SALTUS GRAMMAR SCHOOL

S7 Science

Topic 7J – Electrical Circuits

Name: ……

Class: …… **Date:**……

Summary

This unit uses the context of household electrical wiring to cover the measurement of current in series and parallel circuits. It also looks at some of the uses and dangers of electricity, and at the idea of using models to help us think about things.

The unit briefly revisits work on electrical circuits from KS2, and goes on to look at current and its measurement; how we use electricity safely, including fuses; series and parallel circuits; electricity and the body. Electricity can be a difficult topic for many students to grasp and a conceptual model is used to help students to think about the ideas involved.

NOTE: Bermuda uses the US/Canada system of 110V/60Hz rather than the UK system of 240V/50Hz. Also, fuses in plugs are not a standard feature of the US/CAN/BDA household.

Topic	**Objectives**
Live and Dangerous	• To be able to recall the rules for electrical safety • To be able to explain what is required to make an electric current flow • To be able to explain what electrical conductors and insulators are • To be able to draw simple circuit diagrams
Electrical Current	• To be able to use an ammeter to measure the current in a circuit • To know that resistance is a measure of how hard it is for current to flow through something • To be able to describe some ways to change the current in a circuit • To be able to explain what a fuse does and how to choose a fuse
Using Models	• To be able to describe a current as a flow of electrons that transfer energy from the cell to the components in a circuit • To be able to use a model to help think about electricity
Series and Parallel	• To be able to describe what series and parallel circuit are • To be able to explain what happens to the current in a parallel circuit • To be able to describe how to use switches to control parts of a circuit • To describe how houses are wired.
Electricity and You	• To be able to recall that nerves carry electrical impulses around the body • To be able to describe way in which electricity can help or harm the body

This unit consists of about 10 lessons and a test, which is about 3 weeks work. Extension material is available. This booklet and additional resources can be found on BlackBoard. Material has been sourced from Exploring Science, Spotlight Science and CGP Books.

1: Live and Dangerous text ref: 134 - 135

Aims:

- To be able to recall the rules for electrical safety
- To be able to explain what is required to make an electric current flow
- To be able to explain what electrical conductors and insulators are
- To be able to draw simple circuit diagrams

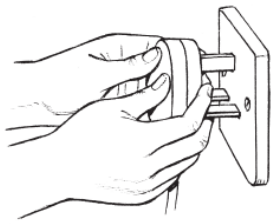
Notes:

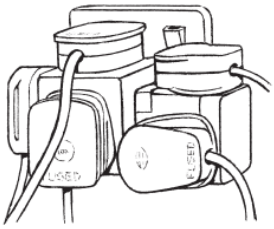
7Ja(1) Live and dangerous

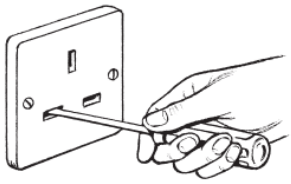
Name _____ Class _____ Date _____

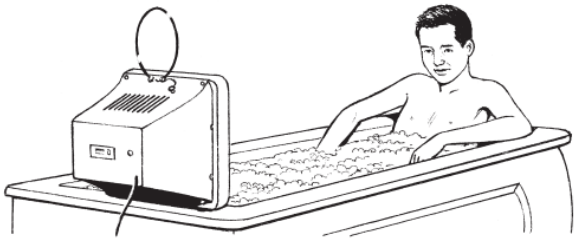
7 J a

1 Match each picture with the correct safety warning by joining the boxes.









Never poke things into sockets.

Keep electricity away from water.

Never touch the bare metal parts of plugs.

Do not plug too many things into one socket.

Never use something that has a damaged wire.

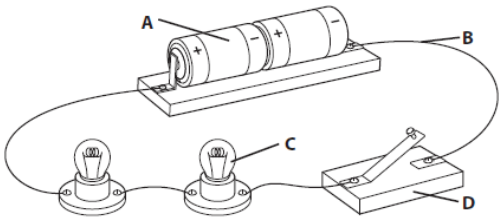
2 a Name the parts of the circuit.

A _____

B _____

C _____

D _____



b Look at the circuit. What will happen to the bulbs if the switch is closed?

Tick the correct answer.

☐ The bulbs go off. ☐ The bulbs come on. ☐ Nothing.

I CAN... • recall the rules for using electricity safely • recall the names of electrical components • recall what is needed for an electric current to flow.

LAB: Conductors and Insulators

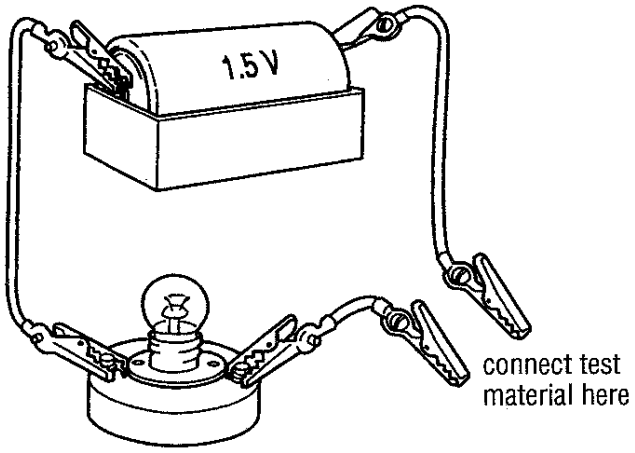
◊ **Fill in the spaces below using the words conductor or insulator.**

A material that will let an electric current flow through it is called a ……

An …… will not let electricity flow through it.

If the material is a ……the bulb will light up.

If the material is an …… the bulb will not light up.



◊ Fill in the table below to show which materials are conductors and which are insulators.

Conductors	*Insulators*

◊ What do all conductors have in common?

……

……

◊ Is air a conductor or an insulator? How do you know?

……

……

Circuit Symbols – card sort

LAB: Measuring Current

An ammeter is used to measure current.

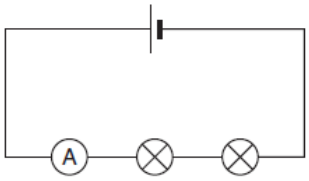
Apparatus

- cells/power pack
- 2 bulbs
- ammeter
- connecting wires

Method

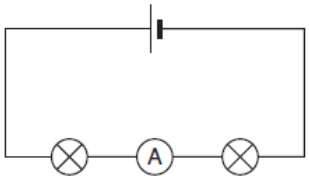
A Build this circuit. Show it to your teacher before you switch on.

Write down the reading on the ammeter.

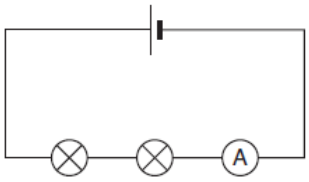


B Now build this circuit.

Write down the reading on the ammeter.



C Build this circuit and write down the ammeter reading.



Considering your results/conclusion

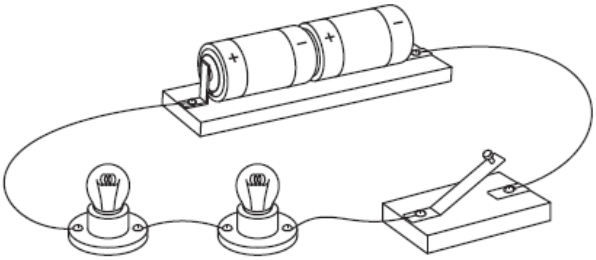
Copy these sentences and fill in the gaps using words from the box. You may need to use some words more than once.

