endothermic chemical reaction and an endothermic chemical process. The exercise will also give you practice in planning investigations.

1 When potassium chloride dissolves in water the temperature drops.

When acid is mixed with sodium carbonate the temperature drops.

Which one of these examples is an endothermic reaction? Give a reason for your answer.

.....

.....

.....

2 Give an example of an endothermic process that is not mentioned in question **1**.

.....

3 Farzana and Vaishali are investigating the reaction of lemon juice and sodium hydrogencarbonate (baking powder). They use lemon juice from a bottle and dilute it. They then add sodium hydrogencarbonate using a spatula. They want to answer the question, 'Does adding more sodium hydrogencarbonate make the temperature fall lower?'

a Which variable will they change?

.....

b How will they measure the variable they change?

.....

c How could they find out how much to increase the sodium hydrogencarbonate by in each test?

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d Which change will they measure? Explain how they will measure it.

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e Make a list of the equipment they will need.

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f Describe how they will carry out their experiment.

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g How should Farzana and Vaishali make sure that their results are reliable?

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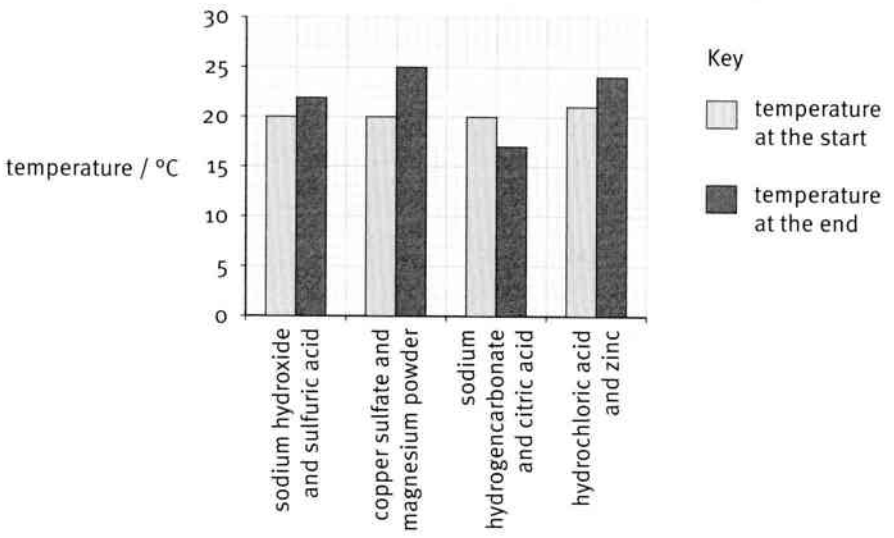
Exercise 5.4 Exothermic or endothermic?

This exercise will help you to distinguish between exothermic and endothermic reactions.

1 Mauren and Esteban have been investigating various reactions to find out if they are exothermic or endothermic. The bar chart below contains their results.



a Which of these reactions are endothermic and which are exothermic?

.....

.....

.....

.....

b Which of these reactions has the largest temperature change?

.....

c Mauren and Esteban carried out these reactions in polystyrene cups rather than glass beakers. Suggest why this was a sensible idea.

.....

.....

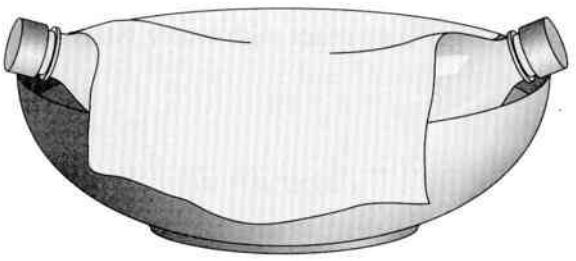
2 Give an example of a useful product that involves an exothermic process or reaction.

.....

3 Give an example of a useful product that involves an endothermic process or reaction.

.....

4 Michela and Simone are camping in a tent during some hot weather. They have no refrigerator to keep their drinks cool. They place their bottles of water in a bowl with water and place a wet cloth over the top.



Use particle theory to help you to explain why this arrangement will help to keep their water bottles cool.

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Exercise 6.2 Reactions of metals in water

This exercise will give you practice in writing word equations. It will help you to think about the reactions of metals with water and steam.

1 The following table summarises the reactions of some metals with water.

Metal	Reaction with water
zinc	reacts only with steam
copper	no reaction
lithium	the metal moves rapidly across the surface, makes a hissing sound and bursts into flame
magnesium	slow reaction with water

a Place the metals in order of how strongly they react with water. Start with the most reactive.

Most reactive .....

.....

.....

Least reactive .....

b Write a word equation for the reaction between lithium and water.

.....

c Name another metal that reacts in a similar way to lithium.

.....

d Using the information above, explain why copper is used for the roofs of buildings but magnesium is not.

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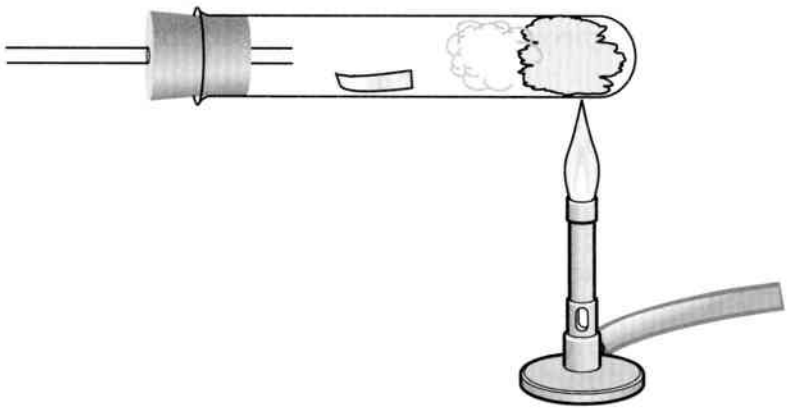
2 The following apparatus was set up to investigate the reaction of some metals with steam.



a Which gas is given off in this reaction?

.....

b How do you test for this gas?

.....

3 A metal such as magnesium or calcium reacts with water. Draw and label the apparatus to collect the gas given off in this reaction.

Exercise 6.3 Reactions of metals with dilute acids

The exercise will give you practice in planning a fair investigation.

Michelle and Justin are carrying out an investigation into the reactivity of different metals with dilute acids. They place a small piece of each metal into a test tube of acid and observe the reaction.

1 How can they tell that a reaction has taken place?

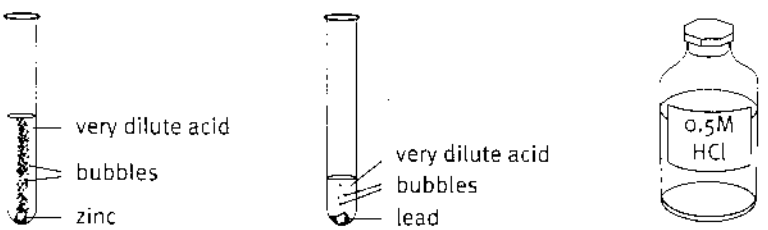
.....

2 How can they tell which metal is more reactive?

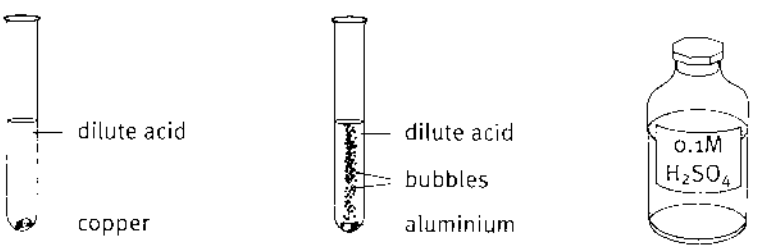
.....

Michelle carries out the test on zinc and lead. Justin carries out the test on copper and aluminium. Michelle uses dilute hydrochloric acid and Justin uses very dilute sulfuric acid for his tests.

Michelle's investigation



Justin's investigation



3 Explain why Michelle and Justin cannot use their observations to decide if copper or aluminium are more or less reactive than zinc and lead.

.....

.....

4 Write a plan for them to use to carry out this investigation, so that their results are more reliable and can be compared fairly.

Remember to include safety information.

Exercise 6.4 Reactivity series

This exercise will help you to use the reactions of metals to identify them.

1 Identify a metal that matches each of the following descriptions. There may be more than one possible metal.

a Reacts slowly with cold water to form a hydroxide.

.....

b Does not react with oxygen when heated.

.....

c Reacts slowly with dilute acid.

.....

d Reacts very vigorously in cold water to form a hydroxide.

.....

2 Some students have been testing some metals and investigating their reactivity. The table shows their results.

Metal	Reaction with oxygen	Reaction with water	Reaction with dilute acid
nickel	slow reaction when heated	no reaction with water but reacts with steam	slow reaction
iron	slow reaction when heated but faster reaction than nickel	no reaction with water but reacts with steam	slow reaction but faster than nickel
zinc	slow reaction when heated but faster reaction than iron	no reaction with water but reacts with steam	slow reaction but faster then iron
magnesium	burns brightly	very slow reaction in water	faster reaction than with zinc

a Use the results in the table to place these metals in order of reactivity, starting with the most reactive.

