Science@School | Book 6G

Changing circuits

Teacher's Guide

Support material for the pupil book
can be found at the dedicated web site:

www.science-at-school.com

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Peter Riley

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Author
Peter Riley, BSc, C Biol, MI Biol, PGCE

Science Consultant
Brian Knapp, BSc, PhD

Art Director
Duncan McCrae, BSc

Senior Designer
Adele Humphries, BA, PGCE

Editors
Lisa Magloff, BA, and Barbara Bass, BA

Illustrations
David Woodroffe

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The pupil book explained unit by unit

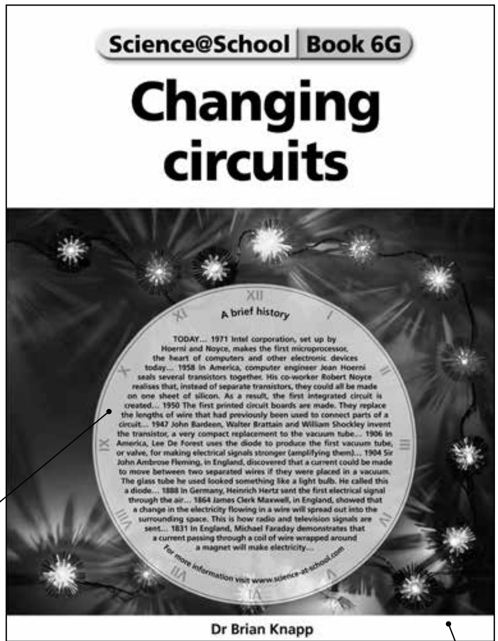
Although the pupil book – *Changing circuits* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Changing circuits*.

It is possible to use *Changing circuits,* and the worksheets and activities, without reading this section, but we would strongly recommend that you take a short time to familiarise yourself with the construction of the pupil book.

The units are arranged in sequence, to help you with your lesson planning. In this section, a brief description of the content of each unit is given, together with hints on how to start or support it. List 1 (Starting a unit with a demonstration) on page 11 sets out the resources that you could use to do the demonstrations where suggested. The activity associated with each unit is also briefly described to help you see how the unit and activity work together.

Title page

The book begins on the title page (page 1). Here you will find information about science and technology in the form of a clock. You may want to use this to set the scene for the study of the book's contents. You may choose to focus on an event which ties in with your work in history, before moving onto the rest of the book. Alternatively, you may wish to skip over this page and return to it later. It is not a core part of the book, but helps the children see how the work they are doing now fits in with the work of scientists and engineers in the past. It may also be used to stimulate more able pupils to research the people and events that are described here.



A time clock giving additional historical information about the topic.

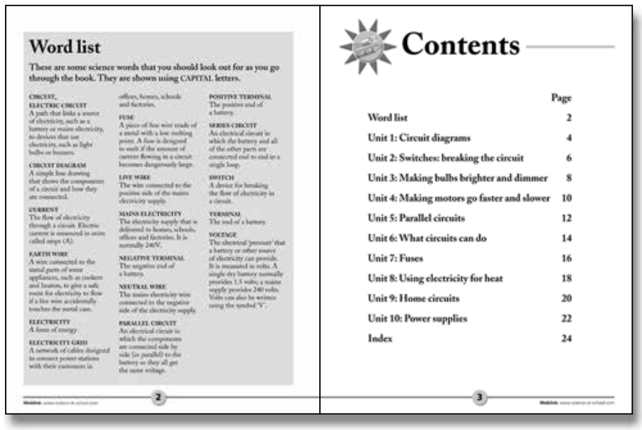
The picture shows part of a cascade of Christmas tree lights. These low voltage lights can be connected to the mains because they are in series.

Word list and contents

The core content of the book begins with a word list on page 2. This is a glossary, brought to the front for the pupils' attention. Pupils could be encouraged to look at the list and see how many of the words they already recognise.

One of the important things about science is the precision with which words are used. However, many scientific words are also common words, often used in a slightly different way from how they would be used in science. The word list presents the opportunity for pupils to consider the words they already know, and the meanings they are familiar with.

When your teaching unit has been completed, you may want to invite pupils to revisit this list and see if their understanding of the words has been enhanced or changed in any way. A visual dictionary is also given on the CD.



The entire contents are shown on page 3. It shows that the book is organised into double page spreads. Each double page spread covers one unit.

The units

Heading and introduction

Each unit has a heading, below which is an introductory sentence that sets the scene and draws out the most important theme of the unit.

Body

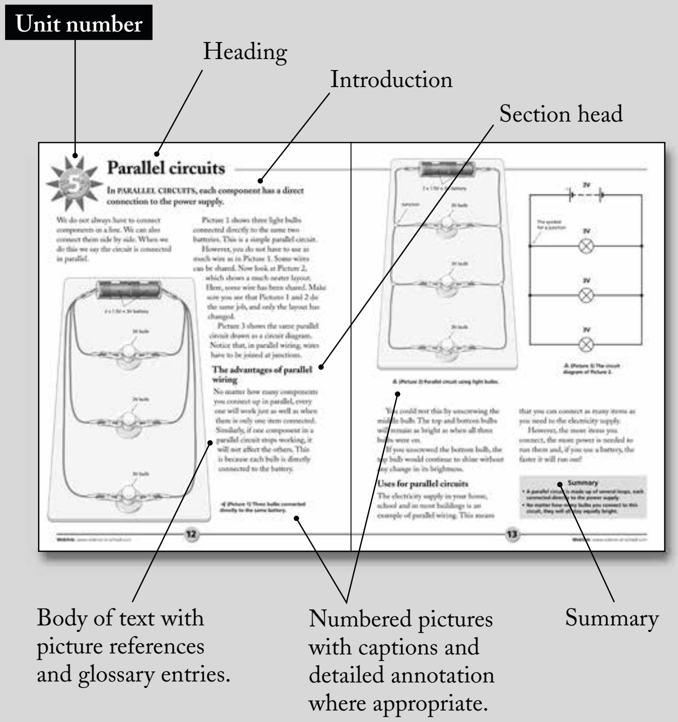
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

Words highlighted in bold capitals in the pupil book are defined in the word list on page 2. A visual dictionary is also given on the CD.

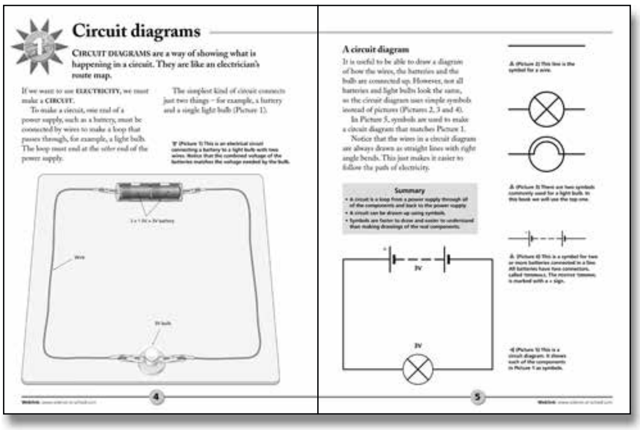
The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

Summary

Each unit concludes with a summary, highlighting and reinforcing the main teaching objectives of the unit.



1 Circuit diagrams

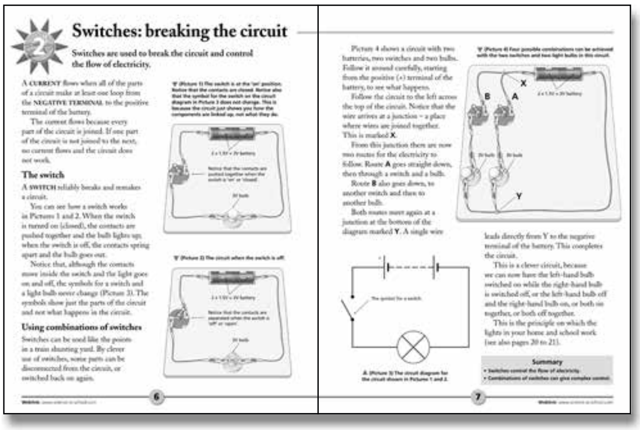


You may like to begin by giving each group a circuit that you have made. The circuit should contain a battery, a switch and a light bulb. Ask the children to draw a picture of the circuit they have on their table. When all the pictures are finished, ask the children to display them on a wall. Point out how the pictures vary, even though they represent the same pieces of equipment. Tell the children that a set of symbols has been devised which is used for making diagrams of circuits. Let the children open the book to find out more about them.

The unit begins by stating that if we want to use electricity, we must make a circuit. This statement is then developed by showing the simplest kind of circuit. The children may already be familiar with this circuit from Unit 5 of *4F Simple electricity,* but here it is used as an introduction into the construction of circuit diagrams. The text then describes the need for circuit diagrams, and further illustrations present the symbols that are needed to make the diagram of the simple circuit. The unit ends by showing how the familiar simple circuit can be represented as a circuit diagram. The purpose of this unit is to build a firm foundation for further study of circuits in the following units.

In the complementary work, the children could look at a circuit board to examine its complexity. In the activity, the children make circuits from diagrams, then make a circuit diagram from a circuit they have made themselves.

2 Switches: breaking the circuit

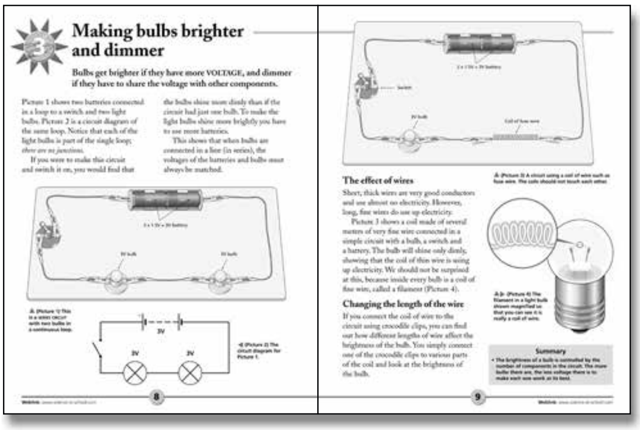


Ask the children how many switches they have used today. Tell them to cast their minds back to getting up in the morning. Did they put on a light switch? Did they press the snooze button on their alarm? What switches did they use in the kitchen at breakfast? What switches have they used in school? On the board, make a list of the switches they have used today. Extend the list by asking the children about other switches they know about but have not used – for example, the switches in a car.

This unit builds on the previous one by introducing a switch into a simple circuit. The unit begins by explaining that a current will only flow in a circuit if all the components are joined. A switch is introduced as a component which can reliably make or break a circuit. The switch mechanism is described in detail. A circuit diagram featuring a switch is presented, and the unit ends by showing how using two switches gives four possible combinations for controlling electricity. The ending of this unit gives you the option of using it to introduce parallel circuits in Unit 5.

In the complementary work, the children can design their own switch and make it from readily available materials. In the activity, the children make circuits from circuit diagrams to see how the arrangement of switches affects current flow. They also use simple materials to make two-way switches.

3 Making bulbs brighter and dimmer



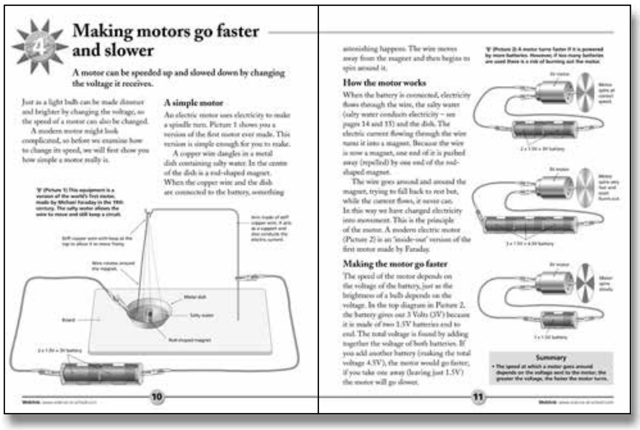
You may like to begin by telling the children that we take light bulbs for granted and just switch them on and off when we want. Tell the children that you want them to think about the light bulbs in their home and answer questions such as: "Where are they?" and "How many are there?"

To help the children, ask them to imagine standing outside their home, then going inside. Ask them what would be the first bulb they switched on. You may wish to keep the survey to hallway, kitchen, living room and bedroom, or try and work out how many bulbs would be alight if everyone went home and lit all the bulbs in their homes.

The previous unit considered the path of the current in the circuit. This unit considers the power of the current in the circuit. The unit begins by emphasising that a circuit forms a loop, along which a current can pass. It then moves on to consider how two bulbs in a line glow less strongly than a single bulb, and the term series is introduced. The flow of electricity through wires of different thicknesses and lengths is considered, and a picture of a circuit is presented which the children can use as a basis for an investigation. The unit ends by explaining that the coil of wire in a light bulb affects the strength at which electricity can be pushed around a circuit.

In the complementary work, the children could make a light survey and find out about energy-efficient lamps. In the activity, the children compare how different materials grip a surface and discover the importance of repeating experiments.

4 Making motors go faster and slower



You may like to begin by putting a car with an electric motor in it on your desk. Set off the car and turn it round before it gets to the edge. Keep doing this as you ask the children about what is happening to make the car go. Look for answers which suggest the car is using electricity from its battery to make a motor turn the wheels. If possible, show the children the position of the battery and the motor. Ask the children to tell you about other devices which have electric motors. Look for: CD player, cassette player, video player, microwave oven, wheelchair and toothbrush. Larger motors, such as those which power cars and trains, may also be mentioned.

This unit builds on the previous one by showing how changing the voltage in a circuit affects the performance of a component. The unit opens by stating that electric motors have a complicated structure, then moves on to describe a simple motor. A large, clear diagram of this intriguing motor is presented which will make the children want to build one. The text describes in detail how the simple motor works. The unit ends by showing how the speed of a more familiar electric motor can be controlled by using different numbers of batteries.

This unit may be particularly useful for introducing electric motors into a technology project.

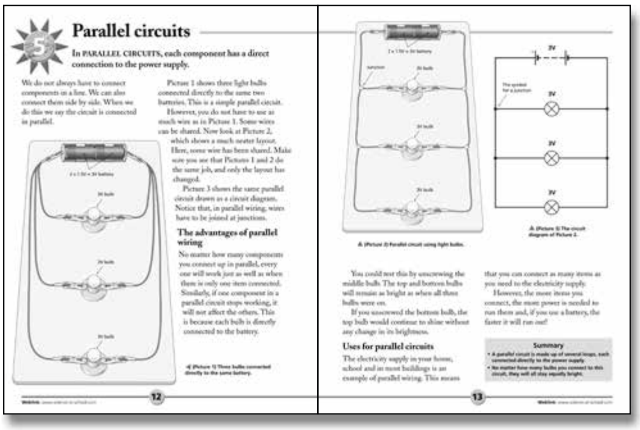
In the complementary work, the children could use secondary sources to find out about electric motors in vehicles. In the activity, the children investigate how bulbs in a circuit affect the performance of a motor.

5 Parallel circuits

This unit builds on Unit 2, in which switches in a parallel circuit were introduced. It can also be used with Unit 3, in which the term series was introduced.

The unit begins by explaining that components can be arranged side by side to make a parallel circuit. A large, clear diagram shows the simplest arrangement of wires and components in a parallel circuit. The unit then moves on to show how the components can be wired more efficiently, and a circuit diagram is provided of the modified circuit to further reinforce understanding. The advantages of and uses for parallel wiring are described.