The reading on the _____ shows the amount of _____ flowing around the _____.

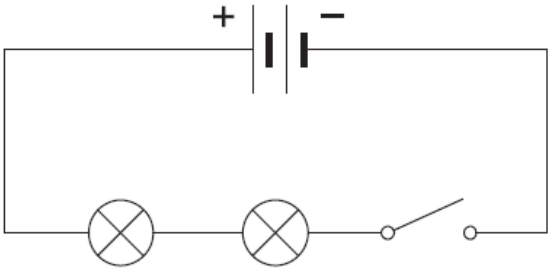
The current is the _____ everywhere in the _____. The current is not _____ by the bulbs.

ammeter	circuit	current	same	used up

Circuit Diagrams



This is a circuit.

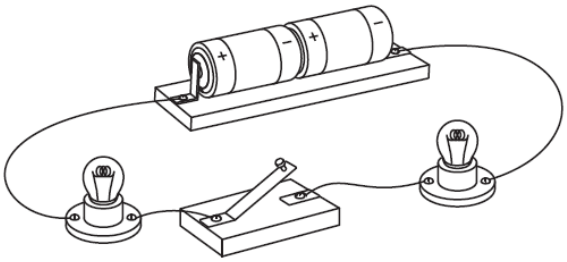


And this is the circuit diagram.

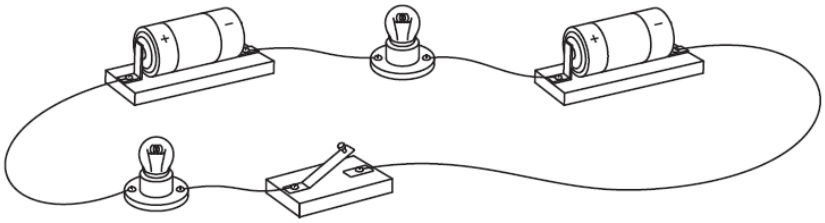
1 Make a neat copy of the circuit diagram above.

2 Draw circuit diagrams for these circuits. Make sure that you show the cells the right way round.

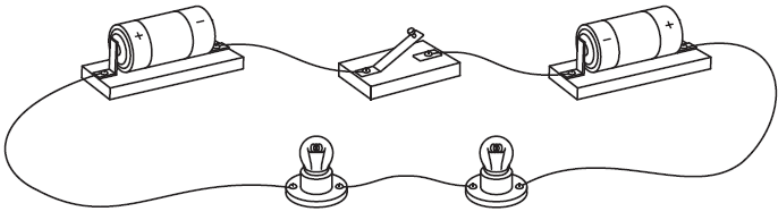
a



b



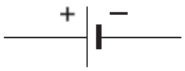
c



3. What is wrong with circuit c?

WORDSEARCH

There are 10 words connected with electricity in this wordsearch. Use the clues to help you to find the words.

1  is the symbol for a _____.

2 Something that will let electricity flow through it is a _____.

3 Bulbs, cells and switches are all circuit _____.

4 A complete _____ is needed for a bulb to light up.

5 Wires are made of _____.

6  is the symbol for a _____.

7  is the symbol for a _____.

8 You measure current using an _____.

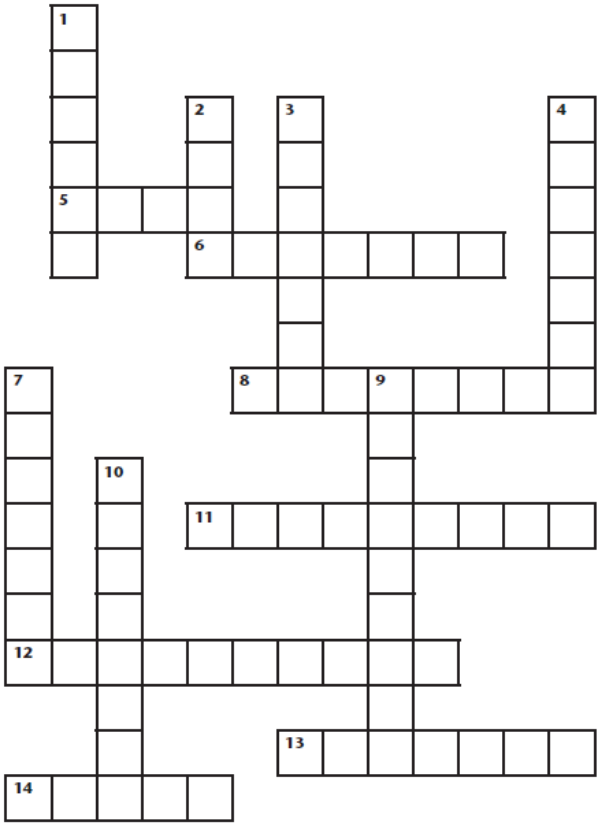
9 Something that will not let electricity flow through it is an _____.

10 The _____ is a way of saying how difficult it is for electricity to flow.

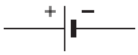
C	E	L	L	E	B	T	U	L	P	I	K	C
O	Q	A	W	R	U	Y	U	I	O	N	J	I
N	D	S	A	D	L	O	R	W	E	S	H	R
D	W	Q	B	V	B	K	T	M	D	U	B	C
U	V	G	A	C	W	M	Y	E	C	L	N	U
C	O	M	P	O	N	E	N	T	S	A	M	I
T	B	E	L	K	J	H	G	A	Y	T	F	T
O	H	X	D	C	S	D	F	L	H	O	D	H
R	Y	A	M	M	E	T	E	R	E	R	E	V
Z	E	U	A	S	D	F	G	H	J	K	W	T
A	S	W	I	T	C	H	E	R	T	J	S	R
Q	W	J	R	E	S	I	S	T	A	N	C	E

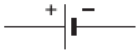
CROSSWORD

Fill in the crossword using the clues below.



Across

5  is the symbol for a _____.

6 A _____ is two or more of these  put together.

8 A _____ can be used to reduce the current in a circuit.

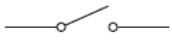
11 Something that will let electricity flow through it is a _____.

12 Bulbs, cells and switches are all circuit _____.

13 A complete _____ is needed for a bulb to light up.

14 Wires are made of _____.

Down

1  is the symbol for a _____.

2  is the symbol for a _____

3 You can increase the _____ by using more cells.

4 You measure current by putting an _____ into the circuit.

7 Wires are usually covered in _____.

9 Something that will not let electricity flow through it is an _____.

10 The thin wire inside a bulb is called the _____.

2: Electrical Current

textbook page ref: 136 - 139

Aims:

- To be able to use an ammeter to measure the current in a circuit
- To know that resistance is a measure of how hard it is for current to flow through something
- To be able to describe some ways to change the current in a circuit
- To be able to explain what a fuse does and how to choose a fuse

Notes:

LAB: Current in Wires

How much current will flow through different lengths of wire?