Most reactive .....

.....

.....

Least reactive .....

b The metal chromium is more reactive than iron but less reactive than zinc.

i What reaction would you expect chromium to have with dilute acid?

.....

ii What reaction would you expect chromium to have with water?

.....

3 The metal aluminium is more reactive than copper.

a How would you expect the reaction of aluminium or copper with dilute acid to be different?

.....

.....

b How would you expect the reaction of aluminium or copper with water to be different?

.....

.....

c How would you expect the reaction of aluminium or copper with oxygen to be different from that of sodium?

.....

.....

Exercise 6.5 Displacement reactions

This exercise will give you practice in interpreting experimental information and writing word equations. It will also help you to use the reactivity series and the reactions of metals to identify them.

1 More reactive metals can displace less reactive ones from solutions of salts.

The table below shows the results of an experiment that uses displacement reactions.

	Iron	**Copper**	**Zinc**	**Magnesium**
Copper sulfate	reaction		reaction	reaction
Zinc sulfate	no reaction	no reaction		reaction
Magnesium sulfate	no reaction	no reaction	no reaction	

a The table shows that zinc displaces the copper in copper sulfate. What does this tell you about the reactivity of zinc and copper?

.....

b Write the word equation for the reaction between zinc and copper sulfate.

.....

c The table shows that there is no reaction between magnesium sulfate and zinc. What does this tell you about the reactivity of these two metals?

.....

d Use the table to work out whether iron is more or less reactive than copper. Then work out whether magnesium is more or less reactive than iron. Write these three metals in order of reactivity. Start with the most reactive.

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2 You may need to refer to the reactivity series on page **86** in your coursebook to help you with these questions.

Asma has been given the task of identifying a metal. She knows that the metal is one of zinc, iron, copper or silver. She has been given a number of small pieces of the metal and also some solutions of copper sulfate, zinc sulfate, iron sulfate and silver nitrate.

a Explain how she could use these solutions to identify the metal.

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b A mystery metal reacts with silver nitrate and copper sulfate but not with zinc sulfate and iron sulfate. Suggest what this metal could be. Give reasons for your answer.

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c Explain how you could use displacement reactions to distinguish between iron and zinc. You may use any solutions you choose.

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Exercise 6.6 Using displacement reactions

This exercise gives you practice in describing and explaining the use of displacement reactions.

1 The most common ore of lead is lead sulfide. To extract the lead, the ore is first heated in air to produce lead oxide. The lead oxide is then heated with carbon to extract the lead.

a Explain why carbon can be used to extract lead from lead oxide.

.....

.....

b Write a word equation for the reaction that takes place when lead oxide is heated with carbon.

.....

c Copper is less reactive than lead. Predict whether carbon can be used to extract copper from copper oxide.

.....

d Aluminium is much more reactive than many metals. The main ore of aluminium is called bauxite. Bauxite is purified to make aluminium oxide. Explain why it is not possible to extract aluminium metal from aluminium oxide using carbon.

.....

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2 Explain why the reaction between aluminum and iron oxide is useful in the railway industry.

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Exercise 7.2 Metals and acids

This exercise will help you to remember some of the reactions that produce a salt and help you to describe an experiment.

1 Some salts can be made by a reaction between a metal and acid. Magnesium metal placed in sulfuric acid produces the salt magnesium sulfate and the gas hydrogen.

a Name another metal that can produce a salt in this way.

.....

b Why is sodium chloride not made by reacting sodium with an acid?

.....

c Why is copper sulfate not made by reacting copper with dilute sulfuric acid?

.....

d Describe the three steps involved in producing crystals of the salt copper sulfate. For each step, describe the method and include the safety precautions needed. Use diagrams if that will help your answer.

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Exercise 7.3 Using carbonates to treat acid soil

This exercise will help you to interpret data from secondary sources and to discuss the details of an experiment.

In Kojonup, Western Australia, the soil is acidic and crops do not grow well. To improve the soil, farmers add crushed limestone (calcium carbonate) to the surface. But this does not improve the crops very much. This is because the acidity of the soil is only reduced at the surface, not deeper down where the roots of the plants are.

Scientists investigated the problem and decided to try using earthworms to help reduce the acidity deeper in the soil. Earthworms take the soil and materials from the surface deeper down into the soil. There were very few earthworms in this area, so earthworms from another part of Australia were used.

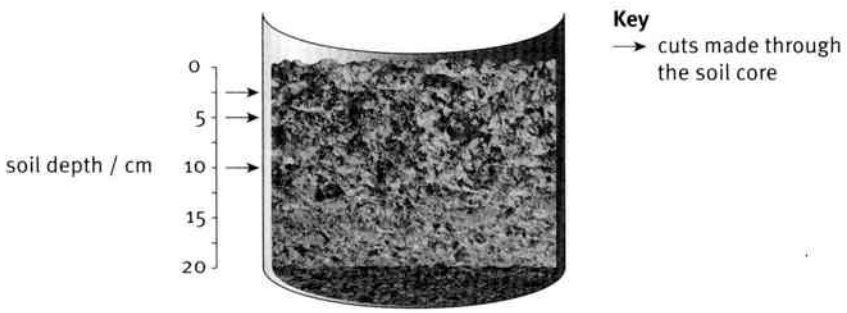
The scientists cut 25 cm lengths of 30 cm diameter plastic piping. They placed the pipes in the soil, with 5 cm projecting above the surface.

They placed 50 pipes in farmland in Kojonup. The same mass of crushed limestone was spread evenly over the surface of the soil inside each pipe.

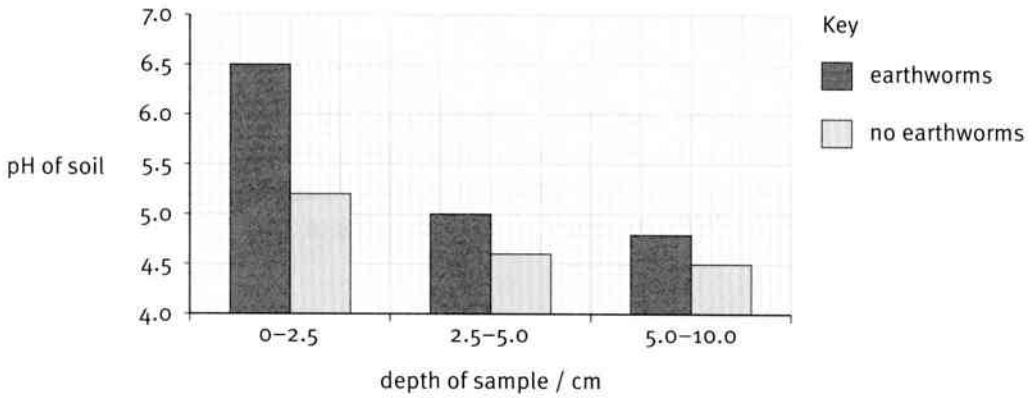
They added 30 earthworms to 25 pipes.The other 25 pipes had no earthworms added. These were the control pipes.

After six months the scientists removed a core of soil from each of the pipes.

The core was cut into measured sections (0–2.5 cm; 2.5–5.0 cm and 5.0–10.0 cm). The pH of each section of soil was measured.



Here is a bar chart of the results.



1 Explain how adding crushed limestone reduces the acidity of the soil. Include a general equation for the reaction.

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2 Why did the scientists think that the addition of earthworms could help with the problem in Kojonup?

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3 Why did the scientists use earthworms from another area of Australia?

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4 Why did the scientists only add earthworms to half of the pipes?

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5 Suggest why the pipes were placed with 5 cm above the soil surface.

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6 The scientists noticed that some of the worms escaped over the rim of the pipes. Suggest how this would affect the results. What could be done to overcome this problem?

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7 How can you test the pH of soil?

.....

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8 When the soil becomes less acidic, does the pH increase or decrease?

.....

9 Describe what the researchers have found out. Use the researchers' results to advise the farmers in Kojonup how they can improve the growth of their crops.

10 When the soil is dry, the earthworms burrow very deep into the soil and do not come to the surface. The average annual rainfall for the area of Kojonup is 550 mm. How might the results have been different if there had been very little rain during the six months of the test?

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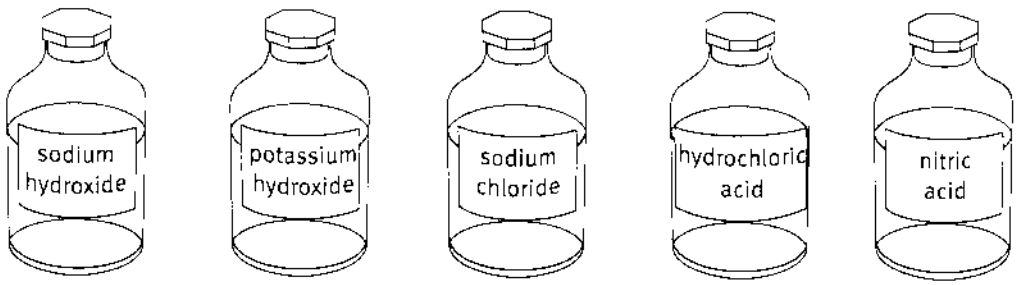
Exercise 7.4 Forming salts by neutralisation

This exercise will help you to remember another way to produce a salt.