You may like to begin by giving a child a tabard on which a large letter B is written. Ask the child to stand at the front and, throughout the demonstration, to be the battery. Now ask a second child to come out and hold hands with the ‘battery’. This child is a bulb. Ask another child to come out and be another bulb and hold hands with the ‘battery’ and first ‘bulb’ to make a ring. Ask a few more children to come out and be bulbs and to make a larger ring. Tell the class that the bulbs in this circuit are arranged in series. As each bulb is added



so they all glow less brightly.

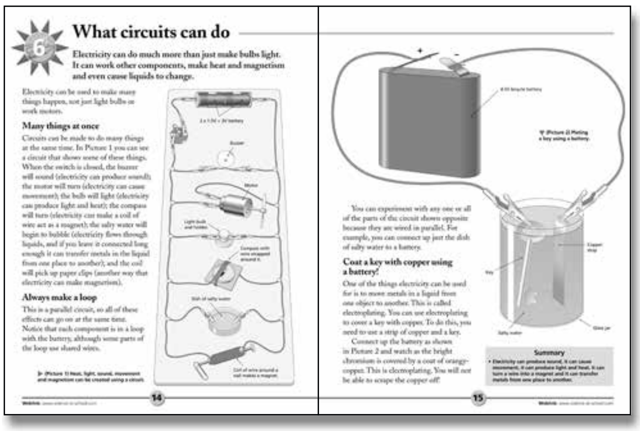
Next start with the original ‘bulb’ and ‘battery’ holding both hands. Have the second ‘bulb’ put one of his/her hands on each shoulder of the first ‘bulb’. Get the other ‘bulbs’ to arrange themselves in parallel in a similar way. Explain that this time they have formed a parallel circuit and are equally bright.

In the complementary work, the children are challenged to make a parallel circuit featuring a buzzer, motor and bulb. In the activity, the children compare series and parallel circuits.

6 What circuits can do

You could begin by asking the children what electricity could do. Look for the following general headings in the answers and write them on the board: heating, light, sound, movement, sending messages. As you are establishing the headings, group any items that are mentioned. For example, under heating you may put electric fire, oven, toaster, kettle and electric blanket. Also show the children that some devices, such as a washing machine, can be in two groups – heating and movement. Tell the children that even the electricity in battery operated circuits can be used in a variety of ways and introduce the spread in the pupil book.

The previous units addressed the fundamentals of circuit design. This unit shows how electricity in circuits can be applied in a variety of ways. A large, clear picture of a parallel circuit is presented in which electricity works a buzzer, turns a motor, lights a bulb, moves a compass, passes through salty water and turns a coil and nail into an electromagnet. The picture is supported by explanatory text which also



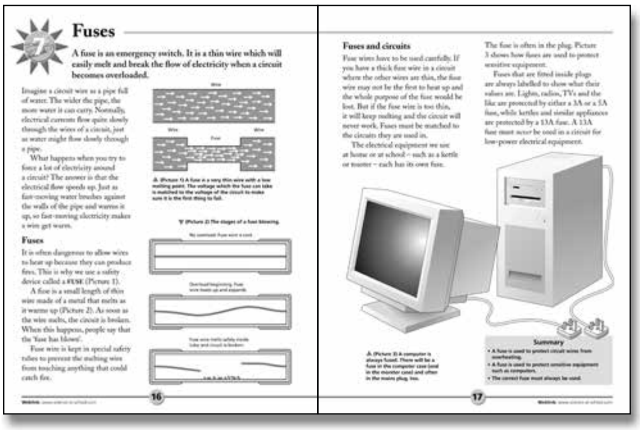
reminds the children of the need to make loops for current to flow. The unit ends by showing how electricity can move copper from a metal strip and deposit it on a key.

In the complementary work, the children can use secondary sources to find out about electromagnets. In the activity, the children perform an investigation on the strength of electromagnets.

7 Fuses

You may like to begin by getting the children to rub their hands together slowly. Tell them that when a current of electricity passes through a wire, it rubs on the metal and makes it warm. Tell the children to rub their hands faster and faster and feel the temperature of their hands change. They should feel their hands becoming hot. Tell the children this is what happens in a wire that is carrying too much electricity. It gets so hot that it can cause its surroundings to catch fire. Tell the children that we have special switches called fuses which turn off the current if it gets too hot. You may wish to show the children a fuse in a plug. Select a new plug which does not have any wire attached to it. Tell the children that they should *never* take plugs apart to find fuses.

This unit builds on the concept of current flow which was established in the previous units, and shows how the flow can be controlled to prevent danger. The unit opens by considering a current of electricity flowing through a wide wire and a narrow wire. A comparison is made with water flowing through a pipe to show that fast moving electricity in a wire warms the wire, just as fast moving water in


Fuses

A fuse is an emergency switch. It is a thin wire which will easily melt and break the flow of electricity when a circuit becomes overloaded.

Imagine a circuit wire as a pipe full of water. The wider the pipe, the more water it can carry. Normally, electrical currents flow quite slowly through the wires of a circuit, just as water might flow slowly through a pipe.

What happens when you try to force a lot of electricity around a circuit? The answer is that the electrical flow speeds up. Just as fast-moving water brushes against the walls of the pipe and warms it up, so fast-moving electricity makes a wire get warm.

Fuses

It is often dangerous to allow wires to heat up because they can produce fires. This is why we use a safety device called a FUSE (Picture 1).

A fuse is a small length of thin wire made of a metal that melts as it warms up (Picture 2). As soon as the wire melts, the circuit is broken. When this happens, people say that the 'fuse has blown'.

Fuse wire is kept in special safety tubes to prevent the melting wire from touching anything that could catch fire.

Fuses and circuits

Fuse wires have to be used carefully. If you have a thick fuse wire in a circuit where the other wires are thin, the fuse wire may not be the first to heat up and the whole purpose of the fuse would be lost. But if the fuse wire is too thin, it will keep melting and the circuit will never work. Fuses must be matched to the circuits they are used in.

The electrical equipment we use at home or at school – such as a kettle or toaster – each has its own fuse.

The fuse is often in the plug. Picture 3 shows how fuses are used to protect sensitive equipment.

Fuses that are fitted inside plugs are always labelled to show what their values are. Lights, radios, TVs and the like are protected by either a 3A or a 5A fuse, while kettles and similar appliances are protected by a 13A fuse. A 13A fuse must never be used in a circuit for low-power electrical equipment.

Summary

16 17

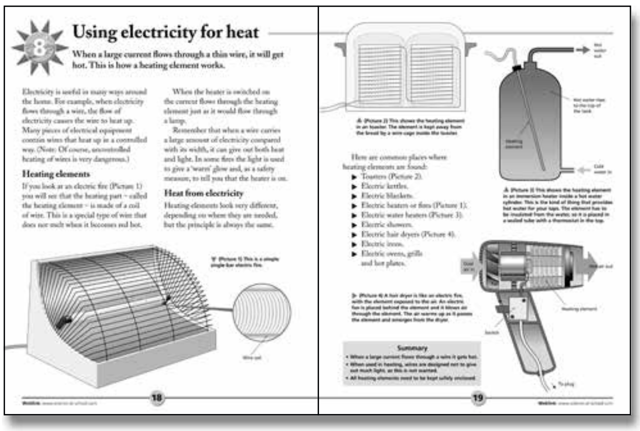
a pipe warms the pipe. The structure of the fuse is described and illustrated and the unit moves on to consider what happens when a fuse is blown. The matching of fuses to circuits is carefully explained and the consequences of mismatches are considered. The unit ends by looking at the sizes of fuses needed for different electrical appliances.

In the complementary work, the children can learn about the dangers of electricity from a school visitor. In the activity, the children examine different fuses and match them to appliances.

8 Using electricity for heat

You may like to begin by telling the children how many times you used electricity for heat as you got ready for school this morning. You could begin by mentioning the heat in the shower, or the hot water provided by an immersion heater. You could mention the heater in a hair dryer, a kettle and toaster. If you put in a load of washing before you left, you could mention the heater in the washing machine and in the dryer. Ask the children to think about the electric heaters they used this morning to get an idea of how often we use electricity for heating.

This unit builds on Unit 6, in which the role of electricity in providing heat was introduced. It also builds on the previous unit, in which the role of heat in melting fuse wire was described. The unit opens by emphasising that in some appliances heat is produced in a controlled way. The heating of an element in an electric fire is illustrated and described in detail. The unit then moves on to consider the heating element in a hair dryer, immersion heater and toaster in a highly


Using electricity for heat

When a large current flows through a thin wire, it will get hot. This is how a heating element works.

Heating elements

Heat from electricity

Here are common places where heating elements are found:

- Toasters (Picture 2).
- Electric kettles.
- Electric blankets.
- Electric heaters or fires (Picture 1).
- Electric water heaters (Picture 3).
- Electric showers.
- Electric hair dryers (Picture 4).
- Electric irons.
- Electric ovens, grills and hot plates.

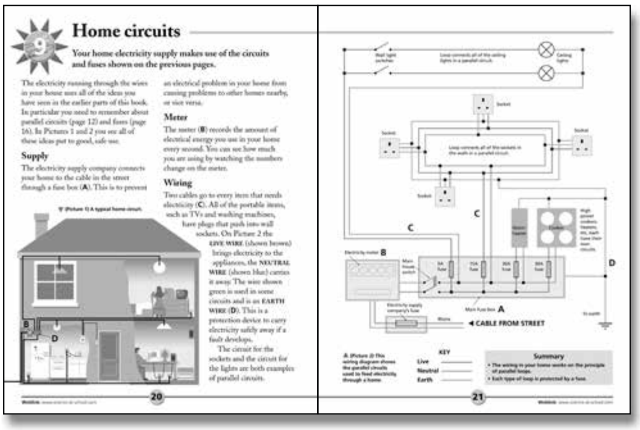
Summary

18 19

illustrative way. The unit ends with a list of common electrical appliances which have heating elements.

In the complementary work, the children can use secondary sources to find out how an electric oven is made and how fuels such as gas and wood are used to provide heat. In the activity, the children design a survey sheet and carry out an investigation to find out about the number of electrical appliances people use to provide heat.

9 Home circuits



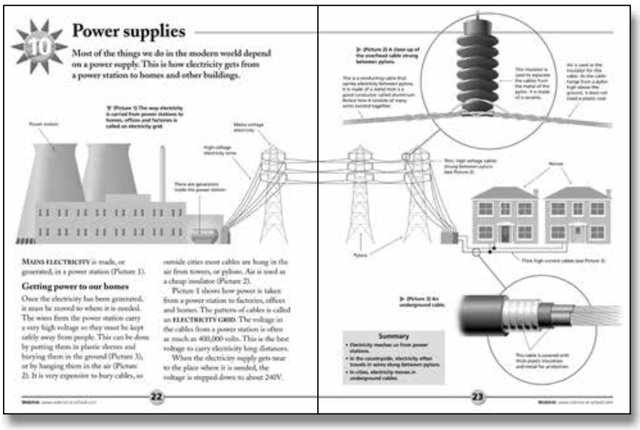
You could begin by asking the children for evidence of circuits in the classroom. They may point out the lights, the light switches and plug sockets. If there is a conduit along a wall, supplying plug sockets, point it out and say that inside are wires that supply the plugs. Tell the children that the wires are hidden away for safety reasons. Show the children a piece of cable and point out that it contains three wires. Each wire has a plastic insulating coat which is a different colour from the others. This tells the electrician how to connect up the wires to make a circuit work.

Remind the children that they should not try and investigate mains electricity as it has a current which is capable of giving a fatal electric shock.

The unit opens by showing people in a home supported by circuits of electricity. The supply of electricity to the home is considered, and the importance of a fuse to isolate the home from others is explained. The use of a meter to measure the consumption of electricity is introduced. A detailed wiring diagram is shown in which fuse boxes, sockets, light bulbs and heaters are illustrated. This diagram helps the children realise the importance of the use of symbols and the clear arrangement of wires to show an accurate path of electricity through the home. The unit ends by describing the use of parallel circuits in providing lighting and power in the home.

In the complementary work, the children can find out about home circuits in other countries. In the activity, the children make circuits in a model room.

10 Power supplies



You may like to begin by showing the children a bicycle with a dynamo on it. Turn the wheel to show how the dynamo turns, and trace the wiring from the dynamo to the bulbs on the bicycle. Turn the wheel and make the dynamo generate enough electricity to light the bulbs. Point to a light in the room. Tell the children that the bulb is also being supplied by a dynamo but this is a huge electrical generator in a power station many kilometres away. The electricity has travelled through overhead power lines and underground cables to reach the bulb.

In this unit, the provision and distribution of electricity for the mains is described. A large, colourful and clear diagram shows the path of electricity from a power station to a home. Throughout the unit, the method of transporting electricity overhead is compared with transporting it by underground cable. The high voltage needed to transport the electricity over large distances is explained, and the process of stepping down is mentioned in reducing the voltage of the electricity before it enters the home.

In the complementary work, the children can find out about the different ways electricity is generated. In the activity, the children find a safe and economic way to supply a home with electricity.

Index

There is an index on page 24.

Using the pupil book and photocopiable worksheets

Introduction

There is a wealth of material to support the topic of changing circuits in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets, and how to integrate them for lesson planning. On the page opposite you will find the resource lists for introductory demonstrations, the complementary work and the activity worksheets. The learning objectives are shown on pages 12 and 13

Starting a unit

Each unit in the pupil book forms the basis for a lesson. You may like to start by reading it with the class, or begin with a demonstration (see List 1 on page 13). Always begin the unit by reading the introductory sentences in bold type. This helps focus the class on the content of the unit and to prepare them for the work.

The first part of the main text introduces the content, which is then developed in the headed sections. The illustrations are closely keyed to the main text, and the captions of the illustrations develop the main text content .

With less skilled readers, you may prefer to keep to the main text and discuss the illustrations when they are mentioned. With more skilled readers, you may want to let them read the captions for themselves. Each unit ends with a summary. The children can use this for revision work. They can also use it to test their understanding by trying to explain the points made in the summary.

The style and content of the unit also make it suitable for use in literacy work, where the needs of both English and science are met. You may wish to use the unit as a topic study in literacy work, or you may want to perform an activity in science time and follow it up with a study of the unit during literacy work.

Using the comprehension worksheets

Each unit in the pupil book has one photocopiable comprehension worksheet in this *Teacher's Guide* to provide a test. The learning objectives for these comprehension worksheets relate directly to the knowledge and understanding component of the science curriculum.

The comprehension worksheets begin with simple questions and have harder questions towards the end.

The worksheets may be used singly, after each unit has been studied, or they may be used along with other worksheets to extend the study.

The teacher's sheet, which is opposite the comprehension worksheet, shows the answers and background information to the unit. This teacher's sheet also carries a section on work complementary to the study topic. This work may feature research using other sources. It may also have value in literacy work.

Using the activity worksheets

The activities are designed to develop skills in scientific enquiry. The learning objectives for practical skills associated with each unit are given on page 13. The activities may be small experiments, may focus on data handling or comprise a whole investigation.