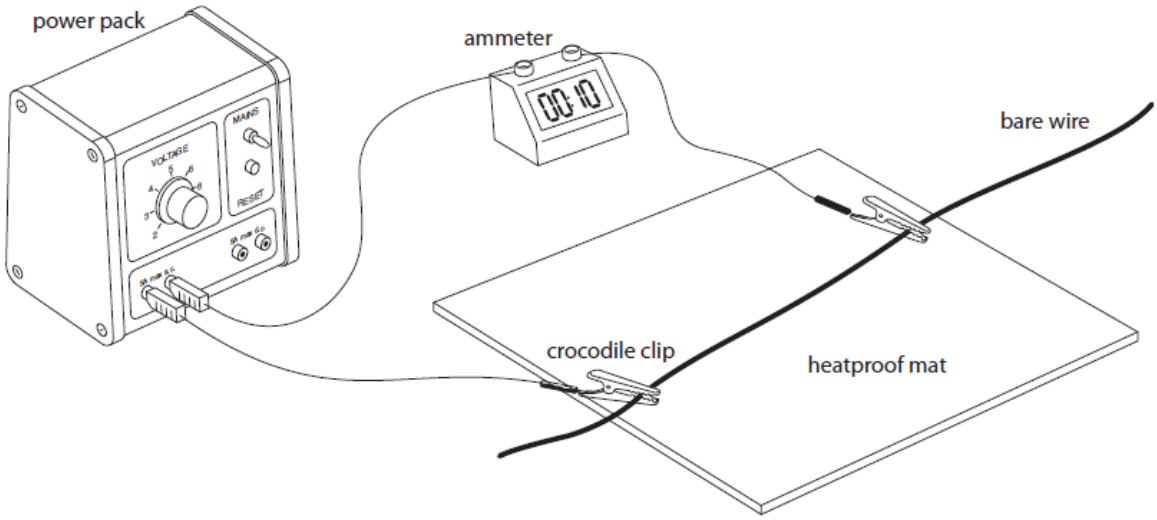
Prediction

I think that _____ (more/less) current will flow through short wires than long wires. It is easier for current to flow through _____ (short/long) wires.

Apparatus

- 1 metre of wire
- power pack
- crocodile clips
- heatproof mat
- connecting wires
- ammeter
- metre rule

The wire can get hot. Take care not to burn your fingers.



Method

A Set up the circuit as shown in the drawing.

B Clip the crocodile clips onto the wire 10 cm apart.

C Show your circuit to your teacher before switching on.

D Switch on and read the ammeter. Write the current in the table. Switch off again.

E Move the crocodile clips until they are 20 cm apart, and repeat step **D**.

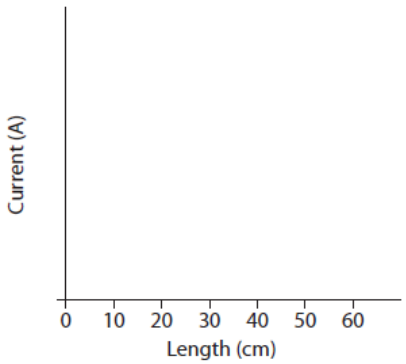
F Keep moving the crocodile clips 10 cm further apart and measuring the current until you have completed the table.

Recording your results

1 Record your results in the table below.

Length of wire (cm)	Current (A)
10	
20	
30	
40	
50	
60	

2 Plot a graph of your results on graph paper. Your axes should look like this:



Considering your results/conclusion

3 I have found out that when the wire is _____ (longer/shorter) the current is _____ (bigger/smaller). This is because it is _____ (easier/more difficult) for current to get through a long wire.

Evaluation

4 Was your experiment a fair test? Explain your answer.

_____

_____

5 Is there any way you could have done your investigation more accurately?

_____

_____

6 Explain how you could improve your investigation.

_____

_____

GRAPH

LAB: Melting Fuses

How much current do you need to melt fuse wire?

Prediction

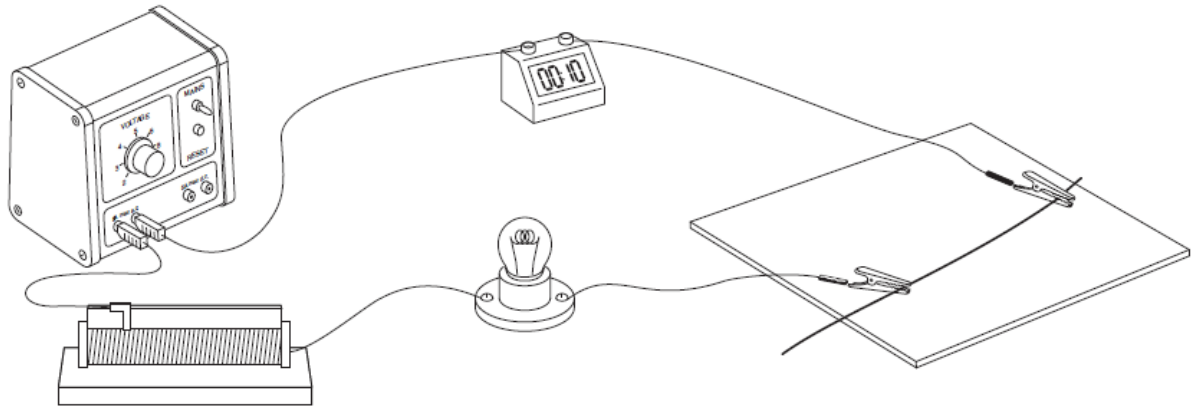
I think that _____ (thin/thick) fuse wire will melt at a lower current than _____ (thin/thick) fuse wire.

Apparatus

- power pack
- ammeter
- bulb
- variable resistor
- connecting wires
- crocodile clips
- heatproof mat
- thick and thin fuse wires

⚠ The wires will get hot and a fuse wire may spark. Take care not to burn your fingers. Wear eye protection.

Method



A Set up the circuit as shown in the drawing, using the thin wire.

B Clip the crocodile clips onto the wire 10 cm apart. Rest the wire on the heatproof mat.

C Make sure the variable resistor is set to give the smallest current. Show your circuit to your teacher before switching on.

D Slowly move the slider on the variable resistor, and watch the fuse wire. When you see it begin to glow, read the ammeter.

E Move the slider very carefully, until the fuse wire melts. Try to see what the ammeter reading was just before it melted. Write the current in the table.

F Switch off. Repeat steps **B** to **E** for the thick piece of wire.

Recording your results

1 Record your results in the table below.

Wire	Current to melt wire (A)
thin	
thick	

Considering your results/conclusion

2 I have found out that a _____ (thin/thick) wire melts at a lower current than a _____ (thin/thick) wire.

Evaluation

3 Was your investigation a fair test? Explain your answer.

_____

_____

_____

4 Is there any way you could have done your investigation more accurately?

_____

_____

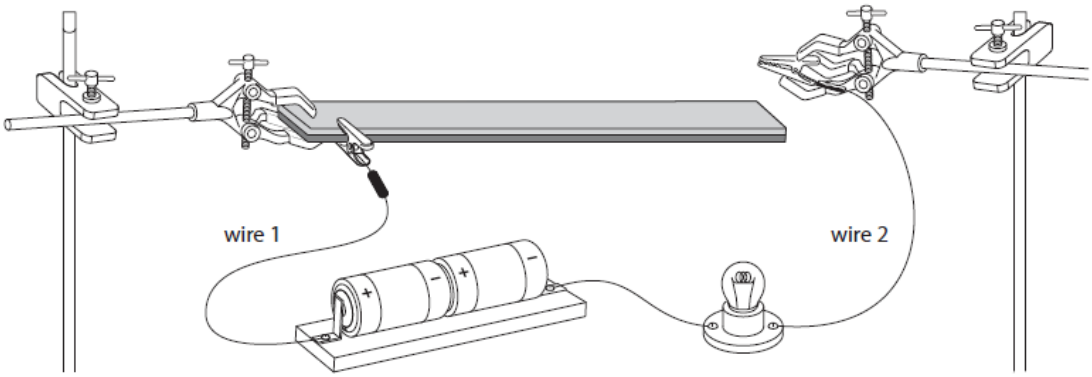
_____

LAB: Build a Fire Alarm

Apparatus

- cells or power pack
- connecting wires
- bimetallic strip
- 2 clamps and stands
- crocodile clips
- emery paper
- bulb
- Bunsen burner

Sparks may come from the switch.