1 Maria has been asked to make the salt sodium nitrate. She can use any of the solutions shown in the diagram.



a Which solutions should Maria use? What other solution, not listed above, does she need to carry out her experiment?

.....

.....

b Maria has a burette, a clamp stand and a conical flask set up ready to use. Which solution should she put in the burette?

.....

c What should Maria do to keep safe as she carries out her experiment?

.....

d How will Maria know when she has made the salt?

.....

.....

e What must she do to prepare clean crystals of sodium nitrate?

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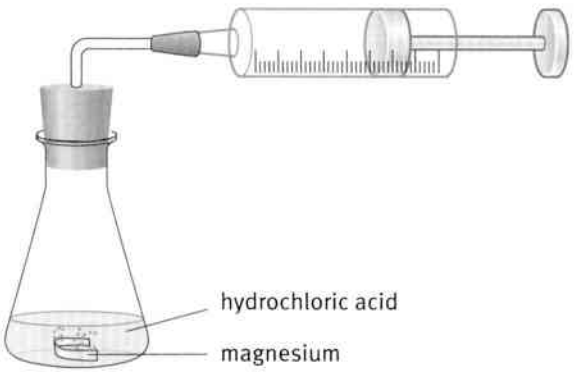
Exercise 8.2 Changes in the rate of reaction

This exercise will help you to interpret data and plot graphs.

1 Xin investigated the rate of reaction between magnesium metal and hydrochloric acid.



a Write the word equation for this reaction.

.....

b Xin repeated his experiment three times. Explain why he did this.

.....

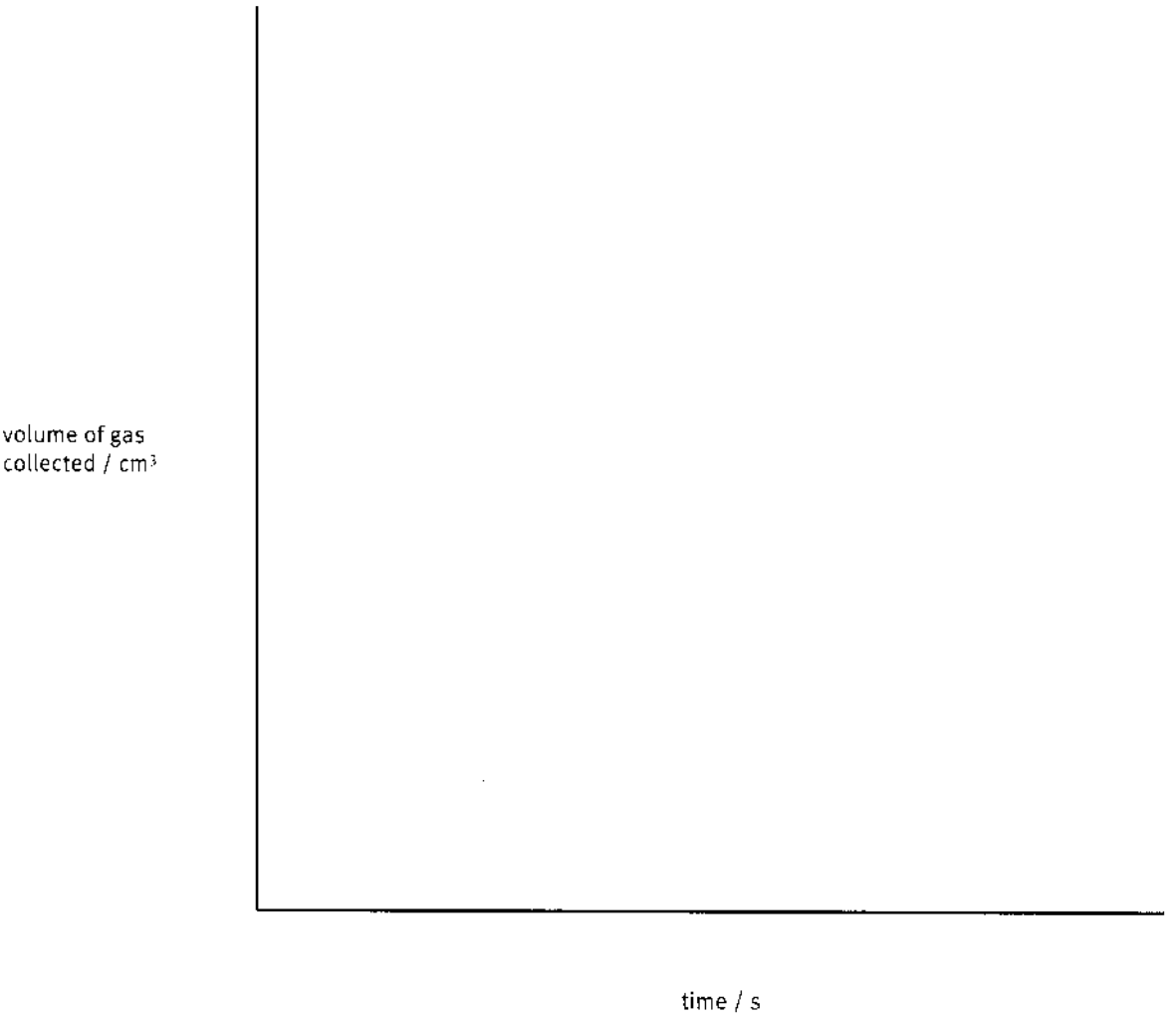
.....

c The table below contains his results.

Time / s	Volume of gas collected / cm³			
	Attempt 1	Attempt 2	Attempt 3	Mean
0	0	0	0	
20	28	31	31	
40	39	48	42	
60	56	53	57	
80	60	59	61	
100	60	59	62	

Complete the table.

d Plot a graph of Xin's results. Draw a line of best fit.



e When did the reaction end? Explain how you know this.

.....

.....

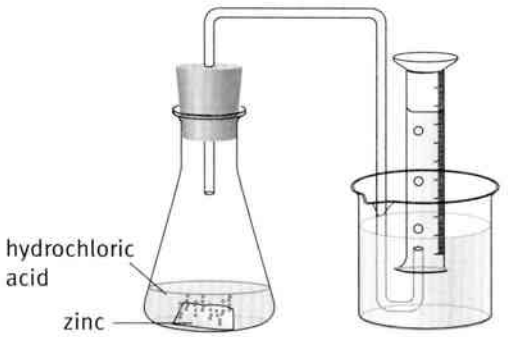
f Complete the following sentence.

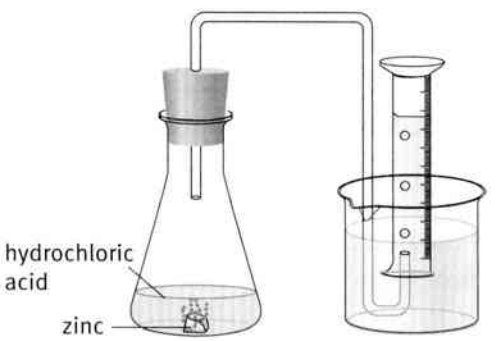
The reaction is fastest between ..... seconds and ..... seconds.

Exercise 8.3 Surface area and the rate of reaction

This exercise will help you to interpret graphs.

1 Abeje investigated the effect of surface area on the rate of reaction. She used a flat piece of zinc and a lump of zinc (of the same mass) in hydrochloric acid and carried out the reaction, collecting the gas over water in a measuring cylinder.





a What practical problems might Abeje have in obtaining her results, using this method of collecting the gas?