Each activity section is a double page spread in this *Teacher's Guide*. On the left hand page is a photocopiable activity worksheet to help the children in practical work, or it may contain data for the children to use or interpret. The page opposite the worksheet is a teacher's sheet providing a step-by-step activity plan to help you organise your work. Each plan has a set of notes which provide hints on teaching or on the use of resources. The activity plan ends with a conclusion, which you may like to read first, to help you focus on the activity in your lesson planning.

Planning to use a unit

The materials in this pack are very flexible and can be used in a variety of ways. First, look at the unit and activity objectives on pages 12 and 13. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

Safety

The practical activities feature equipment made from everyday materials or available from educational suppliers. However, make sure you carry out a risk assessment, following the guidelines of your employer, before you do any of the practical activities in either the pupil's book or the *Teacher's Guide*.

Resources

The three lists below show the resources needed to support the photocopiable worksheets.

- ▶ List 1 shows resources for demonstrations suggested for starting a unit.
- ▶ List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.
- ▶ List 3 details those resources needed for the 10 activity worksheets.

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. Each group of children will need a circuit made from a battery (just one cell), a switch, a bulb and three wires.
2. –.
3. –.
4. –.
5. –.
6. –.
7. –.
8. –.
9. –.
10. Bicycle with dynamo and lamps.

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

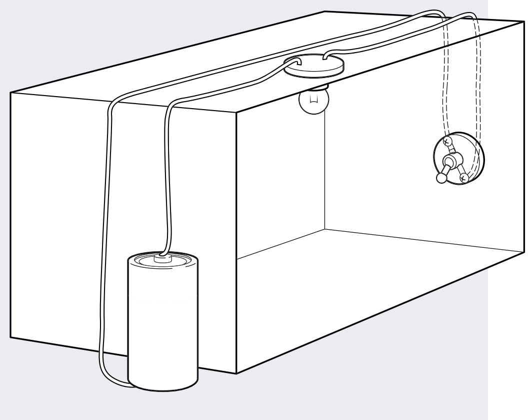
1. A circuit board that has been obtained from an electrician. Do not remove a circuit board from any equipment yourself or encourage the children to look for circuit boards in equipment – for safety reasons.
2. Aluminium foil, card, paperclips, drawing pins, wires, a bulb and a battery.
3. (a) Access to all parts of school to make a light bulb/strip light survey; (b) secondary sources about energy-efficient lamps and how they are made.
4. Secondary sources about electric motors which provide power for: (a) vehicles at an airport; (b) vehicles inside a factory; and (c) electric cars.
5. Two batteries, a motor, a bulb, a buzzer, a switch, wires.
6. Secondary sources about electromagnets.
7. A visitor such as an electrician, engineer, paramedic or doctor to talk about the dangers of electricity.
8. (a) Secondary sources about how an electric oven is made; (b) Secondary sources about how gas and wood are used to provide heat.
9. Secondary sources about the power in home circuits in other countries.
10. (a) Secondary sources about how an electrical generator works; (b) Secondary sources about how electricity can be generated by water, wind, solar power and fuels.

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. One to three batteries, a switch, a light bulb, a buzzer, a motor, wires.
2. A battery, two switches, a bulb, wires, two pieces of wood, six drawing pins, two paperclips.
3. Three batteries, three light bulbs, a switch, seven wires.
4. Two batteries, a switch, a motor, two light bulbs, six wires.
5. Two batteries, a switch, three light bulbs, a buzzer, wires.
6. Two batteries, a switch, an iron or steel nail, a thin insulated wire about 75 centimetres long, paperclips, a compass (optional), a third battery (optional).
7. Two 5 amp and one 30 amp fuse wires, a cartridge fuse, a plug without any cable attached to it, opened and showing the position of the fuse.
8. Access to ten other people, either in school or family and friends.
9. A cardboard box, one or more batteries, bulbs, motor, buzzer, switches, wires, sticky tape, scissors.
10. The sheet from the *Teacher's Guide*.



▲ *Making circuits for a model room in the Unit 9 activity.*

Learning objectives

Comprehension worksheets

The table below shows the learning objectives for knowledge and understanding associated with each unit in the pupil book, using the comprehension worksheets in this *Teacher's Guide*:

Unit 1

- A circuit is a loop from a power supply, through components and back to a power supply.
- The components of a circuit can be represented by symbols.
- The symbols for the components can be linked together to make circuit diagrams.

Unit 2

- Switches control the flow of electricity.
- When a switch is turned on, or closed, a circuit is made and current flows.
- When a switch is turned off, or opened, a circuit is broken and current cannot flow.
- Switches can be used in combinations to give complex control of the current.

Unit 3

- The voltage in a circuit plays an important part in how brightly light bulbs shine.
- When more components are added to a series circuit there is less voltage for each one to work at its best.

Unit 4

- An electric motor contains a permanent magnet and a wire that is made into a magnet when electricity flows through it.
- An electric motor uses electricity to make a spindle turn.
- The speed of an electric motor can be controlled by changing the voltage in the circuit.

Unit 5

- A parallel circuit is made up of several loops.
- Each loop in a parallel circuit is connected directly to the power supply.
- When more bulbs are added into a parallel circuit all the bulbs remain at the same brightness.

Unit 6

- Electricity can be used to make sound, movement, light and heat.
- Electricity can turn a coil of wire into a magnet.
- Electricity can be used to coat one metal with another.

Unit 7

- A fuse is used to protect wires in a circuit from overheating.
- A fuse is used to protect sensitive equipment, such as computers.
- The voltage of a fuse must be matched to the voltage of its circuit to provide protection.

Unit 8

- When a large current flows through a wire, the wire gets hot.
- The wire in a heating element is designed to give out only a small amount of light.
- Heating elements have a protective guard around them for safety.

Unit 9

- The wiring in the home features parallel circuits.
- A fuse protects each circuit.
- A meter is used to measure the amount of electricity used in the home.

Unit 10

- Mains electricity is produced in a power station.
- Pylons are used to support overhead cables.
- In cities, cables are buried underground.

Learning objectives

Activity worksheets

The table below shows the learning objectives for practical skills associated with each unit in the pupil book, using the activity worksheets in this *Teacher's Guide*:

Unit 1
- Read a circuit diagram and make a circuit from it.
- Construct a circuit diagram by observing a circuit.

Unit 2
- Use simple equipment safely.
- Make careful observations.

Unit 3
- Plan an investigation.
- Carry out a fair test.
- Draw conclusions from results.

Unit 4
- Read circuit diagrams and make circuits from them.
- Use knowledge and understanding to explain predictions.
- Compare predictions with results.

Unit 5
- Construct circuit diagrams.
- Use equipment safely.

Unit 6
- Plan and carry out an investigation.
- Identify a pattern in the results.

Unit 7
- Make observations.
- Use knowledge and understanding to explain observations.

Unit 8
- Make a survey.
- Interpret results.
- Draw conclusions from results.

Unit 9
- Use knowledge and understanding to construct circuits.
- Use equipment and materials safely.

Unit 10
- Use knowledge and understanding to solve a problem.

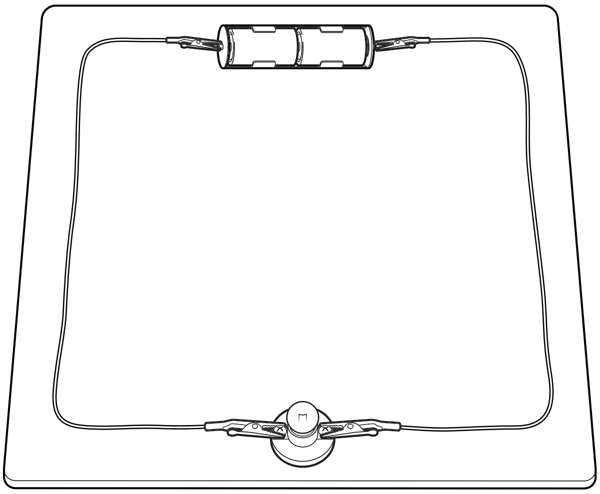
1

Name: .... Form: ....

See **pages 4 and 5** of *Changing circuits*

Circuit diagrams

Circuit diagrams are a way of showing what is happening in a circuit. They are like an electrician's route map.



Q1. The picture on the left shows a circuit. In the space on the right, draw the circuit diagram for the circuit. Label the different parts of the circuit.

Q2. If we want to use electricity, what must we make? ✎..

Q3. Give an example of a power supply. ✎...

Q4. What are the two connectors on a battery called? ✎...

Q5. Which part of a battery is marked with a + sign?

✎...

Q6. (i) Why are circuit diagrams used?

✎...

✎...

(ii) Why are simple symbols used?

✎...

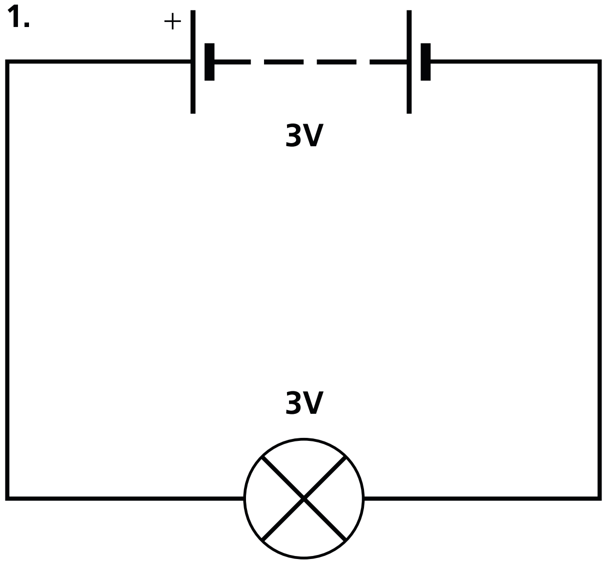
✎...

1 Teacher's sheet: comprehension

See **pages 4 and 5** of *Changing circuits*

Answers

1.



2. **Circuits.**
3. **A battery.**
4. **Terminals.**
5. **The positive terminal.**
6. **(i) To show how wires, batteries and bulbs are connected together;
(ii) Because not all batteries and light bulbs look the same.**

Complementary work

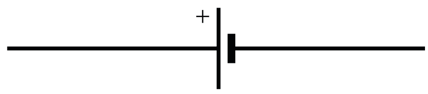
If the children have studied *4F Simple electricity* earlier in their science course they may have done some work on circuit boards. If they have, you may like to remind them of it now. They may have also seen a circuit board that you obtained from an electrician. You could show them the circuit board again and explain that it is constructed using complicated circuit diagrams.

Teaching notes

There is often confusion associated with the word battery. The cylindrical device which supplies electricity is commonly called a battery. Strictly speaking, it is really a single dry cell. It may also simply be called a cell.

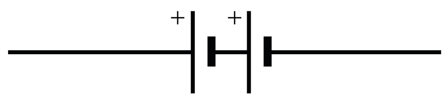
Two or more cells joined together make a battery. You may wish to point this out to the children so that they are aware of the common use of the word battery and the scientific use of the word cell. In the pupil book, the common use of the word battery is used.

In the suggested introductory activity on page 8, the children make a drawing of a circuit which features a battery, switch and bulb. For simplicity, the battery should be made from one cell. This is represented by the symbol:

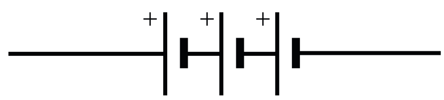


You may like to use the following information when discussing the use of the words cell and battery.

When two cells are joined together they from a two-celled battery which could be represented by this symbol:



When three cells are joined together they from a three-celled battery which could be represented by this symbol:



Generally, for convenience, when more than one cell is used the following symbol is employed, and this is the one children should learn:

This is the symbol used in the book, but it may help the children to know of the alternative ways of representing cells. This may help them to remember the cell symbol.

1

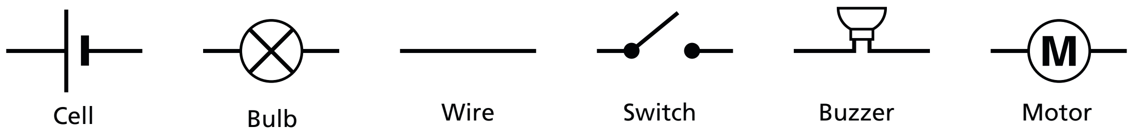
Name: .... **Form:** ....

Based on **pages 4 and 5** of *Changing circuits*

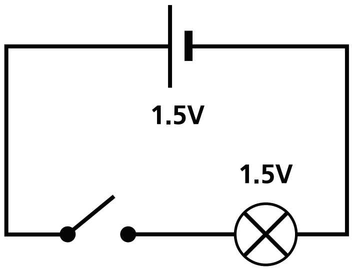
Can you make the circuits?

Try this...

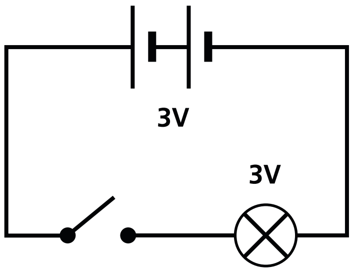
1. Here are some symbols used in circuit diagrams.



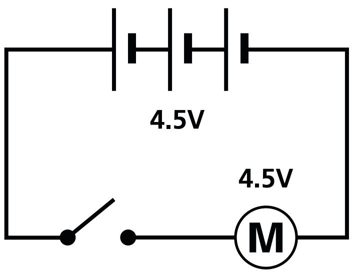
2. Make this circuit and show it to your teacher.



3. Make this circuit and show it to your teacher.



4. Make this circuit and show it to your teacher.



5. Make a circuit of your own design. Test it to see that it works, then draw a circuit diagram of it in the space on the right.

6. Take the circuit apart again.

7. Ask a friend to use your diagram to make the circuit.

1

Teacher’s sheet: activity

Based on **pages 4 and 5** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have read pages 4 and 5 in the pupil book. Show the children the range of equipment you will be using and draw the symbol for each one on the board as you introduce it (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1.

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it.

(e) Go through task 4, then let the children try it.

(f) Go through task 5, then let the children try it (see note (iii)).

(g) Let the children try task 6.

Completing the activity

(h) Let the children try task 7.

(i) When the children have made their circuits, ask them if there were parts of the circuit diagrams which were easy to follow and parts which were difficult to follow.

Conclusion

The equipment in electrical circuits can be represented by symbols. The symbols can be linked together in a circuit diagram to show the structure of the circuit. A circuit can be assembled from a circuit diagram.

Teaching notes

(i) It is very important to spend time making sure the children can relate each piece of electrical equipment to a symbol. You could extend the opening activity by letting the children make their own posters of the symbols so that they can use them in circuit work here and in other activities.

(ii) The children could look at the circuit diagram, make a list of the equipment they need and then collect it. When the children have made their circuit and shown it to you, ask them to switch it on. If it does not work, ask the children to check the connections as they sometimes come loose easily.

(iii) Make sure that the children keep their circuits simple. They should have two to three batteries, or cells, a switch and either two bulbs or a buzzer. They should not try to link a motor, buzzer or bulb together, as they will find that some items work while others do not. This is due to the amount of electricity each item needs in order to operate.