Method

A Build your fire alarm:

- Use the emery paper to clean each end of the bimetallic strip.
- Put the strip into a clamp.
- Connect the wires and bulb as shown in the drawing.
- Move the other clamp so that the crocodile clip on the end of wire 2 is close to (but not touching) the bimetallic strip.

B Gently heat the bimetallic strip. Keep the wires away from the flame. If the bimetallic strip bends away from wire 2, turn it upside down and try again.

1 Why did you need to clean the bimetallic strip?

2 How could you adjust your fire alarm so that the light came on sooner?

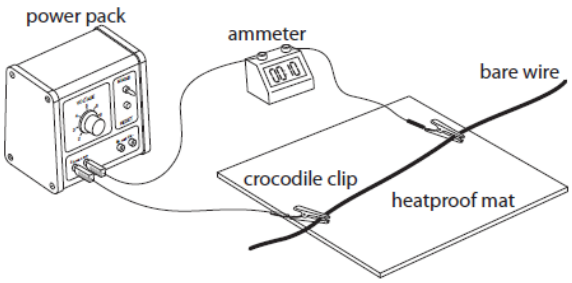
3 How could you change your circuit so that the bulb was on, and went off when the bimetallic strip got hot?

4 Describe in your own words how the fire alarm works.

EXTENSION WORK – Resistance of Wires

Jill set up this circuit. She measured the current in the circuit for different pieces of wire. Each wire was the same thickness, and was made of the same kind of metal. The wires were different lengths. She kept the power pack set on the same voltage each time. The table shows her results.

Length of wire (cm)	Current (A)		
	First test	Second test	Third test
20	0.73	0.78	0.74
40	0.59	0.60	0.63
60	0.46	0.43	0.56
80	0.28	0.31	0.31
100	0.16	0.17	0.13



1 **a** Look at the table of Jill's results. Which result may be a mistake?

b Explain why you chose this result.

c Calculate the average current for each length of wire. Ignore the incorrect result that you identified in part **a**.

d Draw a line graph to show Jill's results. Plot the length of wire on the horizontal axis, and the average current on the vertical axis.

2 Look at the statements below.

a Which one is not a correct conclusion for Jill's investigation?

b Which of these is the best conclusion? Explain your answer.

A The current is biggest when the wire is shortest.

B The longer the wire, the lower the resistance.

C The shorter the wire, the higher the current.

D The longer the wire, the lower the current. This means that the longer the wire, the higher the resistance.

3 **a** Which factor or factors did Jill change in her investigation?

b Which factors did she keep the same?

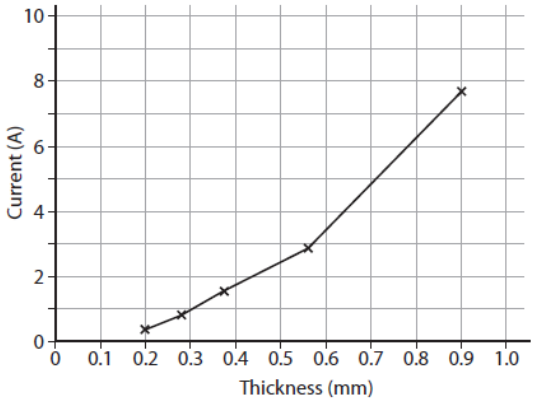
c Was Jill's test fair? Explain your answer.

4 This graph shows the results of Asif's investigation.

a What was Asif investigating?

b Which factors should he have kept the same to make his test fair?

c Write a conclusion for Asif's investigation.



3: Using Models

textbook page ref: 140 - 141

Aims:

- To be able to describe a current as a flow of electrons that transfer energy from the cell to the components in a circuit
- To be able to use a model to help think about electricity

Notes:

Notes:

7Jb(6) Appliances wordsearch

Name _____ Class _____ Date _____

The wordsearch includes the names of 15 things around the home that use electricity.

Find the words, and write them under the wordsearch. Put all the things that use electricity to produce heat in one column, and put the other things in the second column.

7 J b

F	V	B	V	I	D	E	O	N	E	X	V	B	C	P	C
M	F	R	L	A	F	K	O	E	V	Q	Y	I	O	L	D
I	V	W	A	B	C	D	K	E	T	T	L	E	M	S	P
C	R	T	E	D	H	U	F	K	O	E	B	M	P	V	L
R	G	O	H	J	I	V	U	I	W	B	S	N	U	U	A
O	F	A	N	L	R	O	L	M	I	Y	E	T	T	T	Y
W	A	S	H	I	N	G	M	A	C	H	I	N	E	W	E
A	L	T	M	G	E	U	L	F	R	L	V	N	R	W	R
V	G	E	V	H	I	L	C	O	O	K	E	R	G	U	D
E	S	R	C	T	V	N	E	Q	P	O	O	A	W	I	T
O	W	H	J	S	K	O	E	B	U	T	V	D	N	N	Y
V	B	J	K	L	T	U	M	B	L	E	D	R	Y	E	R
E	E	T	E	L	E	V	I	S	I	O	N	P	O	M	R
N	Y	Q	C	D	V	D	P	L	A	Y	E	R	E	R	E

Things which produce heat

_____

_____

_____

_____

_____

_____

_____

_____

Things which do not produce heat

_____

_____

_____

_____

_____

_____

_____

_____

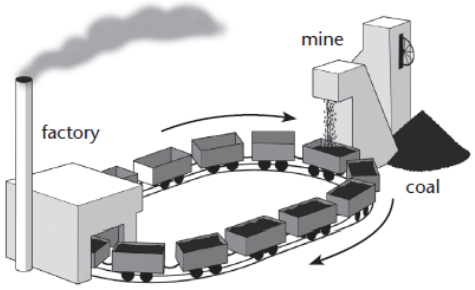
I CAN... • recall which appliances produce heat using electricity.

7Jc(3) Thinking about electricity 1

H S W

Name _____ Class _____ Date _____

The drawing shows a model that can help you to think about electricity.



1 Match up the parts of the model with the parts of a circuit that they represent.

Model	*Circuit*
the coal mine	the electrons moving through the wires
the wagons	the energy transferred by the current
the coal	a bulb or motor
the factory	the cell

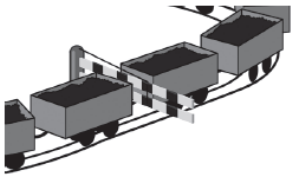
2 a Does the model show that the electrons are not used up as they flow around a circuit? yes/no
If you answered yes, explain how the model shows this.

_____

b Does the model show how the electrons are pushed around the circuit? yes/no
If you answered yes, explain how the model shows this.

_____

3 The model is changed so there is a gate across the track, like this.



a What will happen to the wagons when the gate is closed?