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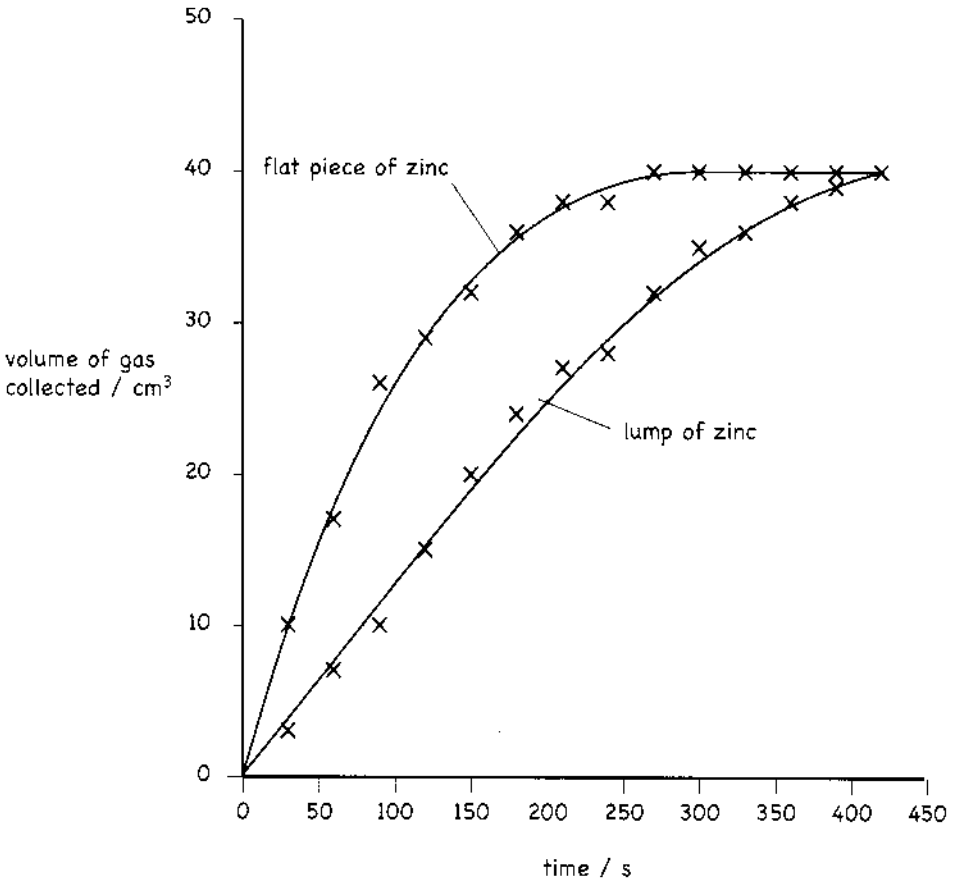
Abeje repeated her experiments and plotted the results for the two different shapes of zinc on the same graph.



b Describe the graph for the reaction with the flat piece of zinc. Remember to include the times at which the rate is fastest and when it changes.

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c How is the line of best fit for the reaction using the flat piece of zinc different from the one using the lump of zinc?

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d Explain the reasons for the difference you have described in **c**.

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e On the graph, draw the line you would expect to see if Abeje did the experiment again using the same mass of powdered zinc.

f Circle the phrase that correctly completes the sentence.

The total volume of gas produced in the two reactions was

i higher in the one with the lump of zinc.

ii lower in the one with the lump of zinc.

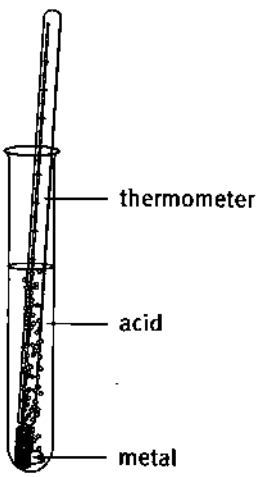
iii the same.

Exercise 8.4 Temperature and the rate of reaction

This exercise will help you to plan investigations and explain the reasons for changes in the rate of reaction of an acid and a metal.

1 Chika and Enlai are investigating the effect of temperature on the rate of reaction.

- They have been told that they can use a suitable metal and an acid.
- They will use the temperature range 20 °C to 70 °C with an interval of 10 °C.
- They will start the stopwatch as soon as the metal is placed in the acid and stop it again when the reaction stops.



a Suggest a suitable metal and acid to use in this investigation.

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b What safety precautions should Chika and Enlai take?

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c Which variables must they keep the same in this investigation to ensure that the test is fair?

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d How will they know when the reaction has stopped?

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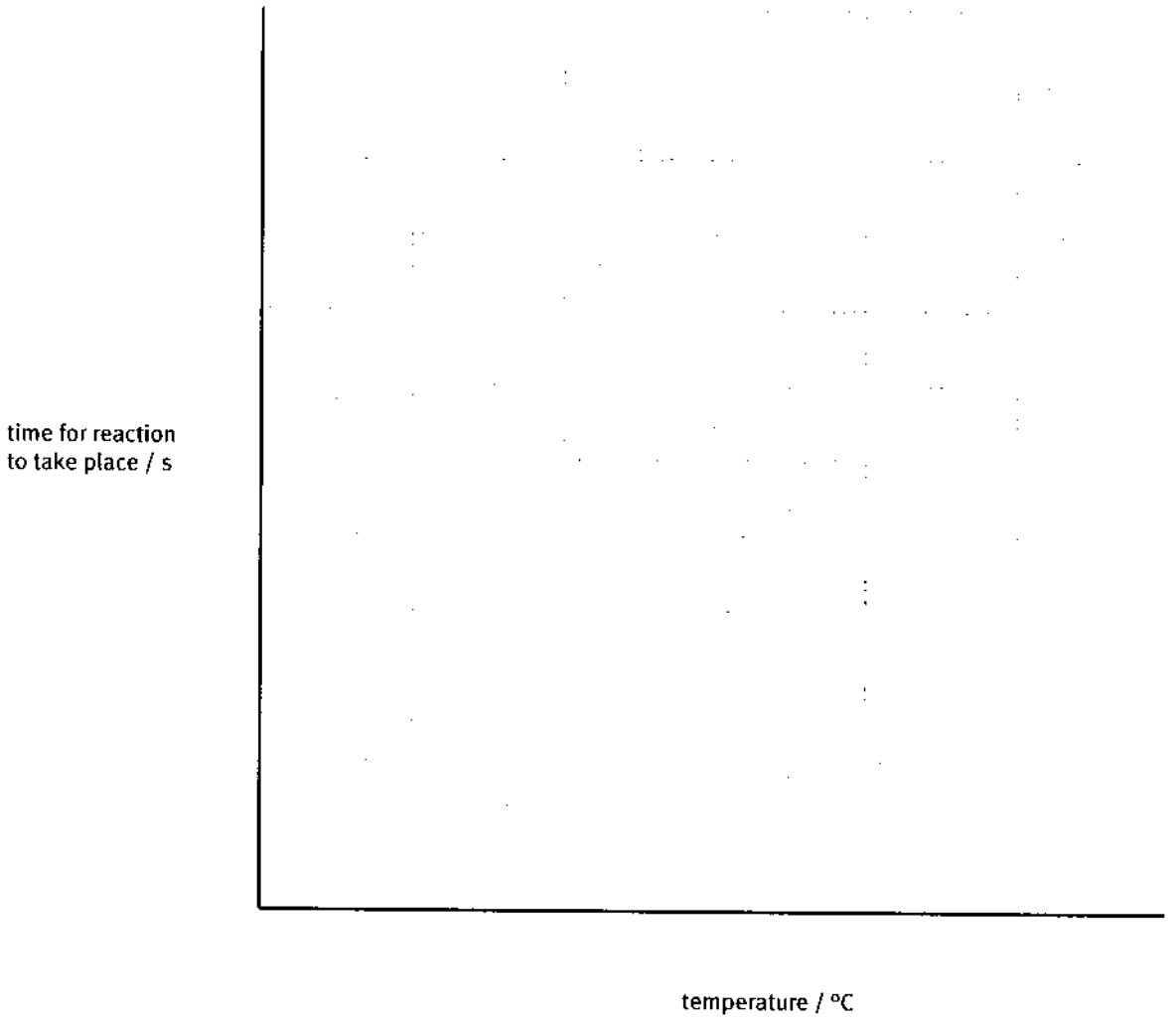
e Construct a results table for their investigation. You cannot fill in their results – just leave that part of the table blank.

f On the grid below, sketch the graph you would expect their results to produce.



g Use particle theory to explain why a change in temperature changes the rate of reaction.

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Exercise 8.5 Concentration and the rate of reaction

This exercise will help you to plan investigations and explain the reasons for changes in the rate of reaction.

Obaid and Atif are investigating the effect of changing the concentration on the rate of reaction between dilute sulfuric acid and zinc. They have been given a number of pieces of zinc of the same size and mass but only one bottle of dilute sulfuric acid. Their first task is to make up five different concentrations of the acid.

1 Explain how they would make solutions of the sulfuric acid at five different concentrations.

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They then carry out their investigation. They keep the volume of acid used the same each time. The mass and size of the zinc used is the same each time. So is the temperature of the acid.

2 What do the boys measure when they carry out the reaction?

.....

3 List the equipment they will need to carry out this investigation.

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4 What would you expect them to find out in this investigation?

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5 Explain why you think they will get these results.

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Exercise 8.6 Catalysts

This exercise will help you to plan an investigation.

Folami and Zahra have carried out an experiment using hydrogen peroxide and a catalyst, manganese oxide. They found that the hydrogen peroxide bubbled and released lots of gas when they added the catalyst.

1 What is the gas that is released?

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2 How could they test for this gas?

.....

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3 They know that a catalyst is not part of the reaction and is not changed chemically. Folami wondered if they could get the catalyst back at the end of the reaction. Explain how she could do this. You can draw a diagram if it helps you to explain.

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4 The girls wanted to know if adding more catalyst would make the reaction faster. Write a plan for their investigation. Make sure that you give details of what the girls should do to keep safe, as part of your plan.

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Exercise 9.1 Understanding density

In this exercise, you will use and interpret information about the densities of some important materials.