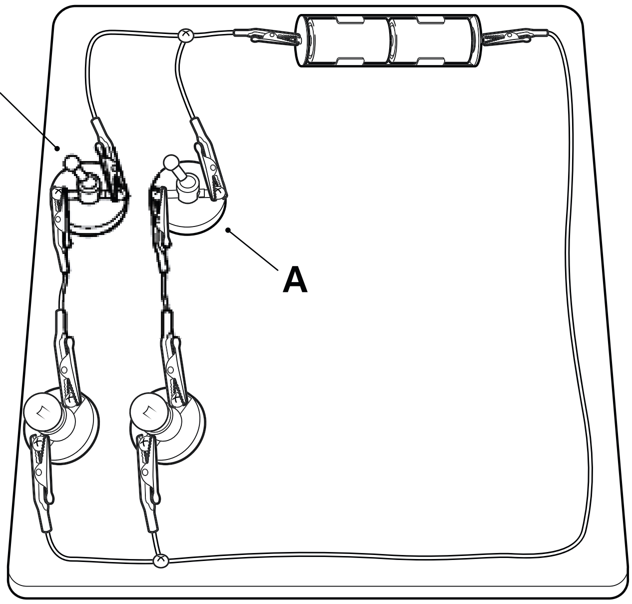
2

Name: .... Form: ....

See **pages 6 and 7** of *Changing circuits*

Switches: breaking the circuit

Switches are used to break the circuit and control the flow of electricity.



Q1. (i) What would happen in the circuit if switch A was on and switch B was off?

✎..

✎..

✎..

(iii) What would happen in the circuit if switch A and switch B were both on?

✎..

Q2. When does a current flow in a circuit?

✎..

✎..

Q3. What happens when one part of a circuit is not joined to the next?

✎..

Q4. What happens when a switch is turned on? ✎...

✎..

Q5. What happens when a switch is turned off? ✎...

✎..

Q6. Why does the symbol for a switch always show it open?

✎..

✎..

Teacher's sheet: comprehension

See **pages 6 and 7** of *Changing circuits*

Answers

1. **(i) The right hand bulb would be on, the left hand bulb would be off; (ii) Both bulbs would be on.**
2. **When all parts of the circuit make at least one loop.**
3. **The current does not flow.**
4. **The contacts are pushed together and the bulb lights up.**
5. **The contacts spring apart and the bulb goes out.**
6. **The circuit just shows you how the components are linked up and not what they do.**

Complementary work

If the children have studied *4F Simple electricity* earlier in their course, you may like to remind them of their work on switches in Unit 6. In the activity in that unit they made a switch by sticking two strips of aluminium foil to a piece of card and folding the card to make the two pieces of foil contact. You could now challenge the children to make another switch from simple materials such as aluminium foil, card and paperclips. They should test their switch in a circuit with one battery and one bulb.

Teaching notes

It is possible to make a circuit without using a switch. This is done by simply joining wires together. However, this causes the wires and battery to wear, and can also be dangerous if a strong current is being used. A switch provides a way of opening or closing a circuit which does not wear down the wires or battery. As the switch is also made from insulating materials, it helps to keep fingers away from wires and reduces the chance of someone receiving an electric shock. You may wish to add that mains switches should never be handled with wet hands as the water may enter the switch and cause the current to flow from the wire to the fingers.

At this level, the switch in the circuit diagram is always shown open and the point is made in the text that the symbols just show the pieces of equipment in the circuit and not what the equipment is doing. This is an important point as sometimes children draw a diagram showing that a bulb is alight or that a motor is moving. At a higher level, a switch may be shown closed, with the acute line moved down to rest horizontally on the two contacts. The children do not need to know about this symbol at this stage. They should concentrate instead on linking the symbols to items of equipment.

2

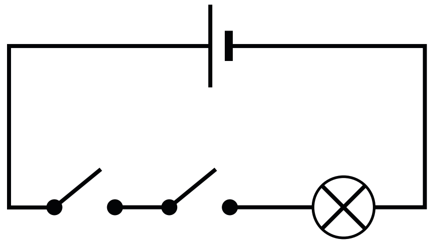
Name: .... Form: ....

Based on **pages 6 and 7** of *Changing circuits*

What do the switches do?

Try this...

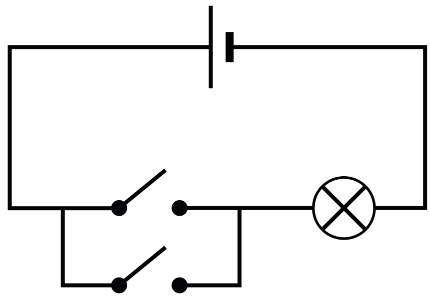
1. Set up this circuit.



2. What must you do to make the bulb light?

✎...

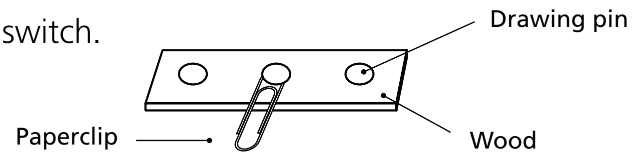
3. Set up this circuit.



4. What must you do to make the bulb light?

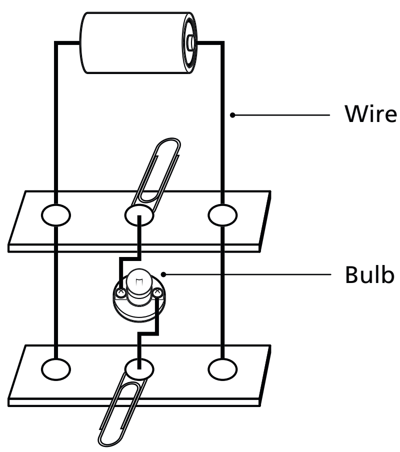
✎...

5. Make this two-way switch.



6. Make a second two-way switch.

7. Set up this circuit with your two-way switches.



8. How must you arrange the switches for the bulb to light?

✎..

✎..

9. Where in the home could you find two-way switches?

✎...

2

Teacher's sheet: activity

Based on **pages 6 and 7** of *Changing circuits*

Introducing the activity

(a) You may like to introduce the activity by showing the children a range of switches that they may use in their circuit work. You could show them a toggle switch, a push switch and a rocker switch. Tell the children that no matter how the switch is designed, it has just one purpose – to control the flow of electricity.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Go through task 5, then let the children try it (see note (v)).

(g) Go through task 6, then let the children try it.

(h) Go through task 7 with the children, then let them try it.

(i) Let the children try tasks 8 and 9.

Completing the activity

(j) Let the children compare their answers to steps 8 and 9.

Conclusion

A switch either lets a current of electricity flow or it stops the flow of electricity. Switches can be arranged in different ways in a circuit. When the switches are arranged in line (in series), both must be closed to make the electricity flow round the circuit. When the switches are arranged side-by-side (in parallel), either one can be closed to make the current of electricity flow. Two-way switches can make a current flow in two directions through a circuit. Two-way switches are often found at the top and bottom of a staircase.

Teaching notes

(i) You may like the children to look at the circuit diagram, make a list of the items they need and then collect them.

(ii) If the children do not get the bulb to light when both switches are closed, ask them to check all the connections in the circuit. In the excitement of making circuits children often fail to secure connections firmly.

(iii) The children can use the same equipment from step one but will need another piece of wire.

(iv) If the bulb fails to light when either switch is used the children need to check the connections.

(v) When the paperclip under the central drawing pin is swung left or right it should make contact with another drawing pin.

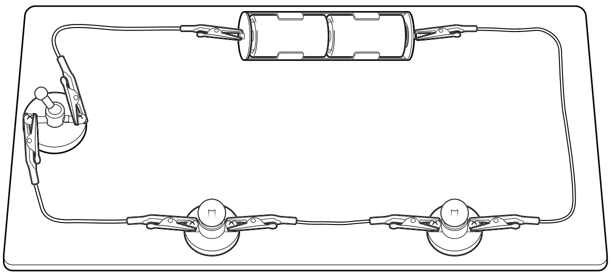
3

Name: .... Form: ....

See **pages 8 and 9** of *Changing circuits*

Making bulbs brighter and dimmer

Bulbs get brighter if they have more voltage, and dimmer if they have to share the voltage with other components.



Q1. In the space on the right, draw a circuit diagram of the circuit shown on the left.

Q2. (i) How could you make the bulbs in the circuit shine more brightly?

✎...

(ii) How could you make the bulbs shine more dimly?

✎...

Q3. What kind of wires use almost no electricity? ✎..

Q4. Imagine that a bulb was taken out of the circuit in the picture and a long coil of wire was put in its place. How would the wire affect the way the remaining bulb shone?

✎...

Q5. What is the coil of wire in a light bulb called? ✎..

Q6. (i) The bulbs in the diagram are in series. What does this mean?

✎...

(ii) How would the bulbs shine if a third bulb was added into the circuit between them? Explain your answer.

✎...

✎...

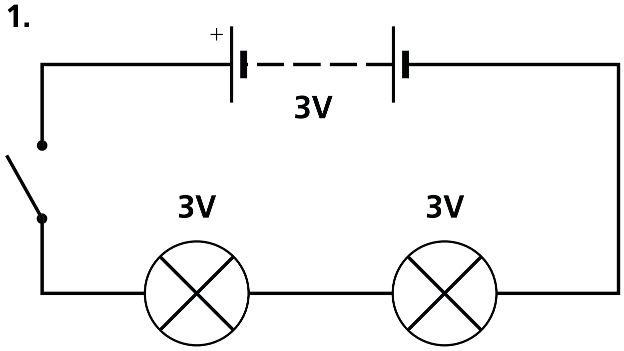
✎...

Teacher's sheet: comprehension

See **pages 8 and 9** of *Changing circuits*

Answers

1.



2. **(i) Add one or more batteries;**
   (ii) Take away a battery.
3. **Short, thick wires.**
4. **It would shine more dimly.**
5. **A filament.**
6. **(i) They are in a line; (ii) They would shine more dimly. The two bulbs would have to share the voltage with the third bulb.**

Complementary work

(a) The children could make a survey of the kinds of lights used in schools. They should be told that fluorescent lights are more economical than filament lights, and they may use this information to draw conclusions about the widespread use of fluorescent lights in school.

(b) The children can use secondary sources to find out about energy efficient light bulbs and how they are made.

Teaching notes

Household light bulbs contain a wire coil called a filament which is surrounded by a gas called argon. This gas is present in the air in very small amounts. In a light bulb, it is used instead of air because oxygen in the air would cause the filament to burn out.

The glass in a light bulb may be clear, to give a bright, clear light, or it may be translucent. Translucent bulbs are called pearl bulbs. They give a softer, more diffuse light than clear bulbs.

Some strip lights, such as those used in kitchens or for lighting under cupboards, have a filament, but the large strip lights used in ceilings in kitchens, garages, schools and offices do not use a filament. When one of these strip lights is switched on, a current of electricity flows through a gas in the tube. As the current passes through the tube, part of it changes to ultraviolet light. This strikes the lining of the tube and makes it glow. The material in the lining is fluorescent. Fluorescent material only glows when it receives ultraviolet light, so the moment you switch off a fluorescent lamp, it stops glowing. Sometimes strip lights of this type are called fluorescent lights.

All electrical devices offer some resistance to the current passing through them. Filaments offer a high resistance to the current, so the current has to work hard and is 'used up' in order to get through the wire. As it is used up, light and heat are produced. The children do not need to know about resistance at this level, but it is a useful concept when comparing series and parallel circuits in Unit 5.

3

Name: .... Form: ....

Based on **pages 8 and 9** of *Changing circuits*

How can the brightness of bulbs be controlled?

Try this...

1. Collect three batteries, three light bulbs, a switch and seven pieces of wire.

2. Make a plan to find out how the number of batteries in a circuit affects the brightness of a bulb. Draw the circuits you plan to make.

3. Show your teacher your plan. If your teacher approves, try your investigation.

4. What did your investigation show?

5. Make a plan to find out how the number of bulbs in a circuit affects the brightness of a bulb. Draw the circuits you plan to make.

6. Show your teacher your plan. If your teacher approves, try your investigation.

7. What did your investigation show?

Teacher's sheet: activity

Based on **pages 8 and 9** of *Changing circuits*

Introducing the activity

(a) You could begin by reminding the children that scientists do not only work out new experiments, but they also repeat the experiments of other scientists in order to test their work. In the pupil book, information was given about how the brightness of a bulb can be controlled. In this activity the children have to devise experiments to test this information.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then let the children try task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Let the children try task 4 (see note (iv)).

(f) Go through task 5, then let the children try it (see note (v)).

(g) Let the children try task 6 (see note (vi)).

(h) Let the children try task 7.

Completing the activity

(i) Let the children compare their results.

Conclusion

When the number of batteries in a circuit is increased, the brightness of a bulb in the circuit also increases. When the number of batteries in a circuit is decreased, the brightness of the bulb decreases.

When the number of bulbs in a circuit is increased, the brightness of the bulbs decrease. When the number of bulbs in the circuit is decreased, the brightness of the bulbs increases.

Teaching notes

(i) Many children find it easier to plan their experiment if they can see the equipment they are going to use.

(ii) The following three circuits should be drawn: one battery, switch and bulb; two batteries, switch and bulb; three batteries switch and bulb. It may be helpful here for the children to draw in each of the batteries they use. When they are wiring up their batteries, they should be able to connect positive to negative terminals easily.

(iii) Check each circuit as the children finish making it. Look at how the terminals of the batteries are wired together. Make sure that none of the circuits have a positive terminal wired to a positive terminal or a negative terminal wired to a negative terminal.

(iv) You may ask the children to devise a table in which to record their results in this task and in task 7.

(v) In this plan, the number of batteries should remain the same in all circuits but the number of bulbs should change. The circuits may have either one, two or three batteries. In the first circuit there should be a switch and a bulb, in the second circuit a switch and two bulbs and in the third circuit a switch and three bulbs.

(vi) Make sure that the bulbs are arranged in series.

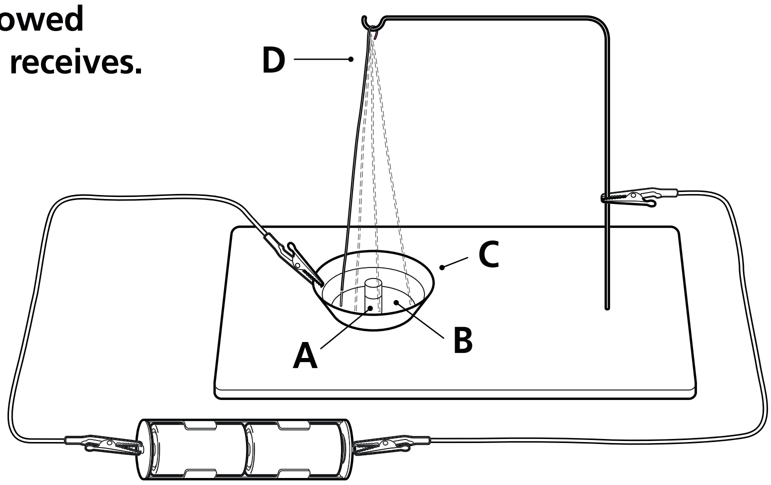
4

Name: .... Form: ....

See **pages 10 and 11** of *Changing circuits*

Making motors go faster and slower

A motor can be speeded up or slowed down by changing the voltage it receives.



Q1. Name the parts labelled A, B, C and D in the diagram.

A ✎...

....

B ✎..

C ✎..

D ✎..

Q2. What does a motor use electricity for?

✎..

Q3. How does D in the diagram move?

✎..

Q4. What does the current of electricity do to D?

✎..

Q5. What does A do to D? ✎..

Q6. (i) A battery has 1.5V written on its side. What word does the letter V stand for?