_____

b What circuit component does the gate represent? _____

c Explain your answer to part **b**.

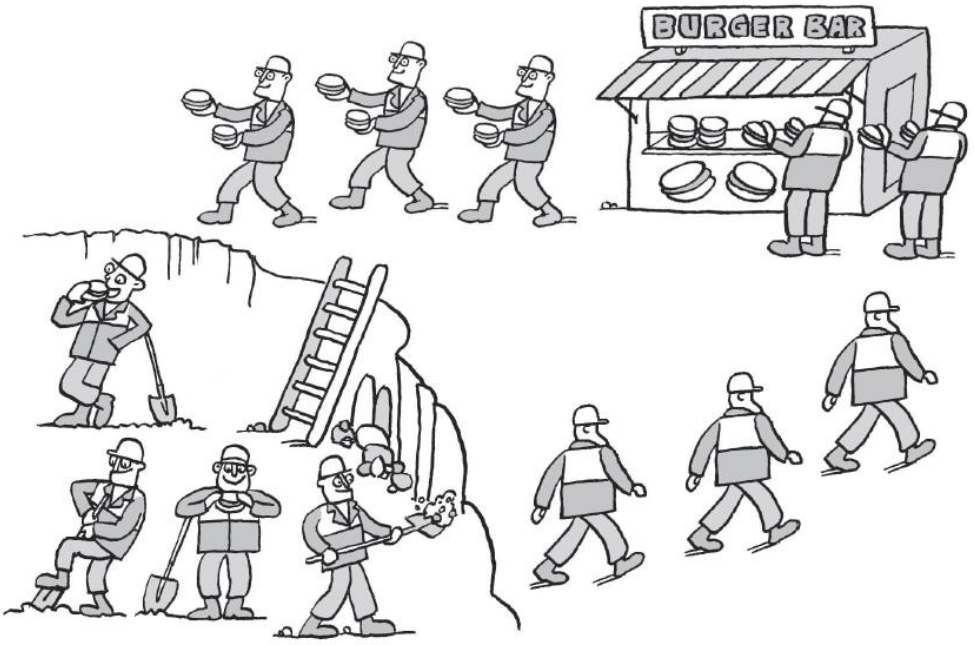
_____

I CAN... • use a model to help me to think about electricity.

7Jc(4) Thinking about electricity 2

H S W

The drawing shows a model that can help you to think about electricity.



7 J c

1 What do the following parts of the model represent?

a the burger bar

b the burgers

c the people carrying the burgers

d the people digging the hole

2 **a** Does the model show that the electrons are not used up as they flow around a circuit?

b Explain your answer.

3 **a** Does the model show how the electrons are pushed around the circuit?

b Explain your answer.

4 How could you change the model to represent a switch? Explain your answer.

5 How could you change the model to show a circuit with a higher resistance? Explain your answer.

6 **a** What are the strengths of this model (which parts of a circuit does it represent well)?

b What are the weaknesses?

I CAN... • use a model to help me to think about electricity • evaluate how good a model is.

4: Series and Parallel Circuits

textbook page ref: 142 - 143

Aims:

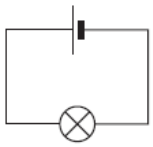
- To be able to describe what series and parallel circuit are
- To be able to explain what happens to the current in a parallel circuit
- To be able to describe how to use switches to control parts of a circuit
- To describe how houses are wired.

Notes:

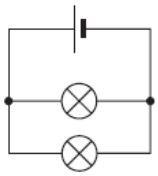
LAB – Parallel Circuits

Build each circuit, and answer the questions.

A Bright bulbs



The bulb is _____ (bright/dim).

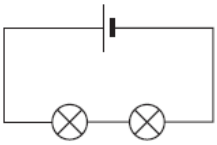


The bulb is _____ (brighter than/the same as/dimmer than) before.

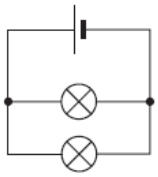
When I add bulbs in parallel the bulbs _____ (stay bright/get dimmer).

In a series circuit, the bulbs get _____ (brighter/dimmer) when more are added.

B Missing bulbs



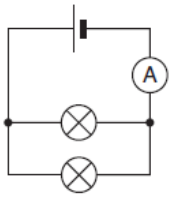
This is a series circuit. If I take out one bulb it leaves a gap in the circuit. The other bulb _____ (goes off/stays on).



This is a parallel circuit. If I take out one bulb the other bulb _____ (goes off/stays on). There is still a complete circuit for the current to flow around through the other bulb.

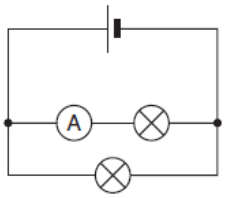
C Current

1



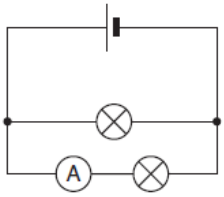
current = _____ amps

2



current = _____ amps

3



current = _____ amps

current (2) + current (3) = _____ amps

The current in the main part of the circuit is _____ (the same as/much bigger than/much smaller than) the current in the two branches added together.

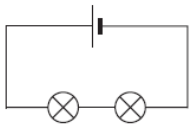
7Jd(4) Spot the differences

Name _____ Class _____ Date _____

You may not be able to answer all these questions when you first use the sheet, but give the best answers that you can. You will have a chance to change your answers later!

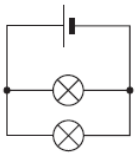
This is a series circuit.

A



This kind of circuit is called a parallel circuit.

B



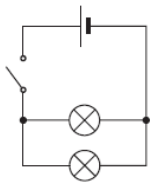
1 What are the differences between the series circuit and the parallel circuit?

_____

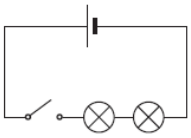
_____

These drawings show series and parallel circuits with switches in them.

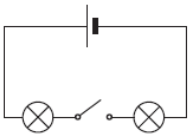
C



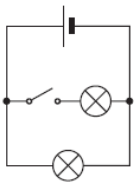
D



E



F



2 Write the letters for circuits C to F in the table.

Series circuits	Parallel circuits

3 What is the difference between:

a circuits C and D

_____

b circuits D and E

_____

c circuits C and F?

_____

4 Which bulbs will be on in each circuit when the switches are open?

circuit C _____ circuit D _____

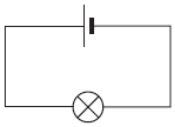
circuit E _____ circuit F _____

I CAN... • interpret circuit diagrams.