1 The table shows the densities of seven solid materials.

Study the table. In the space below, list the materials in order, from least dense to most dense.

Material	Density in g/cm³
nylon	1.2
copper	8.9
cork	0.24
concrete	2.4
marble	2.6
gold	19.3
silver	10.5

Least dense .....

.....

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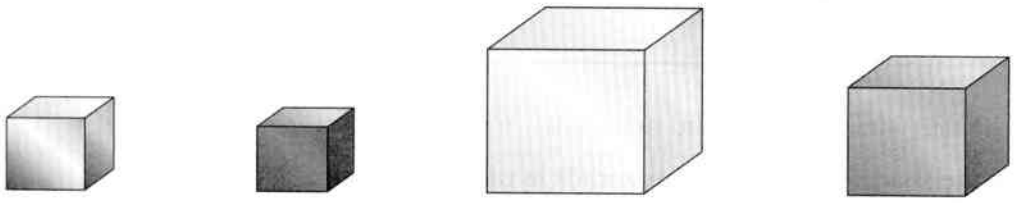
Most dense .....

2 The picture shows cubes of four materials. Each cube has a mass of 1.0 kg.

In the space below, list the materials in order, from least dense to most dense.



iron lead ice brick

Least dense .....

.....

.....

Most dense .....

3 Use the information from the table to answer this question:

Which has a greater volume, 1 kg of gold or 1 kg of silver? Explain your answer.

.....

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4 Gold is denser than silver. A 1 cm cube of gold has more mass than a 1 cm cube of silver.

However, if we could see the atoms of gold and silver, we would see that they are exactly the same size. A 1 cm cube of gold has the same number of atoms as a 1 cm cube of silver.

gold silver

What does this tell you about the atoms of gold and silver?

.....

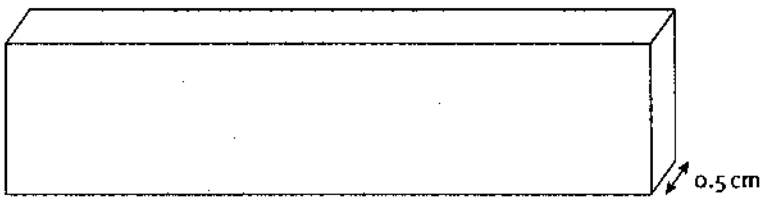
.....

Exercise 9.2 Measuring density

In this exercise, you will use and interpret information to practise measuring density.

1 To find the density of a piece of material, you need to measure its volume.

The picture shows a piece of wood. It is 0.5 cm thick.



Measure the picture and find the volume of the piece of wood.
Give your answer in cm^3.

a length of wood = ...

b width of wood = ...

c volume of wood = ...

2 Bijan wanted to find the density of a piece of metal. He weighed it. Then he measured its volume by placing it in a measuring cylinder which was half-full of water.

Here are his measurements:

mass of metal = 196.0 g

reading on measuring cylinder (water only) = 45 cm^3

reading on measuring cylinder (water + metal) = 68 cm^3

a Calculate the volume of the metal, in the space below.

.....

b Calculate the density of the metal, in the space below.

.....

Bijan used a table of densities to try to identify the metal. The table is shown below.

Metal	Density in g / cm³
aluminium	2.7
brass	8.5
copper	8.9
gold	19.3
iron	7.9
silver	10.5
steel	7.9
tin	7.3

c Which metal might Bijan have been investigating?

.....

Can Bijan be sure of this answer? Explain why/why not.

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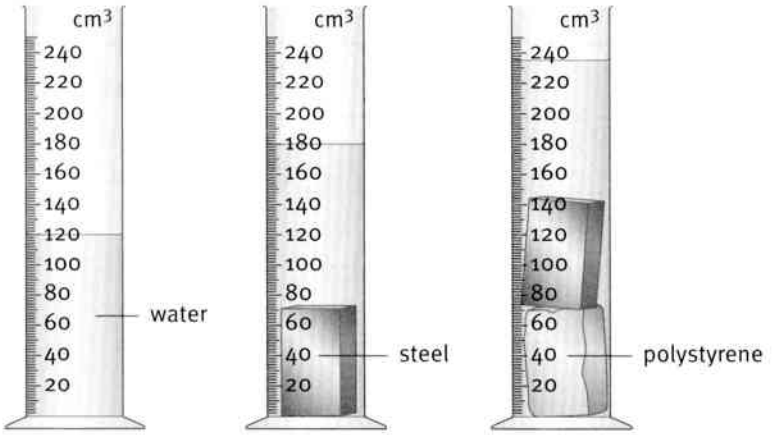
3 Polystyrene foam is less dense than water. Molly measured the volume of a small block of foam by submerging it in water in a measuring cylinder.

The pictures show her results.



a Explain why Molly placed a block of steel on top of the foam.

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b Calculate the volume of the foam.

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Molly weighed the foam to find its mass:

mass of foam = 6.6 g

c Calculate the density of the foam.

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4 Pat says that people are less dense than water. Explain how you could test this idea. Do you agree with Pat?

Exercise 9.3 Calculations involving density

In this exercise, you will use the equation for density to solve some problems.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

1 A classroom measures 3 m × 4 m × 6 m.

a Calculate the volume of air in the room. Give your answer in cubic metres (m^3).

.....

b The density of air is 1.3 kg/m^3. Calculate the mass of air in the room.

.....

2 A steel cube has sides of length 20 cm. Calculate its mass. (Density of steel = 7.7 g/cm^3.) Give your answer in g, and in kg.

.....

3 A stone is made of material with a density of 2.7 g/cm^3. Its mass is 94.5 g.
Calculate the volume of the stone.

.....

4 The density of water is 1.0 g/cm^3. This is useful as it means we can measure the mass of water and easily work out its volume.

a What is the mass of 1 cm^3 of water? .....

b What is the mass of 20 cm^3 of water? .....

c What is the volume of 10 g of water? .....

d What is the volume of 22.5 g of water? .....

e Milan is measuring the density of ethanol. He weighs a bottle three times: first, empty; then filled with water; then filled with ethanol. Here are his results:

mass of empty bottle = 30.0 g

mass of bottle filled with water = 90.0 g

mass of bottle filled with ethanol = 78.0 g

i Calculate the volume of the bottle.

.....

ii Calculate the mass of the ethanol.

.....

iii Calculate the density of ethanol.

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5 Mercury is a liquid metal. Its density is 13.6 g/cm^3. Mercury is supplied in a plastic bottle whose volume is 50 cm^3. The empty bottle has a mass of 25.0 g. Calculate the mass of the bottle when it is filled with mercury.

Exercise 9.4 High pressure, low pressure

In this exercise, you will use your understanding of the idea of pressure to answer some questions.

Read each of the situations described below. For each:

- state whether it is desirable to have high pressure or low pressure
- explain why this is desirable.

Use the words **force**, **area** and **pressure** in your answers.

1 A hotel has a lounge with a wooden dance floor. A notice says that people must not wear stiletto heels.

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2 A butcher regularly sharpens the knives which he uses to cut up meat.

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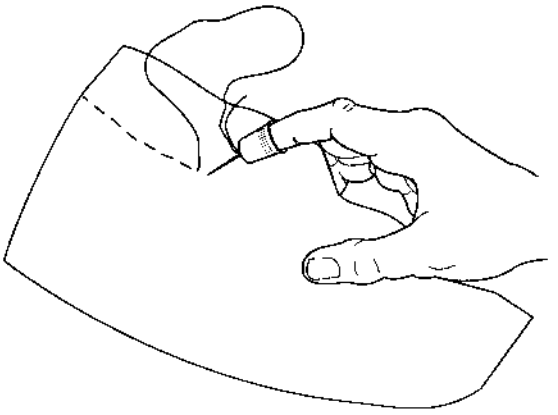
3 A needle used for sewing has a sharp point at one end. The person sewing often wears a thimble on a finger to push the needle through the fabric.



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Exercise 9.5 Calculations involving pressure

In this exercise, you will use the equation for pressure to solve some problems.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

1 This question is about units of pressure.

a The list below shows six different units. Cross out the ones which could not be units of pressure.

Pa **N/cm²** **kg/cm³** **N/m²** **pascal** **g/cm²**

b Which three of the above units are all the same?

.....

2 An elephant weighs 60 000 N. It stands on four feet. Each foot has an area of 0.1 m².

a Calculate the total area of the elephant's feet.

.....

b Calculate the pressure the elephant exerts on the ground.

.....

c The elephant lifts one foot off the ground. Calculate the pressure it now exerts on the ground.

.....

3 A large fish tank is filled with water. The pressure on the base of the fish tank is $4000\,N/m^2$.

The base of the tank is a rectangle measuring 2.0 m by 4.5 m.

a Calculate the area of the base.

.....

b Calculate the force on the base caused by the pressure of the water.