✎...

(ii) How would the movement of the motor in the diagram be different if it was powered by a 1.5V battery and then by a 4.5V battery?

✎..

✎..

✎..

4 Teacher's sheet: comprehension

See **pages 10 and 11** of *Changing circuits*

Answers

1. **A = rod-shaped magnet, B = salty water, C = metal dish, D = copper wire.**
2. **To make the spindle turn.**
3. **It rotates around the magnet.**
4. **It changes D into a magnet.**
5. **It pushes D away.**
6. **(i) Volts; (ii) D would move slowly with the 1.5V battery supplying power. D would move quickly with the 4.5V battery supplying power.**

Complementary work

The children could use secondary sources to find out about electric motors which power vehicles at an airport, inside a factory and electric cars.

Teaching notes

Small electric motors are usually enclosed in a metal casing so nothing can get in the way of the moving parts. There are two parts to the motor in the casing. One part is made from a pair of magnets, and between them is a coil of copper wire. When electricity flows through the coil, the current turns it into a magnet.

The north pole of the coil is repelled by the north pole of one magnet and attracted by the south pole of the other magnet. At the same time, the south pole of the coil is attracted to the north pole of one magnet and repelled by the south pole of the other. These forces of attraction and repulsion turn the coil on its spindle.

There is a special connection in the motor which links the coil to the wires which supply the motor with electricity. When the coil has turned so its poles are facing the opposite poles of the magnets, the connection switches the flow of the electricity so it flows the opposite way through the coil. This makes the poles of the coil change over so that they are again pushed and pulled by the poles of the surrounding magnets, making the coil move again. The coil and connection are set up so the constant changing of the current in the coil keeps it spinning in one direction. This allows the motor to generate a powerful enough force to turn a wheel.

4

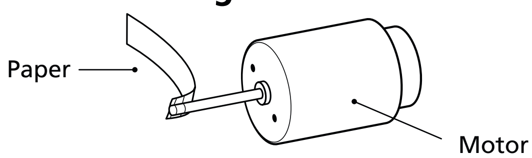
Name: .... Form: ....

Based on **pages 10 and 11** of *Changing circuits*

Controlling the speed of a motor

Try this...

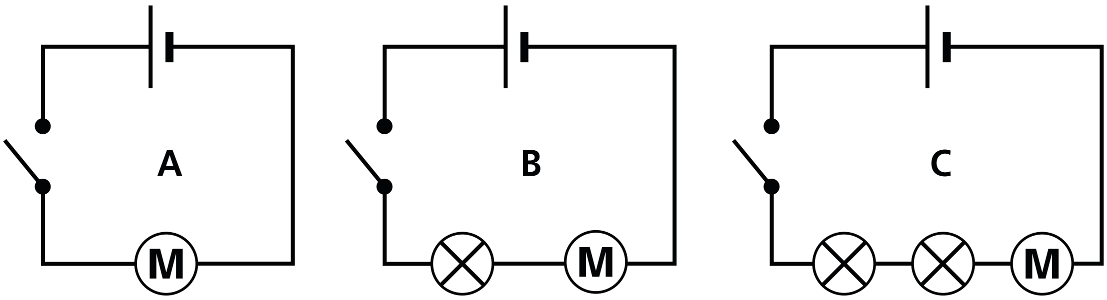
Diagram 1



1. Use tape to stick a piece of paper onto the spindle of a motor as Diagram 1 shows.

2. Look at the three circuits in Diagram 2.

Diagram 2



(i) In which circuit do you predict the motor will turn the fastest? ✎...................

(ii) In which circuit do you predict the motor will turn the slowest? ✎...................

3. Explain your predictions.

✎...

4. Make the three circuits in Diagram 2.

5. Write down your observations after you have made each circuit

Circuit 1 ✎..

Circuit 2 ✎..

Circuit 3 ✎..

6. How do your observations compare with your predictions?

✎...

7. What do you predict would happen if you added another battery to each circuit?

✎...

Try an investigation to test your prediction.

4 Teacher's sheet: activity

Based on **pages 10 and 11** of *Changing circuits*

Introducing the activity

(a) Use this activity after you have done activity 3. It calls upon knowledge and understanding from Unit 3. Tell the children that, in order to try and understand what they see, scientists use information they have already learned. In this activity the children get an opportunity to show what they have learned so far about electricity in circuits.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, go through task 1, then let the children try it (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Let the children try task 3.

(e) Go through tasks 4 and 5, then let the children try them (see note (iii)).

(f) Let the children try task 6.

(g) Go through task 7, then let the children try it (see note (iv)).

Completing the activity

(h) Let the children compare their results.

Conclusion

In circuit A the motor spun round very quickly, and the paper made a high pitched humming note. In circuit B the motor spun round more slowly, it made a lower pitched humming note and the filament of the lamp just glowed. In circuit C the motor spun more slowly still and made an even lower pitched humming note. The filaments of the two bulbs either glowed very dimly or not at all. The reason for these changes was due to the extra resistance of the bulbs in the series circuit.

The motor spun fastest in circuit A because there were no bulbs, and slowest in circuit C because there were two bulbs. When a second battery was added to each circuit, the motor spun more quickly, the bulb in circuit B shone more brightly and the bulbs in circuit C shone too. The reason for these changes is due to the increased voltage from the extra battery.

Teaching notes

(i) The piece of paper should be about a centimetre wide and about four centimetres long. It may be useful to test the motor and paper before the lesson. It should make a high pitched buzzing noise when moving quickly.

(ii) If the children seem to be having difficulty, remind them of how the filaments used up the electricity in the previous unit.

(iii) The children should not be allowed to use too many batteries as the motor in the circuit might burn out.

(iv) If the children are having difficulty, remind them how increasing the number of batteries increases the voltage, or push, on the current.

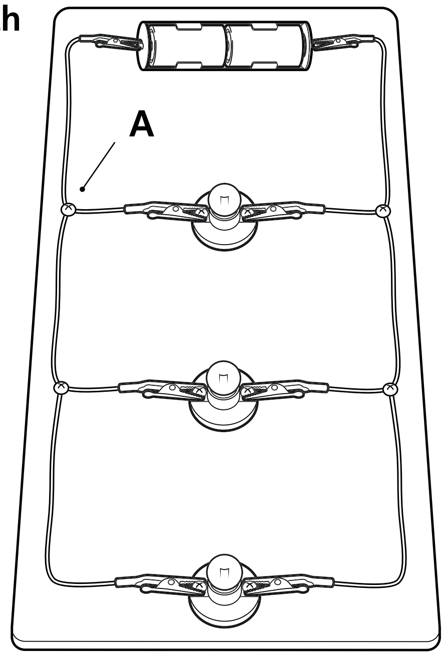
5

Name: .... Form: ....

See **pages 12 and 13** of *Changing circuits*

Parallel circuits

In parallel circuits, each component has a direct connection to the power supply.



Q1. In the space, draw a circuit diagram of the circuit in the picture.

Q2. In the picture, what is labelled A?

✎............................

Q3. How do we connect components in a parallel circuit?

✎..

Q4. When one component stops working in a parallel circuit, how are the other components affected?

✎..

Q5. If you had a circuit like the one in the picture and took out the top bulb, what would happen to the other bulbs?

✎..

Q6. (i) Name two places where parallel wiring is used.

✎.. ✎..

(ii) Imagine that you had a circuit with just one bulb in it, and a circuit like the one in the picture. In which circuit would a bulb shine longer? Explain your answer.

✎..

✎..

✎..

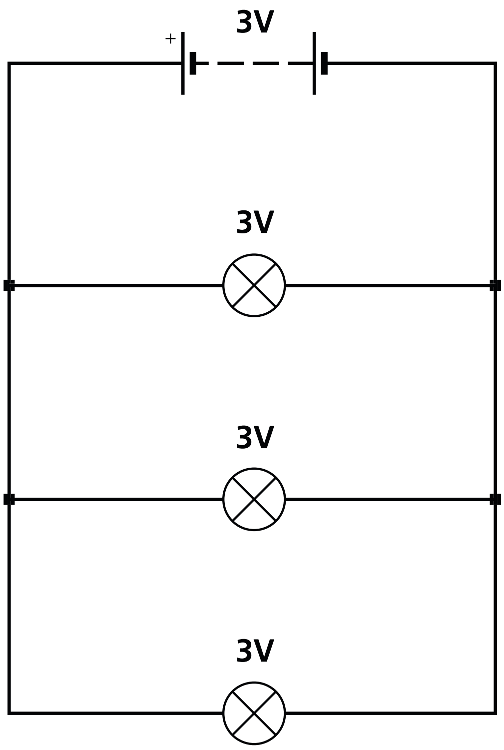
5

Teacher's sheet: comprehension

See **pages 12 and 13** of *Changing circuits*

Answers

1.



2. **A junction.**

3. **We connect them side by side.**

4. **They are not affected, they keep working.**

5. **They would keep shining.**

6. **(i) At home and at school; (ii) In the circuit with one bulb. The circuit in the picture uses more power, so the batteries would run out faster.**

Complementary work

Challenge the children to make a parallel circuit which features a bulb, a motor and a buzzer.

Teaching notes

Almost all electrical devices offer some resistance to the flow of current through them. The current has to work against the resistance and in so doing some energy is lost as heat energy. In a filament, the wire is designed so that the bulb also loses energy in the form of light.

When two bulbs are arranged in series, the resistance of one bulb is added to the resistance of the other. This makes it increasingly difficult for the current to get through, and as a consequence both bulbs glow more dimly than if they were each in a circuit with their own battery.

The voltage of a battery is the measure of the push that it gives to the current. When two batteries are connected in series, their voltages are added together and give a more powerful push to the current. This explains why the bulbs in a series circuit glow more brightly when another battery is added to the circuit.

When two bulbs are connected in parallel, each one offers its own resistance to the batteries. The resistances of the two bulbs are not added together to oppose the voltage. This means that each one glows as brightly as if it was in a circuit with its own battery.

5

Name: .... **Form:** ....

Based on **pages 12 and 13** of *Changing circuits*

Series and parallel circuits

Try this...

1. Set up the circuit as shown in Diagram 1 and switch it on.

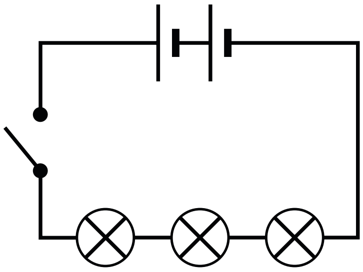


Diagram 1

2. How brightly or dimly do the bulbs shine?

✎..

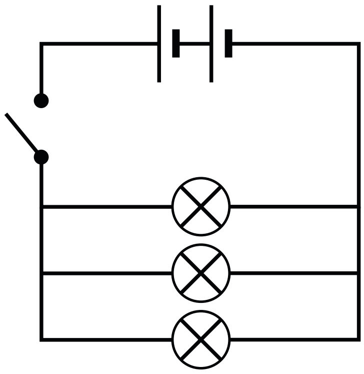


Diagram 2

3. Set up the circuit as shown in Diagram 2 and switch it on.

4. How brightly or dimly do the bulbs shine?

✎..

5. Draw a diagram of a parallel circuit with a bulb and a buzzer in it. Check it with your teacher.

6. If your teacher approves, make the circuit and switch it on.

7. What do you find?

✎..

8. Predict what will happen if you add another bulb in parallel with the buzzer and the first bulb.

✎..

9. Test your prediction. What do you find?

✎..

Teacher's sheet: activity

Based on **pages 12 and 13** of *Changing circuits*

Introducing the work

(a) If you did the introduction to this unit on page 11 of this *Teacher's Guide*, you may like to remind the class of it now so that they are familiar with the terms series and parallel. Tell the children they are going to investigate some circuits with bulbs and a buzzer.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through tasks 1 and 2, then let the children try them (see note (i)).

(c) Go through tasks 3 and 4, then let the children try them (see note (ii)).

(d) Go through task 5, then let the children try it.

(e) Let the children try task 6 (see note (iii)).

(f) Let the children try task 7.

(g) Go through tasks 8 and 9, then let the children try them.

Completing the activity

(h) Let the children compare their results.

(i) As the children have discovered that two bulbs and a buzzer work together, they may like to make a scary face or monster out of cardboard and place it over their circuit. The two bulbs can be its eyes and the buzzer can be its voice.

Conclusion

When three 3V bulbs are arranged in series with two 1.5V batteries they glow dimly because batteries to the value of 9V are needed to match the bulbs. When the three bulbs are arranged in parallel they glow brightly with just two 1.5V batteries because each bulb draws 3V directly from the batteries. When a buzzer and bulb are arranged in parallel, the buzzer sounds and the bulb glows brightly. When two bulbs and a buzzer are arranged in parallel, the two bulbs glow as brightly and the buzzer sounds as loud as in the circuit with one bulb. This is because you can add as many components as you like in parallel without affecting the working of any of the existing components. All that will happen is that the more components there are, the quicker the batteries will run down.

Teaching notes

(i) While the children are making their circuits check that they are arranging the batteries in the correct way – negative terminal to positive terminal and not two positive or two negative terminals together. Also check that the children are making firm connections between the wires and the other components of the circuit.

(iii) The children may need help in joining the bulbs in parallel. The way they make their circuits will depend on what you use to connect the wires. If, for example, you use crocodile clips, one crocodile clip can be snapped onto another to make a joint.

(iii) The children may need reminding about the symbol for a buzzer. The children will also need to know that a buzzer will only work if it is connected the correct way round – that is, the red wire to the positive terminal of the battery, the black wire to the negative terminal.

6

Name: .... **Form:** ....

See **pages 14 and 15** of *Changing circuits*

What circuits can do

Electricity can do much more than just make bulbs light. It can work other components, make heat and magnetism and even cause liquids to change.

Q1. In the space draw a picture of a circuit with two 1.5V batteries, a switch, a buzzer and a light bulb connected in parallel.

Q2. What device allows electricity to cause movement?

✎...

Q3. What happens to a compass when a wire is wrapped round it and the electricity is run through the wire? Explain your answer.

✎...

✎..

✎..

Q4. How could you make a current of electricity pick up paperclips?

✎..

✎..

Q5. How can you tell when electricity passes through salty water?

✎..

Q6. (i) What would happen if you dipped a copper strip and a key into salty water and passed a current of electricity through them?

✎..

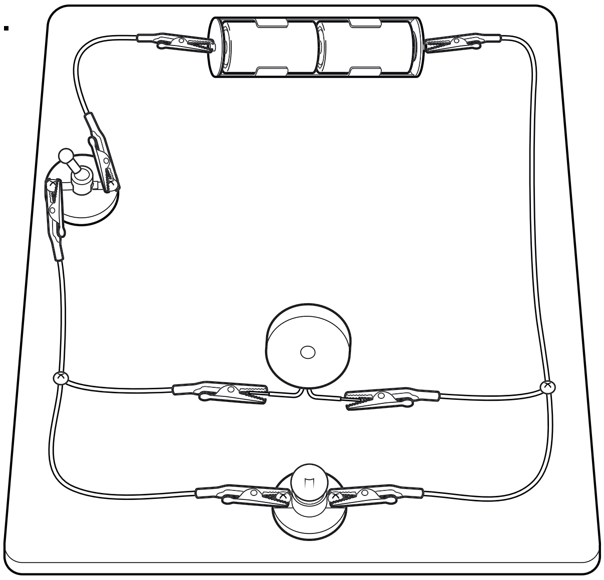
(ii) Which terminal of the battery must the copper be connected to for this change to happen? ✎...