7Jd(6) Parallel circuit questions

Name _____ Class _____ Date _____

1 Draw another bulb and wires to make this circuit into a circuit with two bulbs arranged in parallel.

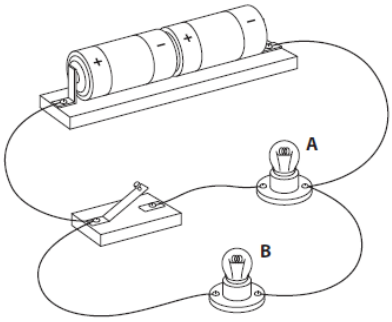


2 Fill in the gaps in this table. Use words from the box.

	Series circuit	Parallel circuit
When you add more bulbs, they all ...		
If one bulb breaks, the others ...		

go off stay the same get dimmer stay on

3 Draw a neat circuit diagram in the box to show this circuit:



4 Look at the picture of a circuit in question **3**.

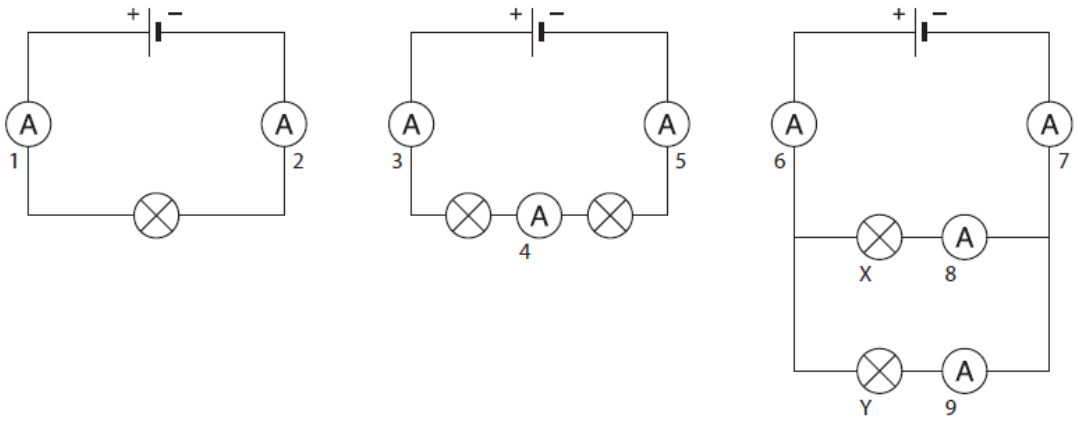
a If the switch is open (like it is in the picture) which bulbs will be on? _____

b If the switch is closed which bulbs will be on? _____

I CAN...
- recall the differences between series and parallel circuits
- explain how switches can control parallel circuits.

SERIES AND PARALLEL - QUESTIONS

Look at these circuit diagrams, then answer the questions. Explain your answers to all questions. The cells and the bulbs are the same in all three circuits.



Circuit A. *Circuit B.* *Circuit C.*

1 Is circuit B or C a parallel circuit?

2 If ammeter 1 reads 2 A, what will ammeter 2 read?

3 What would the current be in circuit A if you added another cell?

4 **a** How bright would the bulbs in circuit B look, compared to the bulb in circuit A?

b The current in circuit A is 1 A. What does ammeter 3 in circuit B read?

c What would ammeters 4 and 5 read?

5 How bright would the bulbs in circuit C look compared to the bulbs in circuit B?

6 Ammeter 6 reads 0.8 A.

a What does ammeter 7 read?

b What does ammeter 8 read?

c What does ammeter 9 read?

d Another cell is added to circuit C. What does each ammeter now read?

7 **a** Copy circuit C, and add a switch that will switch bulb X on and off, but will not affect the other bulb.

b Make another copy of circuit C, and add a switch that will turn both bulbs on and off together.

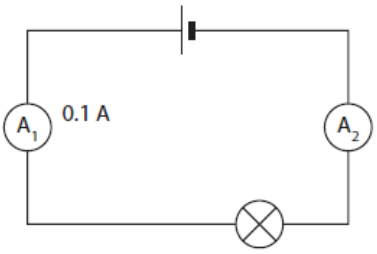
SERIES AND PARALLEL CIRCUITS

1 a Is this a series or parallel circuit? _____

b How many bulbs are there? _____

c How many ammeters are there? _____

d What will ammeter A_2 read? _____

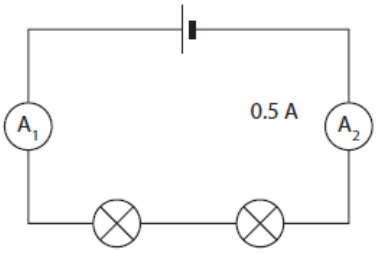


2 a Is this a series or parallel circuit? _____

b How many bulbs are there? _____

c How many ammeters are there? _____

d What will ammeter A_1 read? _____



3 a Is this a series or parallel circuit? _____

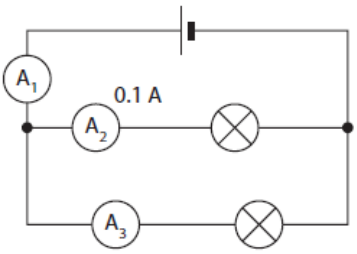
b How many bulbs are there? _____

c How many ammeters are there? _____

d What will ammeter A_1 read?

Tick the correct answer.

☐ 0.2 A ☐ 10 A ☐ 5 A

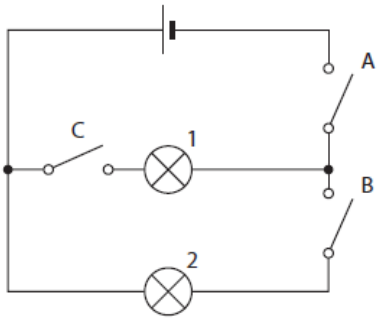


4 Look at the circuit on the right and then complete the sentences.

Switches _____ and

_____ must be closed

to make bulb 1 light up.



5: Electricity and You

textbook page ref: 144 - 145

Aims:

- To be able to recall that nerves carry electrical impulses around the body
- To be able to describe way in which electricity can help or harm the body

Notes:

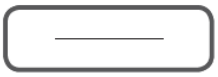
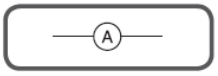
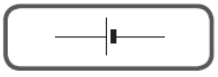
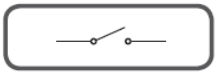
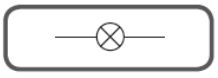
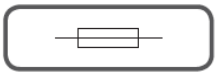
Notes:

7Je(3) Electricity revision 1

Name _____ Class _____ Date _____

7 J e

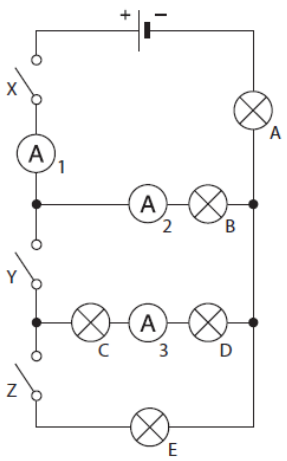
1 Join the boxes to show the symbol for each component, and what each one does.

ammeter		melts if the current is too high
cell		makes or closes a gap in the circuit
bulb		gives out light if an electric current flows through it
fuse		makes electricity flow around a circuit
switch		conducts electricity around a circuit
wire		measures the size of the current

2 **a** How many bulbs are there in this circuit?

_____

b How many bulbs are lit with the switches as they are shown in the drawing? _____



3 Sam presses switch X.

a Which bulbs will come on?

_____

b Ammeter 1 reads 1 A. What will ammeter 2 read? _____

4 Sam presses switch X and switch Y.

a Which bulbs will come on?

_____

b Ammeter 2 reads 1 A and ammeter 3 reads 0.5 A. What will ammeter 1 read? _____

5 Sam presses switches X and Z.

a Which bulbs will come on? _____

b Explain your answer to part **a**. _____

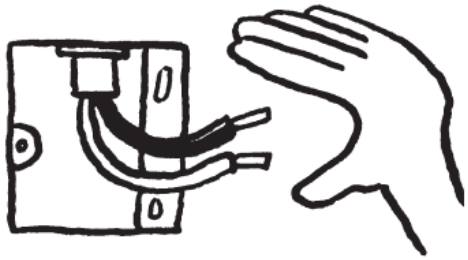
_____

I CAN... • recall important facts about electricity and circuits.