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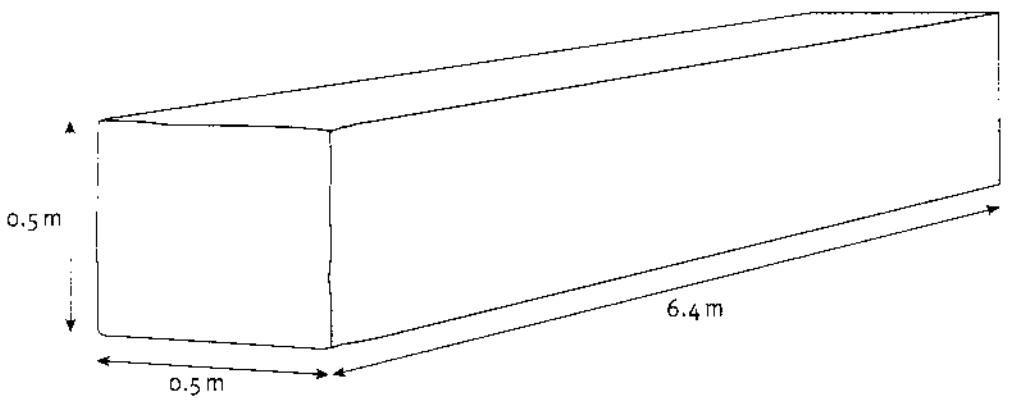
4 In this question, you will have to use the equation for density as well as the equation for pressure.

The picture shows a concrete beam lying on the ground.



a Calculate the volume of the beam.

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b Calculate the mass of the beam. The density of concrete is 2400 kg/m^3.

.....

c Calculate the weight of the beam. Remember that a mass of 1 kg has a weight of 10 N.

.....

d Calculate the area of the concrete beam in contact with the ground.

.....

e Calculate the pressure of the beam on the ground.

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5 Estimate the pressure you exert on the ground when you stand on one foot.

a Explain how you have made your estimate.

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b Compare your answer with the pressure exerted by an elephant (question **2**).

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Exercise 9.6 Gas pressure

In this exercise, you will imagine what it would be like if you were a particle in a gas.

You are surrounded by a mixture of gases, which is called air. At room temperature, the gas particles that make up air have an average speed of about 400 m/s.

1 a Estimate your own top speed when running. Give your answer in m/s.

.....

b How many times faster does a gas particle within air move?

.....

2 If you are in a room, the air in the room exerts pressure on the walls, the ceiling and the floor. This is because the particles within air bounce off these surfaces.

In the space below, draw a diagram to show how the particles within air move in a room.

3 Now imagine that you are a particle of a gas in the room. You move around the room rapidly, bouncing off the walls, the ceiling and the floor.

a If the temperature increases, what will happen to your speed? Will you move faster or more slowly?

.....

b Will you bounce off the walls more or less frequently?

.....

c Will you create a bigger or smaller force on the walls?

.....

d Will the pressure on the walls increase or decrease?

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4 Imagine that the room you are in gets much smaller. Explain whether the pressure on the walls will get bigger or smaller.

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Exercise 9.8 Moment of a force

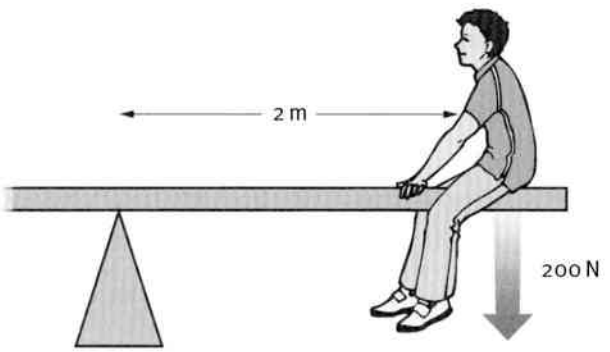
In this exercise, you will use the formula for the moment of a force.

moment = force × distance from pivot

1 Calculate the moment of the boy's weight about the pivot.

Give your answer in newton metres (N m).

Say whether the weight will make the beam turn clockwise or anticlockwise.



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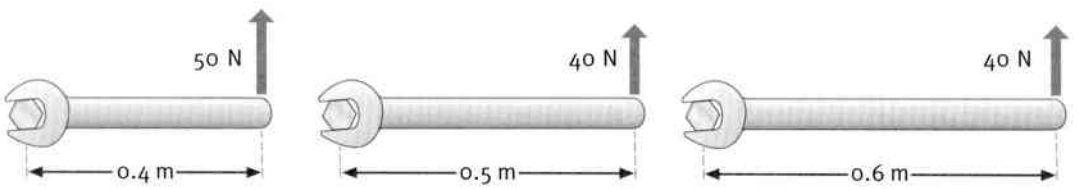
2 Calculate the moment of each force on the spanner. In which diagram does the force have the greatest turning effect?



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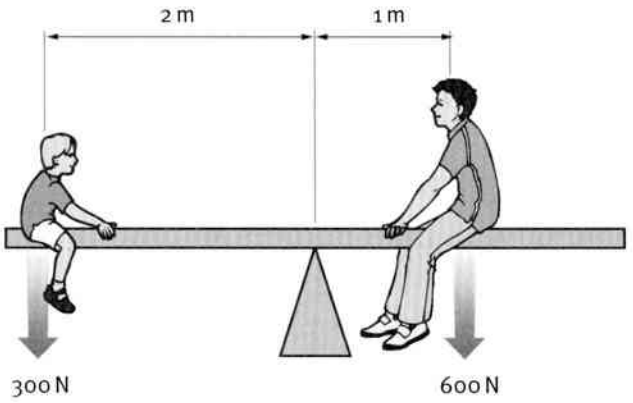
3 The diagram shows a seesaw with two boys on it. To decide whether the seesaw is balanced, you need to calculate the moment of each force. Is it balanced? Show your working in the space below the diagram.



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Exercise 9.9 Balancing moments

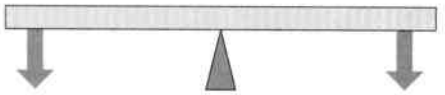
In this exercise, you will use the formula for a balanced beam.

clockwise moment = anticlockwise moment

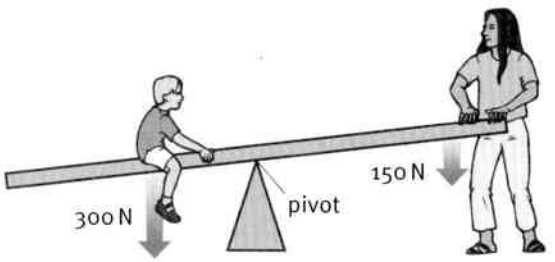
1 The diagram below shows a balanced beam. The arrows represent two forces acting on the beam.

One force has a clockwise moment. Label this force C.

The other force has an anticlockwise moment. Label this force A.



2 The picture shows a boy on a seesaw. The moment of his weight is balanced by the moment of the man's pushing force.



a The boy is sitting 0.4 m from the pivot.

Calculate the moment of his weight about the pivot.

.....

b The man pushes down on the seesaw.

Calculate the distance from the pivot at which he must push.

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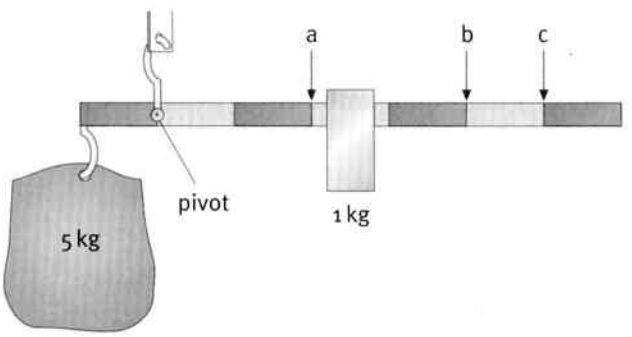
3 The diagram shows a type of balance that is often used by market traders.



At which position (a, b or c) must the 1 kg mass be placed to balance the beam?
Give a calculation to justify your answer.

.....

Exercise 10.3 Moving electrons

In this exercise, you will use what you know about static electricity to check and correct some statements.

For each of the statements below, decide whether it is correct or incorrect. Put a tick or a cross next to the statement.

If a statement is incorrect, cross out the words that are wrong and write words that will make the statement correct.

1 The nucleus of an atom has a negative charge.

.....

2 The electrons are firmly held on the outside of the atom.

.....

3 A neutral object is uncharged because it has equal amounts of positive and negative charge.

.....

4 When an acrylic rod is rubbed with a cloth, the rod gains a positive charge because electrons are transferred from the rod to the cloth.

.....

5 The cloth also gains a positive charge.

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6 The rod and the cloth will attract each other.

.....

7 The charged rod will only attract objects with an opposite charge.

.....

Exercise 10.4 Electricity on the move

In this exercise, you will think about some of the ways we make use of electricity.

In the first three topics of this unit, you have been studying static electricity. 'Static' means 'not moving'. In static electricity, the electric charges do not move around.

Now you are going to study current electricity. Currents in electric circuits make things happen.

Think about some of the things we use electricity for. Write about 100 words describing part of a day; each time you mention an electrical appliance, underline it. How many can you fit in?