Teacher's sheet: comprehension

See **pages 14 and 15** of *Changing circuits*

Answers

1.



2. **A motor.**

3. **The compass moves. The wire behaves as a magnet.**

4. **Wrap a coil of wire around a nail and pass a current of electricity through the coil.**

5. **The water begins to bubble.**

6. **(i) The key would become coated in copper; (ii) The positive terminal.**

Complementary work

(a) The children can use secondary sources to find out about the use of electromagnets.

(b) You may also like to use this unit with Unit 6 in *6D Changing materials* where instructions for performing an investigation on electroplating are provided.

Teaching notes

In this unit the use of electricity to provide sound and light is featured, but more unfamiliar uses are also introduced. The children may know about the flow of electricity through liquids from warnings about drying their hands before using a light switch.

In this unit electricity is shown to travel through salty water. When electricity passes through the salt water it breaks the water up into the two substances from which it is made – hydrogen and oxygen. These gases escape from the liquid in the bubbles. When the copper and key are set up as the diagram shows, copper dissolves in the water and then settles again on the surface of the key.

Electricity and magnetism are closely related phenomena. When a current passes through a wire it creates a magnetic field around the wire. If the wire is coiled, an object with a much stronger magnetic field, called a solenoid, is created. The power of the coiled wire, or solenoid, is further increased by placing a steel or iron nail inside it.

6

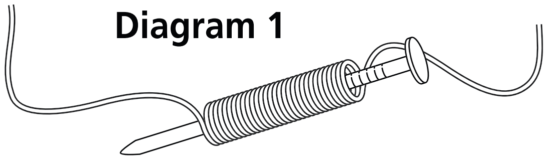
Name: .... **Form:** ....

Based on **pages 14 and 15** of *Changing circuits*

Making an electromagnet

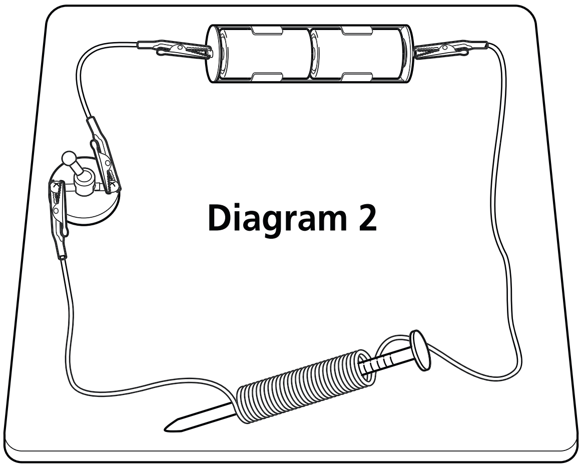
Try this…

1. Take a long nail and wrap a wire around it as Diagram 1 shows.



Make about thirty coils of wire around the nail.

2. Set up the coil and nail as shown in Diagram 2.



3. Bring a small paperclip next to the coil and the nail.

4. Switch on the current.

5. What happens to the paperclip?

✎..

6. Plan an experiment to find out how the number of coils around a nail affects its magnetic power. Write down your plan here.

✎..

✎..

✎..

✎..

7. Show your plan to your teacher. If your teacher approves, try the investigation.

Looking at the results.

8. What do the results show?

✎..

6

Teacher's sheet: activity

Based on **pages 14 and 15** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Remind the children that electricity and magnetism are linked, and tell them that they are going to investigate this relationship.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through task 1 (see note (i)).

(c) Let the children try task 1.

(d) Go through task 2, then let the children try it (see note (ii)).

(e) Go through tasks 3, 4 and 5, then let the children try them (see note (iii)).

(f) Go through task 4, then let the children try it (see note (iii)).

(g) Go through task 6, then let the children try it.

(h) Let the children try task 7 (see note (iv)).

(i) Let the children try task 8.

Completing the activity

(j) Let the children compare their results.

(k) Ask the children how they think the electromagnets would perform if three batteries were used instead of two, then let them test their prediction.

Conclusion

The number of coils in an electromagnet affects its power. As the number of coils increases, the power of the electromagnet increases.

When a third battery is used in the circuit the power of the electromagnet increases.

Teaching notes

(i) Some children may have coiled the wire tightly so that it does not need any further support. Some children may need to use sticky tape to hold their coil in place.

(ii) When the children assemble the circuit check to see if the batteries are lined up correctly.

(iii) The children should find that the paperclip does not stick to the nail in task 3 but it does in task 4, when the current is switched on. The children could also confirm that the coil and nail are behaving like a magnet by placing a compass near the nail then noticing that the compass needle swings when the current is turned on.

(iv) In the plan, look for the idea that the strength of the electromagnet can be measured by counting the number of paperclips it can hold. Look also for electromagnets with different numbers of coils.

7

Name: .... Form: ....

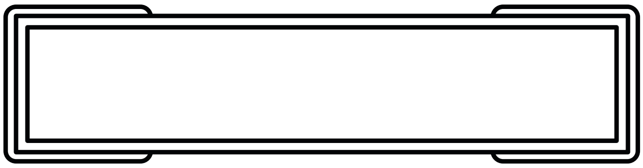
See **pages 16 and 17** of *Changing circuits*

Fuses

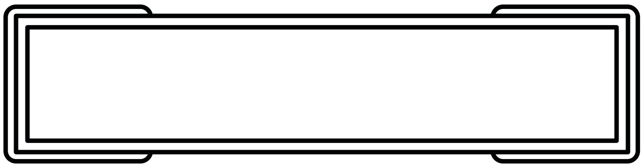
A fuse is an emergency switch. It is a thin wire which will easily melt and break the flow of electricity when a circuit becomes overloaded.

A

B



C



Q1. Picture A shows a fuse in a circuit which is not overloaded.

(i) In picture B, draw how the wire looks when the current is beginning to be overloaded.

(ii) In picture C, draw how the wire looks a few moments after the circuit has been overloaded.

Q2. What happens to the current when you try to force a lot of electricity round the circuit?

✎...

Q3. (i) What happens to a wire when you try to force a lot of electricity around a circuit?

✎...

(ii) How can the change in the wire be dangerous?

✎...

Q4. What happens if a fuse wire is too thin for a circuit?

✎...

Q5. Name two pieces of electrical equipment which have their own fuse.

✎.. ✎..

Q6. Are fuses with thick wires always the best to use? Explain your answer.

✎...

✎...

7 Teacher's sheet: comprehension

See **pages 16 and 17** of *Changing circuits*

Answers

1. **(i) The wire is bent and thicker than in A; (ii) The wire is broken and there is debris on the bottom of the case beneath the gap.**
2. **The current flow speeds up.**
3. **(i) It gets warm; (ii) It may cause a fire.**
4. **It will keep melting and the circuit will never work.**
5. **Kettle, toaster, TV, computer, radio.**
6. **Not always. If the other wires in the circuit are thinner than the fuse they may heat up first when the circuit is overloaded and cause a fire.**

Complementary work

You could arrange for someone to visit the school to talk about the dangers of electricity. This person could be an electrician, an engineer, a paramedic, a nurse or a doctor.

Teaching notes

There are two kinds of fuses, fuses for houses and other buildings and fuses for plugs. Household and building fuses are also known as fuse boxes, and are shown in the circuit diagram on page 21 of the pupil book. There are two types of these fuses, fuse wires and cartridge fuses.

If fuse wires are used, a 5 amp fuse is needed for the lighting circuit, a 15 amp fuse is needed on circuits which supply an appliance working at up to 3 kilowatts and a 30 amp fuse is needed on a circuit supplying an appliance working at up to 13 kilowatts, such as a cooker.

If cartridge fuses are used in a building, a 5 amp fuse is used for a lighting circuit, a 15 amp fuse is used for appliances up to 3 kilowatts, a 20 amp fuse for a water heater, a 30 amp fuse for some cookers and showers and a 45 amp fuse for cookers which have a power greater than 13 kilowatts.

There are two fuses for plugs. 3 amp cartridge fuses are used for appliances below 700 watts and 13 amp cartridge fuses are used for appliances above 700 watts.

Children may become confused if too many electrical terms are introduced, and it is best to keep their use to a minimum. For simplicity, volts measure the push of the current made by the power supply, amps measure the size of the current flowing through a wire, and watts measure the power of an appliance. The power is the rate at which an appliance changes one form of energy to another. For example, a 40 watt bulb changes electrical energy into light energy more slowly than a 100 watt bulb and so shines less brightly.

Name: .... **Form:** ....

Based on **pages 16 and 17** of *Changing circuits*

Fuses

Try this…

1. Read this: **The size of the current flowing through a wire is measured in amps. The symbol for amps is A.**

2. Look at the three pieces of fuse wire. One can carry a current of 3A, another a current of 15A and the third a current of 30A. Just by looking at the wires, predict which size current each wire can carry. Explain your answer.

✎...

✎...

✎...

3. Look at a fuse and describe it.

✎...

✎...

4. Look at the position of a fuse in a plug. Describe how the fuse is held in place.

✎...

5. Read this: **Electricity is a form of energy. It can be converted into other forms of energy such as light and heat. The speed with which something changes from one form of energy to another is called its power. Power is measured in units called watts. The symbol for watts is W. Low power devices work below 700W and need a 3A fuse. High power devices work above 700W and need a 13A fuse.**

6. Look at the power of these electrical devices and write down the size of fuse each one needs.

Item	Power needed	Fuse needed
Iron	over 700W	
CD player	below 700W	
Vacuum cleaner	over 700W	
Hair dryer	below 700W	
Toaster	over 700W	
Table lamp	below 700W	

Teacher's sheet: activity

Based on **pages 16 and 17** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Remind the children that tampering with electrical devices is very dangerous and should never be done. Tell the children that they can look at fuses in this activity because they are not connected to any device which can be wired to the mains.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it.

(e) Go through task 4, then let the children try it.

(f) Let the children try task 5, then ask them to try task 6.

Completing the activity

(g) Let the children compare their results.

Conclusion

The thinnest fuse wire can carry a current up to 3A. The medium-sized fuse wire can carry a current up to 15A. The thickest fuse wire can carry a current up to 30A. The thicker wires can carry more current because there is more room for the current to flow through them.

A fuse is a glass cylinder with metal caps at each end. There is a label which shows the size of current which can pass through the fuse. A wire passing from one end of the fuse to the other may be seen.

The fuse is held in the plug with metal spring clips.

The fuse needed for an iron is 13A, a CD player needs a 3A fuse, the vacuum cleaner needs a 13A fuse, the hair dryer needs a 3A fuse, the toaster needs a 13A fuse, the table lamp needs a 3A fuse (see note (iii)).

Teaching notes

(i) If the children ask about how amps are different from volts they can be told that the voltage is a measure of the push of the electricity. An amp is a unit which measures the size of the current running through a wire.

(ii) The children can simply look at or handle the wires and discover that they are different thicknesses.

(iii) Remind the children never to open electrical devices to look at a fuse or to change a fuse. This must be done by an adult who knows what to do. The purpose of the information here is to help the children understand what a fuse looks like and what it does.

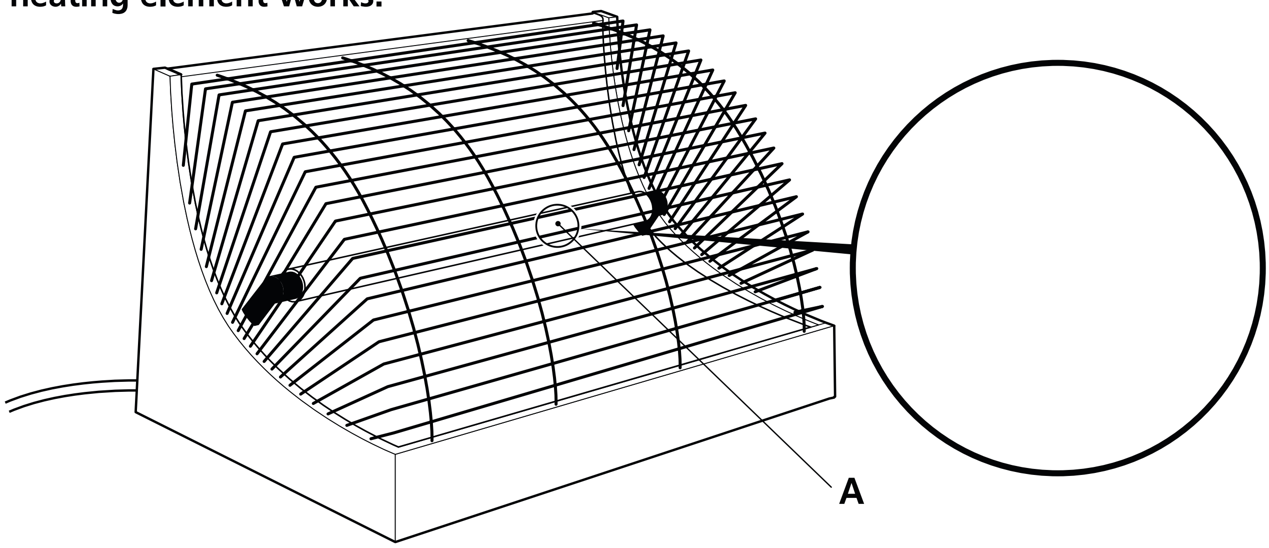
8

Name: .... Form: ....

See **pages 18 and 19** of *Changing circuits*

Using electricity for heat

When a large current flows through a thin wire, it will get hot. This is how a heating element works.



Q1. The diagram shows a single bar electric fire.

(i) What is the part labelled A? ✎...

(ii) In the circle, draw what part A looks like close up.

Q2. When electricity flows through a wire,
what else may flow through the wire besides heat? ✎..

Q3. How could you tell that an electric fire was on just by looking at it?

✎..

Q4. What is an immersion heater used for?

✎..

Q5. What prevents bread from touching the hot wires in a toaster?

✎..

Q6. In hair dryers, what does the fan do?

✎..

✎..

✎..

Teacher's sheet: comprehension

See **pages 18 and 19** of *Changing circuits*

Answers

1. **(i) The heating element; (ii) A coil of wire as shown on page 18 of the pupil book.**
2. **Light.**
3. **It will have a dull orange or red glow.**
4. **It provides hot water for the taps.**
5. **A wire cage.**
6. **It blows air through the heating element so that warm air emerges from the dryer.**

Complementary work

(a) The children could use secondary sources to find out how an electric oven is made.

(b) The children could use secondary sources to find out how gas and wood are used to provide heating.

Teaching notes

If the children have studied *4F Simple electricity* they will have already met heating appliances in Unit 2. It may be useful to remind them of their work. They need to be reminded that heating appliances such as kettles, ovens and irons have a heating device called an element. This is made from a coil of wire and is enclosed in a protective case. In kettles, the element is enclosed in a water-tight case, as is the immersion heater featured in this unit. The heating element in the hob of an electric cooker is enclosed in a strong case which can take the weight of a pan without bringing the case and pan into contact with the element.

In the supporting activity in *4F Simple electricity*, the children cut out pictures of household appliances and grouped them according to the rooms in which they were found in homes. The children then had to describe the use of each heating appliance and perform a survey on the use of appliances in their home. In this survey they had to divide the day into four time periods – morning, daytime, evening and night – and find out when each item was used. From this they could find out the time period when their home needed the most power. You could review that activity here or, if the children have not studied *4F*, they could do the survey now.