EXTENSION WORK – SHOCKING

Electric shocks from mains electricity can be fatal. Electric shocks can burn you, and they also affect the nerves in your body. The effect of the shock depends on how much current flows through your body, and the route it takes.

This person will receive a bad shock if he touches the wires. His body will complete the circuit between the two wires, and a current will flow through his hand. The shock will burn his hand, and it may make the muscles in his hand contract and grip the wire. The current will continue to flow through his hand until a fuse blows or someone switches the power off. However, the current will probably not kill him because it is not going through his heart.



If the man touches one wire with his hand, a current will flow through his body to the ground. There is a large difference in voltage between the wire (usually at about 230V) and the ground (0V), so a current will flow. The current will affect the nerves in his heart and chest. This shock is more likely to be fatal, because it could stop his heart or lungs working.

These birds are sitting on a high voltage wire. They do not get electric shocks because there is hardly any difference in voltage between their two feet. Current only flows when there is a difference in voltage between two places.

1 How can electricity harm the body?

2 If it is the current that causes damage, why do dangerous places have signs warning you of the high voltage? (*Hint*: what is the connection between current and voltage?)

3 If the man in the second picture had been wearing shoes with rubber soles, he might not have received a shock. Explain why.

4 Why is it dangerous to touch someone who is receiving an electric shock?

5 Who is more likely to be hurt; a bird sitting on electricity wires or a boy flying a kite near the wires? Explain your answer.

6 Find out what you should do if you find someone who has had an electric shock.

7J AT1 Investigation

Length of wire and resistance (Exploring 1 in Topic 7Jb)

Level	Planning	Obtaining and presenting	Considering	Evaluating
Working towards level 4	Pupils decide on any **simple method** to compare current with different components in the circuit *(e.g. how the brightness of bulbs varies when more bulbs are added).*	Relevant observations made *(e.g. brightness or current).* **Results recorded** in a simple table.	Simple description of what was found *(e.g. 'when I added more bulbs, they got dimmer').*	A **simple suggestion** as to how to improve the practical *(e.g. 'I could try it with more bulbs next time').*
4	Pupils **decide on an appropriate approach** *(e.g. decide to measure the current with different numbers of bulbs in the circuit).* They **use a fair test** *(e.g. 'the voltage setting can affect the current, so I need to keep that the same each time').* They **select suitable** equipment and information from that provided *(e.g. power pack/cells, length of wire, ammeter, connecting wires).*	They **select and use methods that are adequate** for the task *(e.g. current recorded when more bulbs are added, or when a longer length of wire is used).* Following instructions, they take action to control **obvious risks** to themselves *(e.g. not touching hot wires).* They make a **series of observations** and measurements and **vary one factor** while keeping others the same *(e.g. voltage setting kept the same).* They **record** their observations, comparisons and measurements using tables and bar charts *(if different numbers of bulbs used)* and **begin to** plot points to form **simple graphs** *(if different lengths of wire used).*	They **begin to relate their conclusions** to patterns in data, including graphs, and to scientific knowledge and understanding *(e.g. 'it is more difficult for the electric current to get through more bulbs/wire, so the current is less').* They **communicate** their conclusions using appropriate scientific language *(e.g. they use the words current and/or resistance correctly).*	They **suggest improvements** in their work, **giving reasons** *(e.g. 'I could try it with more bulbs next time and so get more results. This would make the pattern clearer').*
5	Pupils **decide on an appropriate approach** *(e.g. they identify length of wire, voltage setting and type of wire as key factors, and plan to vary only the length of wire).* They **select apparatus** *(e.g. they decide to use an ammeter to measure the current with different lengths of wire in the circuit).*	They **select and use methods that obtain data systematically** *(e.g. length of wire recorded to nearest cm, at least five different lengths of wire used).* They **recognise hazard symbols** and make, and **act on**, simple suggestions to **control risks to others as well as themselves** *(e.g. by not leaving the current on too long each time and so preventing the wire getting too hot).* They use line graphs to present data.	They **interpret** numerical data and draw conclusions from them *(e.g. 'the current goes down as the length of the wire goes up, so the longer the wire, the higher the resistance').* They **analyse findings** to draw **scientific conclusions** that are **consistent** with the **evidence** *(e.g. 'a longer wire has a bigger resistance, so less current can get through').* They communicate these using **scientific and mathematical** conventions and terminology.	They evaluate their working methods to **make practical suggestions for improvements** *(e.g. 'the wire got hot when I left the current switched on for a long time, and this may have affected my results. I should make sure that the current is only switched on for a short time for each length of wire').*

7J Level Ladder

Name _____ Class _____ Date _____

My Target Level is: ☐ **My final level is:** ☐

Tick the boxes that apply. Or use traffic lights to show how confident you are (red = 'I don't know this'; orange = 'I'm not very confident about this'; green = 'I'm confident I know this').

Level	At the end of the Unit:	I can do this	This needs more work
Working towards Level 4			
HSW	Describe some uses of electricity.	☐	☐
HSW	Describe what happens in simple circuits.	☐	☐
	Recall some materials that let electricity through them.	☐	☐
Level 4			
HSW	Use a model to describe an electric circuit.	☐	☐
HSW	State some examples of useful circuits.	☐	☐
HSW	Construct simple electrical circuits.	☐	☐
HSW	Identify patterns and trends in data.	☐	☐
HSW	Use electricity safely.	☐	☐
	Recall why fuses are used.	☐	☐
	List some dangers of electricity.	☐	☐
Level 5			
HSW	Describe some of the technological developments made possible by electricity.	☐	☐
HSW	Tell others about your ideas on how to stay safe when doing investigations with electricity.	☐	☐
HSW	Draw conclusions about what happens in different circuits.	☐	☐
HSW	Draw circuit diagrams using standard symbols.	☐	☐
	Recall that current is the same everywhere in a series circuit.	☐	☐
	Describe the effect of adding more bulbs to a series circuit.	☐	☐
	Describe the effect of adding more bulbs to a parallel circuit.	☐	☐
Level 6			
HSW	Use a model to show the difference between current and energy transfer in a circuit.	☐	☐

7J Level Ladder (continued)

Name _____ Class _____ Date _____

7J

Level	At the end of the Unit:	I can do this	This needs more work
HSW	Measure current accurately.	☐	☐
	Explain how fuses work.	☐	☐
	Describe how the current divides between the branches in a parallel circuit.	☐	☐
	Explain the advantages of series and parallel circuits.	☐	☐
	Explain how electrical current is a way of carrying energy and how that energy is transferred.	☐	☐
	Explain what resistance is.	☐	☐
Level 7			
HSW	Explain how scientific ideas about electricity have changed.	☐	☐
HSW	Wire a plug correctly.	☐	☐
HSW	Explain the strengths and weaknesses of some of the models used to explain electricity.	☐	☐
HSW	Explain the hazards of electricity and how the risks of using it are identified and controlled as part of an investigation plan.	☐	☐
	Predict what the currents will be in different parts of series and parallel circuits.	☐	☐
	Apply the idea that nerves are electrical conductors to explain the dangers of electricity.	☐	☐

7J Summary Sheets

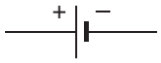
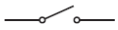
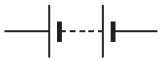
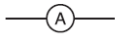
Electrical circuits

Electricity is a flow of **electrons**. Electricity can flow through **conductors** but not through **insulators**. Metals are good conductors of electricity. Plastics are good insulators.