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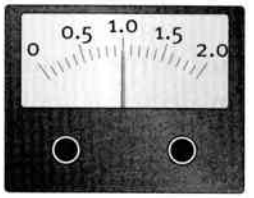
Exercise 10.5 Electric current in a series circuit

In this exercise, you will use what you know about electric current in a circuit.

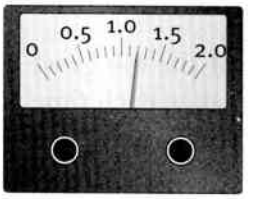
1 Study the three ammeters below. For each one, write the value of the current it is measuring.

A

B



C

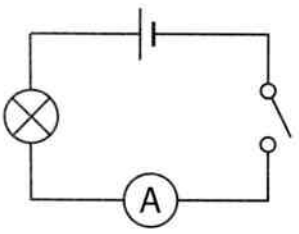


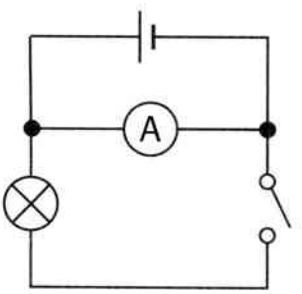
A current = ...

B current = ...

C current = ...

2 The circuits below show how an ammeter might be used to measure the current in a circuit. Only one is correct.





a Put a tick next to the correct circuit and a cross next to the incorrect one.

b Explain your answer.

.....

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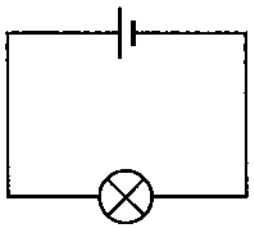
3 Study the circuit shown below. A cell is making a current flow through a lamp.
For each of the following statements, decide whether it is true or false.



Statement	True/false
The cell and the lamp are connected in series.	
The current leaving the lamp is less than the current entering the lamp.	
The current leaves the positive end of the cell.	
No current enters the negative end of the cell.	
The current travels clockwise around this circuit.	

Exercise 10.6 Electrons and electric current

In this exercise, you will learn more about how electric current flows in a circuit.

1 Metals are good conductors of electricity because they contain electrons that can move easily through them.

In the space below, draw a circuit diagram to show how you would show that a piece of copper is a good conductor of electricity.

Describe what you would expect to observe in this experiment.

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2 a What charge does an electron have, positive or negative?

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b An electric current is a flow of electric charge. Explain why electrons flow around a circuit when the circuit is complete.

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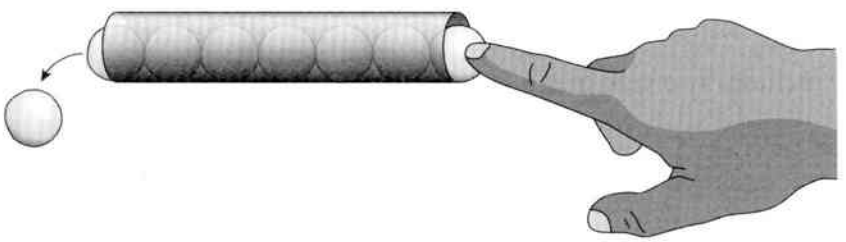
3 Here is a model of an electric current; a model helps us to understand our observations.

Picture a long tube, full of peas. You push an extra pea in at one end. Immediately, a pea drops out of the other end.



This can help us to understand why a light comes on as soon as it is switched on.

a What do the peas represent in this model?

.....

b What does the long tube represent?

.....

c Explain how this helps us to understand why the light comes on immediately.

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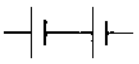
Exercise 10.7 Cells and batteries

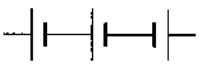
In this exercise, you will use what you know about using two or more cells to provide a bigger voltage in a circuit.

1 Study the three diagrams below. For each one, write the value of the voltage it will provide.

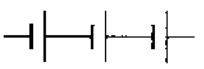
A 1.2V 1.2V



B 1.2V 1.2V 1.2V



C 2.0V 2.0V 1.5V

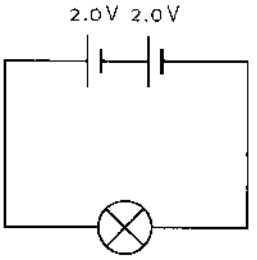


A voltage = ...

B voltage = ...

C voltage = ...

2 The circuit shown below includes two cells and a lamp.



a What voltage will the cells provide in the circuit?

.....

b Add a voltmeter to the diagram to show how you would measure this voltage.

c Explain why the lamp is brighter when two cells are used instead of one.

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3 Neemi has several 1.5 V cells. She needs to connect a lamp to a 6 V supply to make it shine brightly.

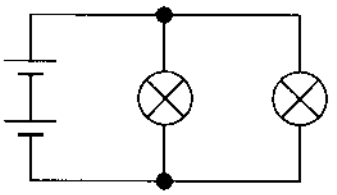
In the space below, draw the circuit she should use to do this.

4 In your home, you may have different items, which use cells ('batteries'). In the space below, make a list of these items together with the value of the voltage each item needs to work properly.

Exercise 10.9 Current in parallel components

In this exercise, you will use what you know about how electric current flows when components in a circuit are connected in parallel.

1 The diagram below represents a circuit used to light up two lamps.



a Are the cells connected in series or in parallel with each other?

.....

b On the diagram, mark the positive (+) end of each cell.

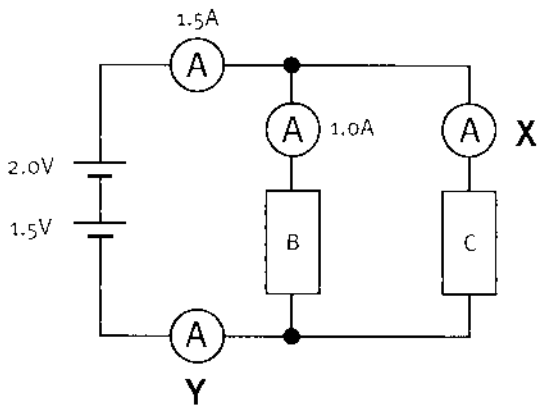
c Add an arrow to the diagram to show how the current flows from the cells.

d Mark with an X the point where the current divides.

e Add an arrow to each lamp to show the direction of the current in the lamp.

f Mark with a Y the point where the current recombines (joins up again).

2 The diagram below represents a circuit in which two resistors are connected in parallel with each other. Four ammeters have been included in the circuit to measure the current at different points.



a What is the combined voltage of the two cells? Show your calculation.

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The values of the current measured by two of the ammeters is shown next to them.

b What will be the reading on ammeter X? Show your calculation.

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c What will be the reading on ammeter Y? Explain your answer.

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d Which resistor, B or C, has more resistance? Explain your answer.

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3 The table below can be used to summarise the difference between series and parallel connections. Use phrases from the list to complete the table.

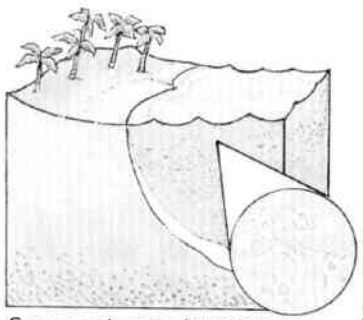
connected side-by-side **current divides**
current is the same **connected end-to-end**

Connection	How they are connected	How the current flows
components in series		
components in parallel		

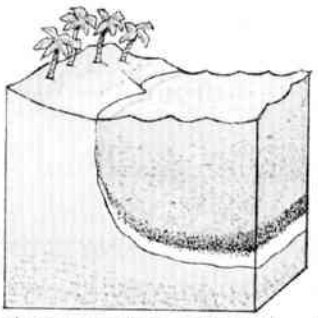
Exercise 11.2 How fossil fuels were formed

In this exercise, you will use what you have learnt about energy to explain how fossil fuels form.

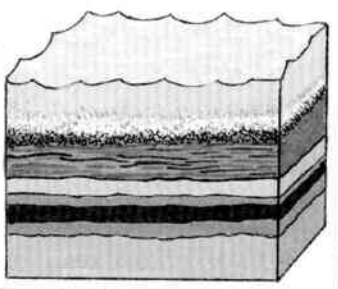
1 The sequence of pictures below shows how oil and gas are formed. Study the pictures and answer the questions that follow.



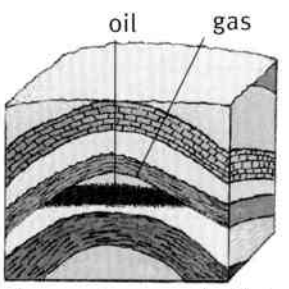
Sea creatures store energy.



These creatures die and sink to the bottom.



The dead creatures are buried under layers of sand.



The creatures gradually turn into oil and gas which are trapped under rock.

a Use what you have learnt about food chains to explain how the sea creatures get their energy.

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b Use the idea of density to explain why the dead creatures sink to the seabed.

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c Over millions of years, the dead creatures are squashed. Use the idea of pressure to explain this.