8

Name: .... Form: ....

Based on **pages 18 and 19** of *Changing circuits*

How do people use electricity for heat

Try this…

1. People use heat for making meals, keeping clean and tidy and keeping comfortable. List the appliances that people use for each of these activities under the headings below.

Making meals	Keeping clean	Keeping comfortable

2. On a separate piece of paper, design a survey sheet which you can use to ask ten people about which heating appliances they use in their daily lives and how often they are used.

3. Make your survey.

4. What does your survey show?

✎...

✎...

5. Add your results to the class results.

6. How did the results of your survey compare with the class results?

✎...

✎...

Teacher’s sheet: activity

Based on **pages 18 and 19** of *Changing circuits*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. Tell the children that scientists sometimes gather information by making surveys and in this activity they are going to design and use their own survey sheet.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 with the children (see note (i)).

(c) Let the children try task 1.

(d) Go through task 2 with the children, then let the children try it (see note (ii)).

(e) Go through task 3, then let the children try it (see note (iii)).

(f) Let the children try task 4 (see note (iv)).

(g) Let the children try task 5.

(h) Go through task 6 with the children, then let them try it (see note (v)).

Completing the activity

(i) Let the children compare their results.

Conclusion

The following appliances may be used for making meals: kettle, microwave oven, oven, toaster, slow cooker, sandwich maker. The following appliances may be used to keep clean: heater in shower, immersion heater, hair dryer, washing machine and tumble dryer. The following appliances may be used to keep comfortable: electric fire, convection heater, electric blanket. The frequency with which the appliances are used will depend on the people surveyed.

Teaching notes

(i) The children should see that kettles and ovens are used for making food; showers and hair dryers are used for keeping clean; and fires and electric blankets are used for keeping comfortable.

(ii) The left hand column should have the appliances grouped into making meals, keeping clean and keeping comfortable. There should be ten further columns in which the children can place a tick if the person they are surveying uses a particular appliance. There may be a total column for each appliance and a total line at the bottom of the table for each person. There may also be a column to indicate when each item is used.

(iii) The children could survey pupils in other classes, or friends, neighbours and members of their families. The children should be reminded not to talk to strangers when making their survey.

(iv) The children should total up the number of times an appliance is used. They may also total up the number of appliances used by each person. They should comment on these totals.

(v) The children should look for similarities and differences in the results. They may also find that they have some appliances in their survey which are not found in the class survey or that the class survey has some appliances which they have not featured on their survey sheet.

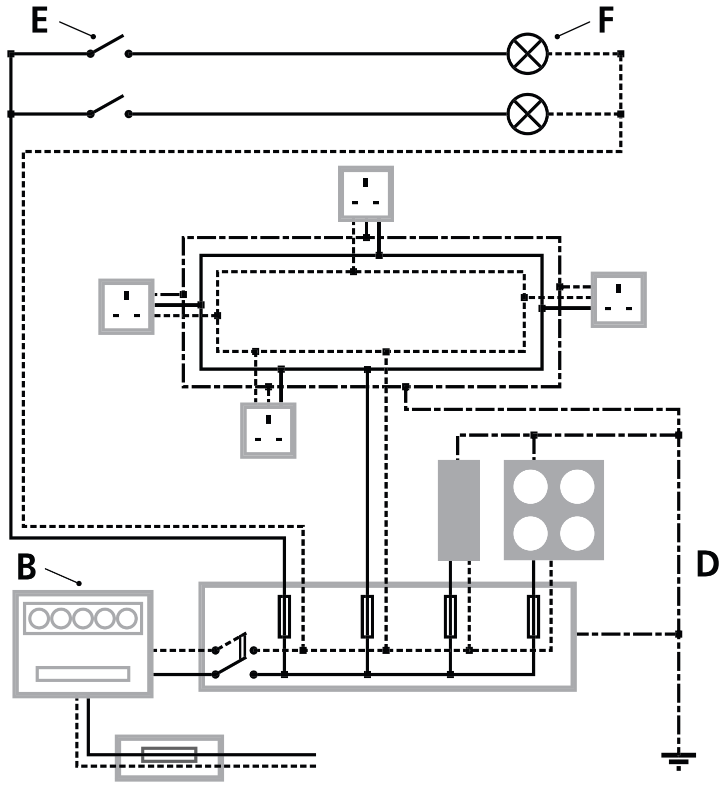
Note: This activity could be used as an ICT exercise.

9

Name: .... Form: ....

See **pages 20 and 21** of *Changing circuits*

Home circuits



Your home electricity supply makes use of the circuits and fuses shown on the previous pages.

Q1. Name the parts labelled B, D, E and F.

B ✎...

D ✎...

E ✎...

F ✎...

Q2. What carries electricity along the street?

✎..

Q3. (i) What is the first thing that electricity passes through when it enters a home?

✎..

(ii) Label this device with an A on the diagram.

(iii) How does this device protect the home?

✎...

Q4. What does device B do?

✎...

✎...

Q5. What is the name of the wire that brings electricity to an appliance?

✎..

Q6. What kind of circuit is used for the sockets in the home?

✎...

Teacher's sheet: comprehension

See **pages 20 and 21** of *Changing circuits*

Answers

1. **B = electricity meter, D = earth wire, E = wall light switch, F = ceiling light.**

2. **A cable.**

3. **(i) A fuse box; (ii) The fuse box should be labelled A as in the pupil book;**
   (iii) Prevents problems in one home from affecting others.

4. **It records the amount of electrical energy used in the home every second.**

5. **Live wire.**

6. **Parallel circuit.**

Complementary work

The children could use secondary sources to find out about the voltages used in other countries to provide power to home circuits.

Teaching notes

In Great Britain the plug for the mains has three pins on it. The top pin is the earth pin. Looking at the plug from the front, the pin at the lower left is the live pin and the pin at the lower right is the neutral pin. Cables attached to plugs have three wires. The wire with the green and yellow cover is the earth wire, the wire with the brown cover is the live wire and the wire with the blue cover is the neutral wire. *Do not* let children wire up a plug.

When the plug is placed in the socket, and the socket is switched on, a current of electricity flows through the live and neutral wires. The voltage is 240 volts. This is the voltage at which a wide range of electrical appliances can be used and at which people will usually survive an electrical shock (but some may not).

An earth wire gives protection if an electrical appliance develops a fault. For example, if an electric kettle with a metal casing developed a fault, the current could flow into the casing. Anyone touching the casing would receive a shock that might kill them. The earth wire is connected to the casing so that if a fault occurs, the current is taken away to the earth (or it may be connected to a copper water pipe which goes into the ground). As the current is drawn away to the earth it melts the wire in the fuse and the circuit is broken. All this happens very quickly, and makes the kettle safe to handle.

9

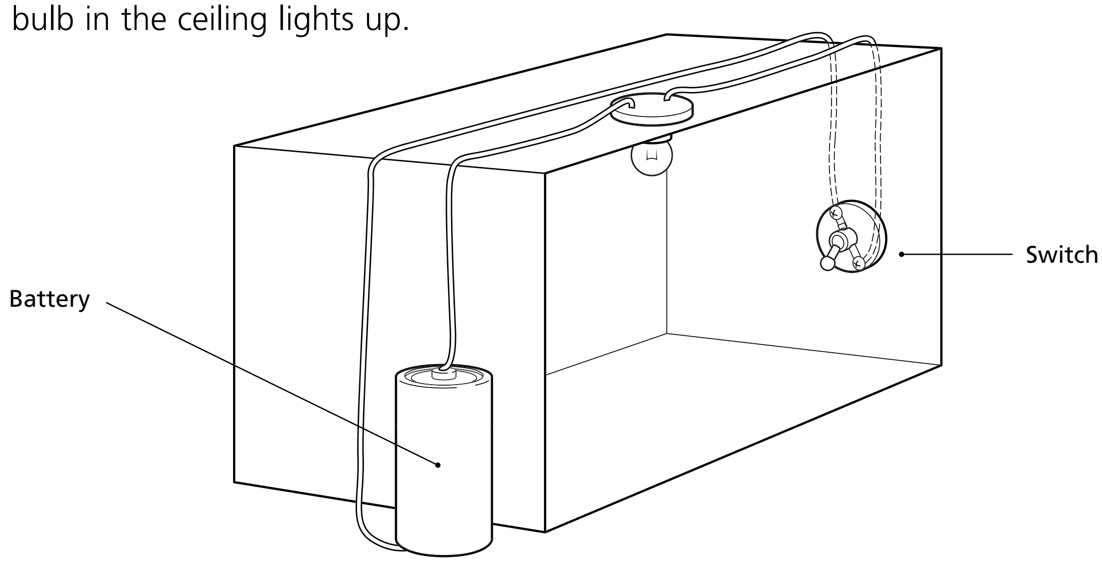
Name: .... Form: ....

Based on **pages 20 and 21** of *Changing circuits*

Making circuits for a model room

Try this…

1. Look at the diagram. It shows a box which is being used as a model room. A simple circuit has been added to the model room so that when the switch in the wall is turned on the bulb in the ceiling lights up.



2. Make a model room and circuit as shown in the diagram.

3. What problems did you have in setting up the circuit?

✎...

✎...

✎...

4. Plan another circuit to add to the room. Write or draw your plan here.

5. Show your teacher your plan. If your teacher approves, add the circuit to the model.

Teacher’s sheet: activity

Based on **pages 20 and 21** of *Changing circuits*

Introducing the activity

(a) Tell the children that although we cannot use mains electricity for investigations, we can make a model of the wiring in a room. By doing this we can see some of the problems an electrician faces when wiring up a room (see note (i)).

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through task 1 (see note (ii)).

(c) Let the children try task 2.

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Let the children complete task 5 (see note (v)).

Completing the activity

(g) Let the children compare the circuits they have made, or their rooms.

Conclusion

A battery, wires and other components can be used to make circuits in a model room. They can provide light, sound for a door buzzer and movement for a fan. The circuits must be set up in parallel so that each one can be used on its own.

When circuits are made in model rooms, care must be taken to make sure the wires are connected securely and that switches, bulbs and other components are secured to the room walls or ceiling.

Teaching notes

(i) You may also refer to doll’s houses which have electric lights in them.

(ii) Get the children to trace the path of the circuit with a finger. Make sure that they understand that some of the wires are shown behind the wall.

(iii) The children should think about the difficulties in judging how much wire to use and making the components of the circuit stick together and to the room.

You may wish to introduce the concept of cost, and say that wire is expensive so it should not form long wavy lines on the outside of the room, but go straight between components.

(iv) Some children may have difficulty thinking about other circuits to make. Here are some circuits for them to try. A door could be made in the room and a circuit with a buzzer and switch set up. A motor could be put in the ceiling to power a fan and a switch could be put on the wall, a lamp could be put outside the door with a switch on the inside of the room.

(v) Make sure that the second circuit is in parallel with the first.

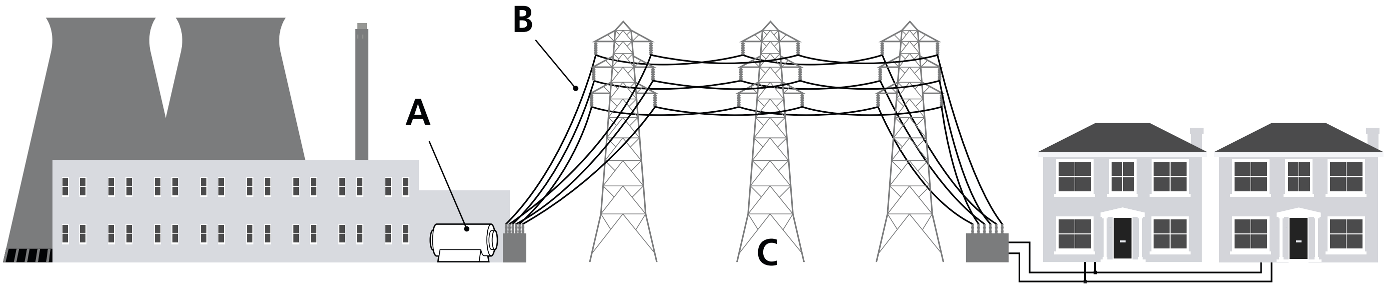
10

Name: .... Form: ....

See **pages 22 and 23** of *Changing circuits*

Power supplies

Most of the things we do in the modern world depend on a power supply. This is how electricity gets from a power station to homes and other buildings.



Q1. (i) What is found in the power station at A? ✎...

(ii) What is B? ✎..

(iii) What is C? ✎..

Q2. Why is electricity carried high in the air or underground?

✎..

Q3. Why are more cables suspended in the air than buried underground?

✎..

Q4. What is the electricity grid?

✎..

Q5. (i) Name two insulators used to help transport electricity safely overground.

✎.. ✎..

(ii) Name an insulator used to help transport electricity safely underground.

✎..

Q6. Why is electricity transported at 400,000 volts?

✎..

✎..

Teacher’s sheet: comprehension

See **pages 22 and 23** of *Changing circuits*

Answers

1. **(i) A generator; (ii) A high voltage cable; (iii) A pylon.**
2. **To keep it away from people.**
3. **It is very expensive to bury cables.**
4. **A pattern of cables that supply electricity.**
5. **(i) Air and ceramics; (ii) plastic.**
6. **This is the most efficient voltage to carry electricity long distances.**

Complementary work

(a) The children could use secondary sources to find out how electricity is generated at a power station.

(b) The children could use secondary sources to find out about the different ways in which electricity is generated.

Teaching notes

In Unit 4, the children learned that there was a link between magnetism and electricity, and this is used to make an electric motor. Magnetism is also used to make an electric current in an electrical generator. The dynamo on a bicycle is an example of a small electrical generator. It contains a coil of wire and a magnet.

A magnet has an area around it in which its magnetic force is active. This area is called the magnetic field. It is easily seen by sprinkling iron filings on paper held over a magnet. When the magnet in a generator turns, its magnetic field sweeps through the coil of wire and makes a current of electricity. The current created in a power station is at about 25,000 volts. This is passed through a transformer which raises, or steps up, the voltage to about 400,000 volts so that it can be transported economically in overhead power lines or transmission lines.

When the current comes to the end of its journey on the transmission line, it passes into another transformer which lowers, or steps down, its voltage.

Currents at high voltages are stepped down in a series of stages. The step down process takes place at a substation. For heavy industry, such as steelworks, large substations step the current down to 33,000 volts. Railways use electricity at 25,000 volts, while hospitals receive their electricity at 11,000 volts, which is stepped down again before use. Neighbourhood substations step down electricity, ready to distribute it to homes. Children must be warned to keep away from them.