Cells and power packs provide safe, low-voltage electricity. Most appliances use **mains electricity**. This can be dangerous if it is not used properly.

A complete **circuit** is needed for electricity to flow.

We use symbols when we draw circuits:

Component	Symbol	Component	Symbol
cell		switch	
battery of cells		fuse	
bulb		ammeter	

The **current** is the amount of electricity flowing in the circuit. The unit for current is the **amp** (**A**). Current is measured using an **ammeter**.

The **resistance** of a circuit is a way of saying how easy or difficult it is for electricity to flow.

- high resistance = hard for electricity to flow = small current
- low resistance = easy for electricity to flow = large current

Thin wires and resistors have high resistances. Thick wires have low resistances.

7J Summary Sheets (continued)

Electricity and heat

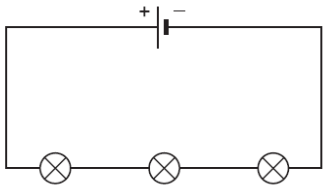
When electricity flows through a wire, the wire can get hot. Hot wires are used in electric fires, irons and cookers.

A **fuse** is a thin piece of wire that melts if too much electricity flows through it. It is used for safety.

Models

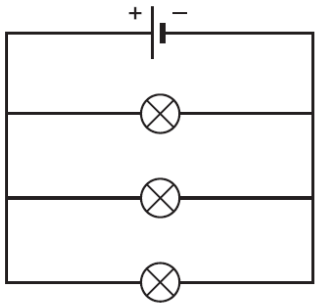
We can use models to help us to think about electricity and circuits. One model for a circuit is a central heating system. The boiler and pump represent the cell, the pipes represent the wires, and the radiators represent bulbs.

Circuits can be **series** or **parallel circuits**.



SERIES CIRCUIT

- If one bulb breaks, all the others go off.
- The current is the same everywhere.
- If you put more bulbs in they will be dimmer, because it is harder for the electricity to get through. The resistance of the circuit is higher.



PARALLEL CIRCUIT

- If one bulb breaks, the bulbs in the other branches stay on.
- The current splits up when it comes to a branch. The current in all the branches adds up to the current in the main part of a circuit.
- If you add more bulbs, they stay bright. It is easier for the current to flow with more branches, because there are more ways for the electrons to go.

Electricity and your body

Electrical signals in your body travel along nerves. If an electric current passes through your body you may get an electric shock. This could burn you, or stop your heart or lungs working.

Electricity can be used to help the body. A pacemaker is used to help people whose hearts do not work properly. A defibrillator can be used to start someone's heart if it has stopped beating.

7J Quick Quiz 2

On your answer sheet, write in or circle the correct letter for each question.

7Ja

1 Which of these statements is true?
- **A** Metals are conductors because they let electricity flow through them.
- **B** Plastic is an insulator because it lets electricity flow through it.
- **C** Plastic is a conductor because it lets electricity flow through it.
- **D** Metals are insulators because they let electricity flow through them.

2 Which of these is *not* a good rule for using electricity safely?
- **A** Plug as many things as you can into each socket.
- **B** Turn off the power pack before you make any changes to your circuit.
- **C** Never use electrical appliances with wet hands.
- **D** Do not poke things into sockets.

3 Which instrument would you use to measure current?
- **A** a motor
- **B** a voltmeter
- **C** an ammeter
- **D** a cell

4 Resistance is a way of saying:
- **A** how many cells are in a circuit.
- **B** how many switches are in a circuit.
- **C** how much electricity is flowing.
- **D** how hard it is for electricity to flow.

7Jb

1 When electricity flows through wires:
- **A** they get cold.
- **B** nothing changes.
- **C** they get hot.
- **D** they melt.

2 A fuse is used to:
- **A** heat things.
- **B** make things move.
- **C** stop electricity flowing if something is wrong.
- **D** control the temperature of something.

3 A fuse is:
- **A** the part of a plug that sticks into a socket.
- **B** a metal strip that bends when it is hot.
- **C** a piece of wire that melts when it gets too hot.
- **D** a piece of plastic that does not let electricity through.

4 An electric heater has a current of 10 A flowing through it. Which fuse should be used?
- **A** 13 A
- **B** 5 A
- **C** 3 A
- **D** 30 A

7Jc

1 An electric current is:
- **A** a source of energy.
- **B** tiny particles called electrons flowing through the wires.
- **C** a kind of liquid inside the wires.
- **D** tiny particles called atoms flowing through the wires.

2 We need to use models to help us to think about electricity because:
- **A** electrons are imaginary
- **B** electricity is not real
- **C** it makes electricity more fun
- **D** electrons are too small to see

3 A central heating system can be used as a model for a circuit. Which of these statements is *not* true?
- **A** The radiators represent the bulbs.
- **B** The pump represents an ammeter.
- **C** The boiler and pump represent the cell.
- **D** The pipes represent the wires.

7J Quick Quiz 2 (continued)

4 An obstacle in a race represents:

A a high resistance, because it is easy for runners to get over it.

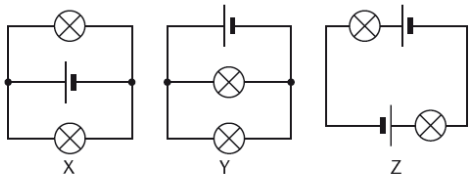
B a low resistance, because it is hard for runners to get over it.

C a high resistance, because it is hard for runners to get over it.

D a wire, because people move along the race track.

7Jd

1 Which of these circuits are parallel circuits?



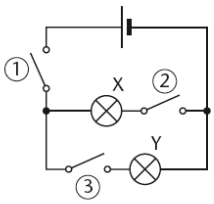
A X and Z only

B X and Y only

C all of them

D Y and Z only

2 Which switches must be pressed to make bulb X come on?



A 1 and 3 only

B 2 and 3 only

C 1 and 2 only

D all three of them

3 Parallel circuits are used for house lights:

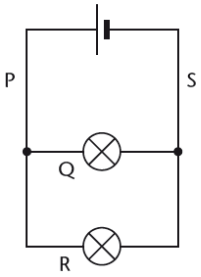
A so you know when one breaks, because all the others go off.

B so they can all be switched on and off together.

C so they can all be switched on and off separately.

D so they use a bigger current.

4 Which of these statements is not true?



A The currents at Q and R add up to give the current at S.

B The current is the same at Q and R.

C The current is the same at P and Q.

D The current is the same at P and S.

7Je

1 Messages are carried in our bodies by:

A bones.

B blood.

C skin.

D nerves.

2 If you touch electrical equipment with wet hands:

A you might damage the equipment.

B you might make the equipment dirty.

C you might get your hands dirty.

D you could get an electric shock.

3 What happens if a large electric current flows through your body?

A Nothing at all.

B It will improve your circulation.

C Your heart could stop working.

D Your eyeballs could explode.

4 What is a pacemaker?

A A machine to measure the length of your stride.

B A computer game.

C An electrical device that keeps the heart beating regularly.

D Someone who helps you run at the right speed in a race.