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d Gas and oil form from the dead creatures. The gas and oil are trapped under layers of rock. Use the idea of density to explain why the gas is on top of the oil.

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e What form of energy is stored by these fossil fuels?

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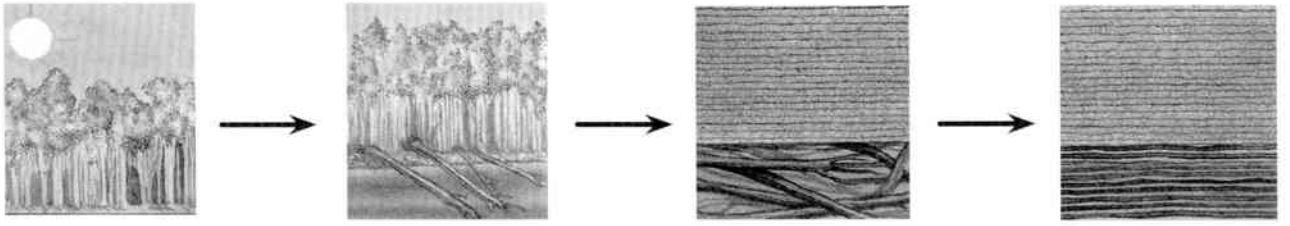
2 The next sequence of pictures shows how coal forms over millions of years. Study the pictures.



Trees store energy from sunlight as they grow.

Dead trees fall into swamps.

The dead trees are buried under layers of mud.

The trees gradually turn into coal.

Someone says, "When we burn coal, we are using the energy of ancient sunlight." Write a scientific explanation of what this means.

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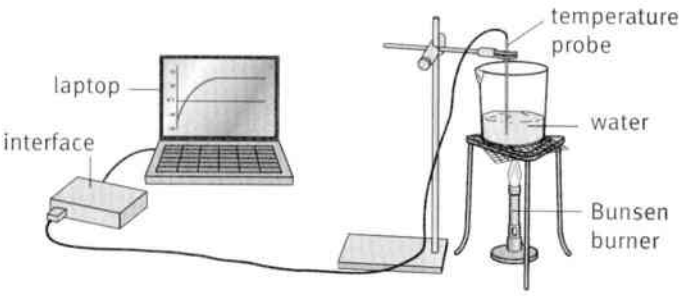
Exercise 11.5 Investigating convection

In this exercise, you will interpret data concerning energy losses by convection. You will be practising your scientific enquiry (SE) skills.

Mona is investigating how energy escapes from a beaker of hot water. She uses a Bunsen burner to heat some water as shown in the picture.

The datalogger records the temperature of the water every 10 seconds and the computer displays a graph of the measurements.



When the water reaches a temperature of 80 °C, Mona turns off the Bunsen burner. Then the water starts to cool down.

1 Explain how energy can escape from the water by convection.

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2 Suggest another way that energy can escape from the water.

.....

3 State two advantages of using a temperature probe and datalogger in this experiment.

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4 When Mona has gathered enough data, she repeats the experiment. This time, after she turns off the Bunsen burner, she places a cardboard lid on top of the beaker.

The table below shows her results.

Time since burner turned off / seconds	Beaker without lid temperature / °C	Beaker with lid temperature / °C
0	82	86
50	73	82
100	65	78
150	59	75
200	54	72
250	50	69
300	46	67

On the graph grid, draw graphs to represent both sets of data. Make sure that you label the graph lines 'with lid' and 'without lid'.

5 From the graph, how long did it take the temperature of the water to drop from 80 °C to 70 °C:

a without a lid? .....

b with a lid? .....

Indicate on the graph how you found these answers.

6 Mona said, "I think that, when there is no lid, convection is the main way that energy escapes from the water."

Has she drawn a good conclusion from her results? Explain your ideas.

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Exercise 11.6 Radiation explanations

In this exercise, you will use what you know about how radiation is absorbed and reflected to explain some observations.

1 Why do dark clothes make you feel hot on a sunny day?

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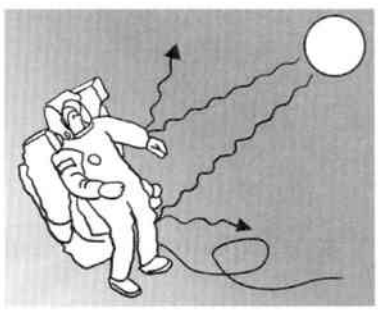
2 Why do astronauts wear shiny suits for space walks?



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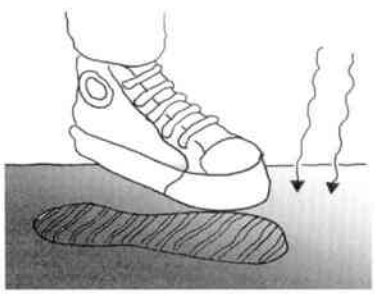
3 Why does the tar on roads melt in the summer sun?



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4 Why are houses in hot countries often painted white?

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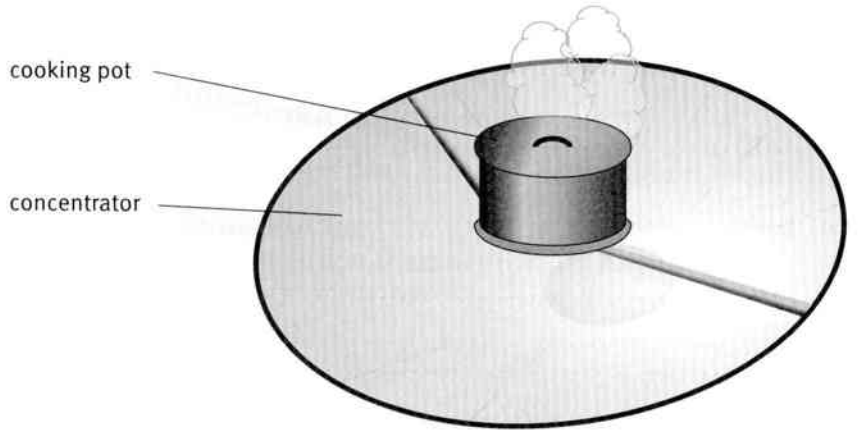
5 The picture below shows a solar cooker. It is made from a curved metal bowl; the cooking pot sits above the centre of the bowl.



a Explain how the cooker works.

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b Suggest why a cooker like this would be useful in a sunny country where fuels are scarce or expensive.

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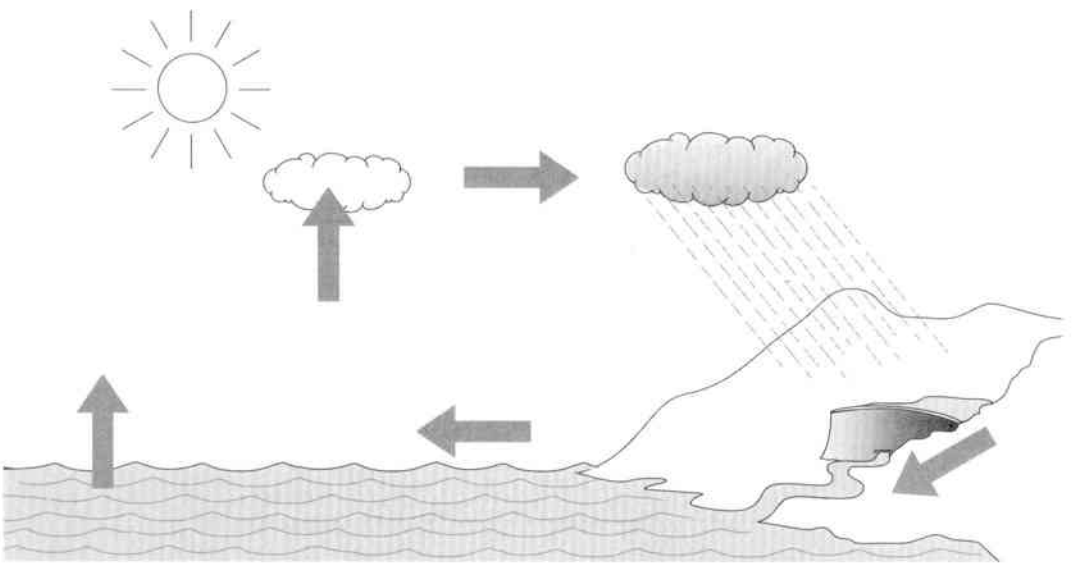
Exercise 11.7 Electricity from the Sun

In this exercise, you will use what you know about thermal energy transfers to explain how hydroelectricity relies on energy from the Sun.

The picture below shows a hydroelectric power station which has been built in a river valley in the hills. Water is stored behind the dam. It flows through turbines to generate electricity.



Your task is to use what you have learnt about energy transfers in this unit to explain how energy from the Sun ends up as electrical energy.

In your explanation, you must use all of the words in the list below at least once. Underline them in your explanation when you use them.

radiation **evaporate** **condense** **absorb**
convection current **kinetic energy** **water vapour**
gravitational potential energy

You may wish to add some labels to the diagram.

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