10

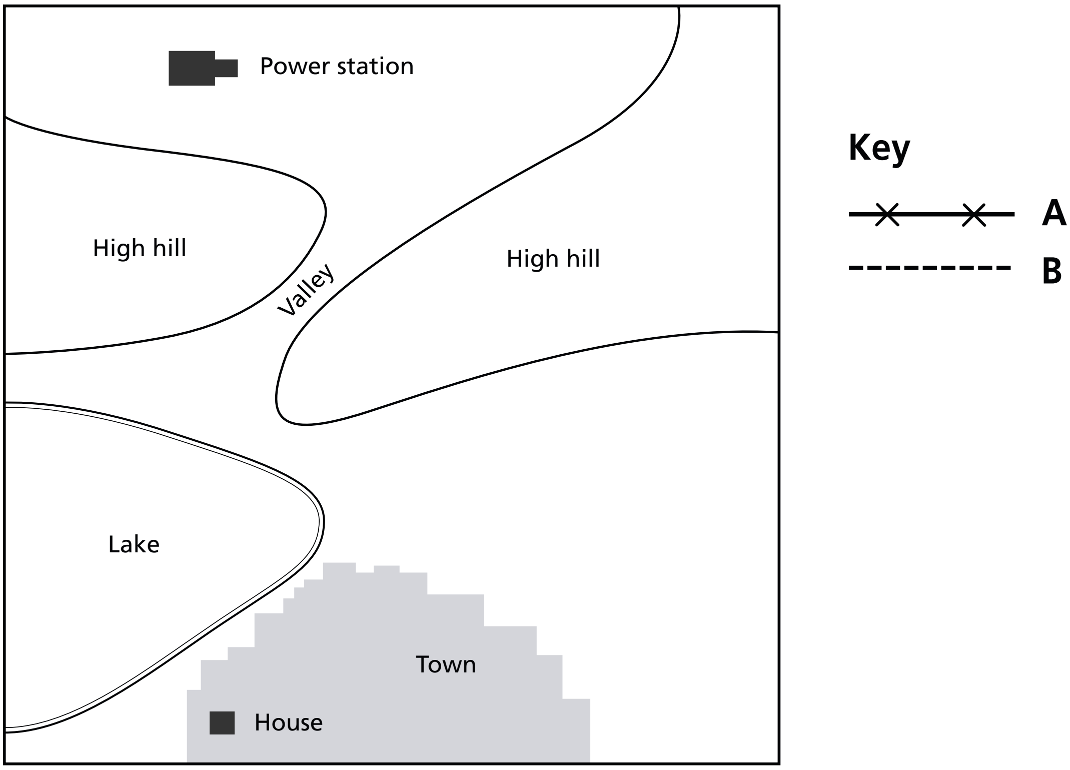
Name: .... Form: ....

Based on **pages 22 and 23** of *Changing circuits*

Can you supply the water?

Try this…

1. Look at the map. The map shows the position of a power station, hills, a valley, a lake, a town and a house in the town.



2. Look at the two symbols on the key to the map. The symbol for a transmission line is shown at A, and the symbol for an underground cable is shown at B.

3. Read this: **It is cheaper to supply power by transmission lines. It is safer to supply power by underground cables in places where there are a lot of people.**

4. You have to show how you would transfer electricity from the power station to the house as cheaply and safely as possible. To do this, you must draw in the path of the power line, and show where you would use transmission lines and where you would use underground cables.

5. Explain why you have used the path you did.

✎...

✎...

Teacher's sheet: activity

Based on **pages 22 and 23** of *Changing circuits*

Introducing the activity

(a) You may like to begin by telling the children that when new power stations or towns are set up, engineers have to think carefully about how they will supply electrical power. Tell the children that in this activity they are going to work as engineers and run a power line from a distant power station to a house in the middle of a town.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through tasks 2 and 3 with the children.

(d) Go through task 4, then let the children try it (see note (ii)).

(e) Let the children try task 5.

Completing the activity

(f) Let the children compare their plans and decide which is cheapest and safest.

Conclusion

The cheapest and safest method of supplying power would be to use transmission lines from the power station, through the valley round the edge of the lake to the edge of the town.
An underground cable would then run from the edge of the town directly to the house. Placing underground power lines through the hills or under the lake would be very expensive. Building islands to support pylons in the lake, to take the power directly to the opposite side of the lake would also be possible, but expensive. Using overhead transmission lines through the town would be cheaper than an underground cable but it would not be safe enough.

Teaching notes

(i) Make sure that the children recognise all the features on the map.

(ii) Make sure that the children know that if they change the power line from overhead transmission lines to underground cable, or from underground cable to transmission lines, they simply change the symbols. They can change the method of supply as often as they like.

QUESTIONS

Name: .... **Form:** ....

Q1. Jane has made a circuit with one battery, a switch and a bulb.

(i) Draw the circuit diagram for this circuit.

(ii) When the switch is open, the bulb does not light. Why is this?

✎...

✎...

(iii) The voltage of the battery is 1.5V. Jane adds another battery to the circuit. What is the voltage of the current in the circuit now? ✎.........................

(iv) How does the brightness of the bulb change when the second battery is used in the circuit?

✎...

(v) What is the name of the coil of wire in a bulb which glows when electricity passes through it? ✎..

Q2. (i) Which component of a circuit has a + sign on it?

Tick one box:

Battery ☐ Switch ☐ Bulb ☐ Motor ☐

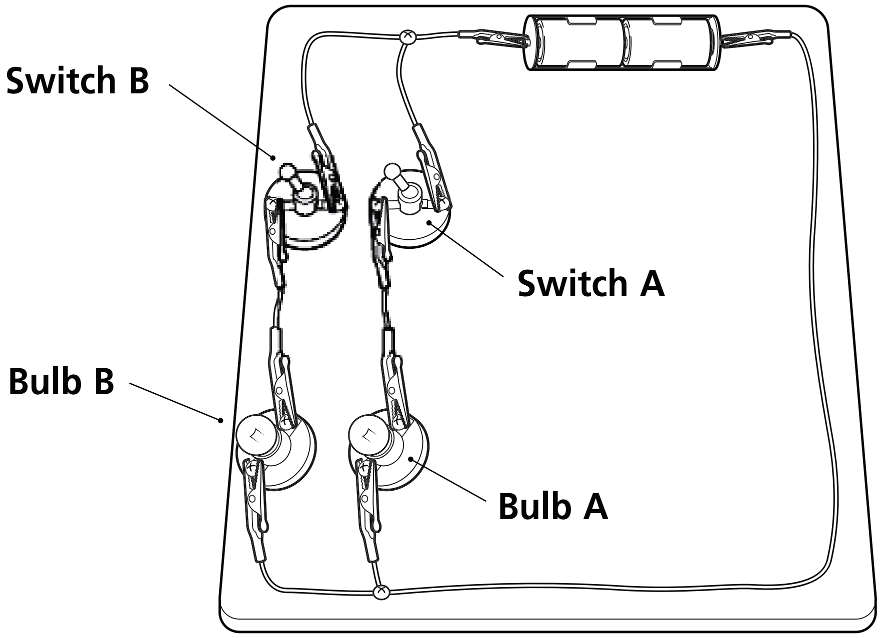
(ii) What does the + sign mark on the component?

✎...

QUESTIONS

Name: .... Form: ....

Q3.



(i) Make a circuit diagram of the circuit above. You do not have to label the bulbs and switches.

(ii) Arif turned the switches on and off as shown in the table. Complete the table by filling in whether the bulbs were on or off.

Switch A	Switch B	Bulb A	Bulb B
on	on		
off	on		
on	off		
off	off		

QUESTIONS

Name: .... Form: ....

Q4. Paul has a circuit with two batteries and two bulbs in it.

(i) What could he add to the circuit to make the bulbs shine more brightly?

✎..

(ii) State two things he could do to make the bulbs shine more dimly.

1 ✎..

2 ✎..

Q5. (i) Draw the circuit diagram for two batteries, a switch and three bulbs in series.

(ii) Draw a circuit diagram for two batteries, a switch and three bulbs in parallel.

(iii) In which circuit will the bulbs shine more brightly?
Explain your answer.

✎..

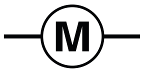
✎..

✎..

QUESTIONS

Name: .... **Form:** ....

Q6. Here is the symbol for a motor:



(i) Draw a circuit diagram for a circuit which has two batteries, a switch and a motor in it.

(ii) Mina adds a bulb to the circuit. She connects it in line with the motor. Draw the circuit Mina has made.

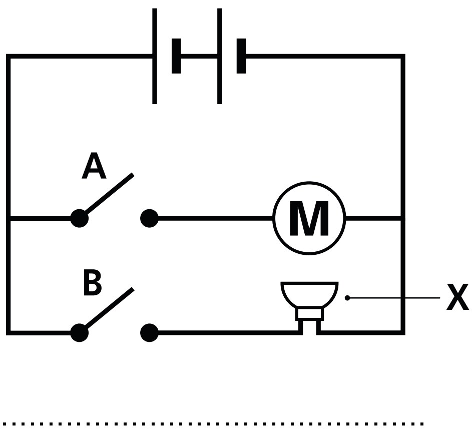
(iii) When Mina switches on the circuit, will the motor spin as quickly as in her first circuit? Explain your answer.

✎..

✎..

✎..

Q7. Jane builds the circuit shown in this circuit diagram.



(i) What is the component marked X?

✎..

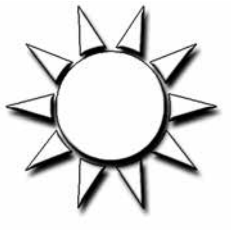
(ii) What happens when Switch A is closed and switch B is opened.

✎..

(iii) What happens when switch A is closed and switch B is closed.

✎..

(iv) Is this a series or a parallel circuit? ✎...



QUESTIONS

Name: .... **Form:** ....

Q8. Paul set up a circuit with two batteries, a bulb and a switch. He found that when he switched on the circuit, the bulb shone very brightly. He then set up circuits with different coils of wire in them and recorded the brightness of the bulb. The coils varied in length. He recorded his results in this table:

Length of coil (cm)	Brightness of bulb
15	bright
25	less bright
35	dim

(i) How did the brightness of the bulb change when Paul added the first coil to his circuit?

✎...

(ii) What was the effect on the bulb of adding longer coils?

✎...

(iii) Paul found a coil 50 centimetres long. How do you think this coil will affect the way the bulb shines?

✎...

(iv) Mina found another coil and tried it in Paul's circuit.
The bulb shone brightly. How long was the coil Mina had found? ✎.........................

Q9. Arif has a long piece of wire.

(i) What must he do to turn it into a magnet?

✎...

✎...

✎...

(ii) How could Arif show that he had made a magnet?

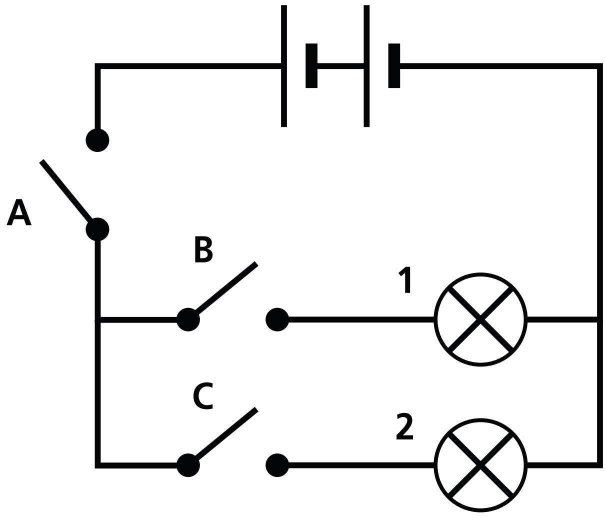
✎...

✎...

QUESTIONS

Name: .... **Form:** ....

Q10. Here is a circuit diagram with three switches:



The table shows how the switches were closed and opened. Complete the table to show how each combination of switches affected the bulbs.

Switch			**Bulb**	
A	**B**	**C**	**1**	**2**
closed	open	open		
closed	closed	open		
closed	closed	closed		
open	closed	closed		

Q11. Where does the mains electricity come from?

✎...

Q12. What kind of circuits are used for the lights and plug sockets in homes?

✎...

Q13. What is used to measure the amount of electricity that is used in the home?

✎...

Q14. What is used to prevent fires when electrical faults develop?

✎...

ANSWERS

1. (ii) The contacts of the switches are not together, so the current cannot flow through them. *1 mark*
(iii) 3 volts. *1 mark*
(iv) It gets brighter. *1 mark*
(v) Filament. *1 mark*

2. (i) Battery. *1 mark*
(ii) The positive terminal. *1 mark*

3. (ii) To complete the table, line 1 should be on, on; line 2 off, on; line 3 on, off; line 4 off, off.
4 marks

4. (i) Another battery. *1 mark*
(ii) Take away a battery, add another bulb. *2 marks*

5. (iii) The parallel circuit. The bulbs do not have to share the voltage of the batteries as they do in the series circuit. *2 marks*

6. (iii) It will spin more slowly, as some of the electricity is used up by the bulb. *1 mark*

7. (i) Buzzer. *1 mark*
(ii) The motor spins. *1 mark*
(iii) The motor spins and the buzzer sounds.
1 mark
(iv) A parallel circuit. *1 mark*

8. (i) It changed from shining very brightly to just bright. *1 mark*
(ii) As the length of the coil increased the amount of light produced by the bulb decreased. *1 mark*
(iii) It will not shine, or will be very dim. *1 mark*
(iv) 15cm. *1 mark*

9. (i) Coil the wire round a nail, connect the wire into a circuit with one or more batteries and switch on the current. *2 marks*
(ii) Either bring the coil next to a compass, and see the compass needle turn, or bring the coil next to a paperclip, and see the coil pick up the paperclip. *2 marks*

10. To complete the table, line 1 should be off, off; line 2 on, off; line 3 on, on; line 4 off, off. *4 marks*

11. A power station. *1 mark*

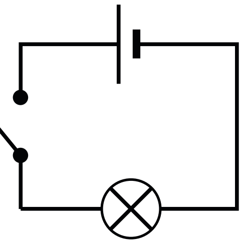
12. Parallel circuits. *1 mark*

13. Electricity meter. *1 mark*

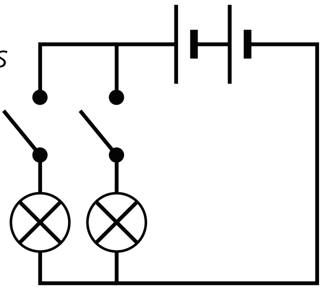
14. Fuses. *1 mark*

Total marks: 61

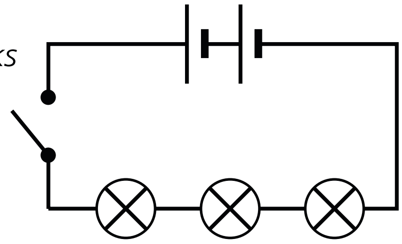
1. (i) *3 marks*



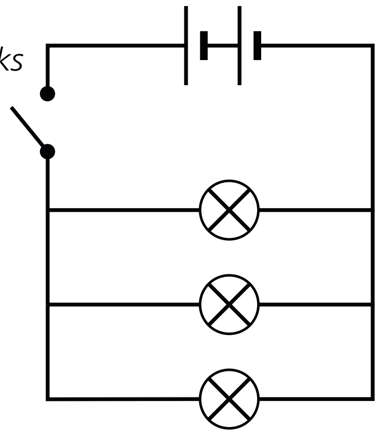
3. (i) *5 marks*



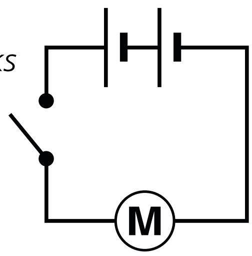
5. (i) *5 marks*



5. (ii) *5 marks*



6. (i) *3 marks*



6. (ii) *4 marks*