

Answer viewer (Student's Book)

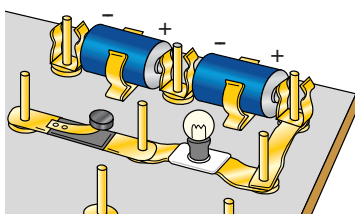
Contents

Unit 8 Making use of electricity

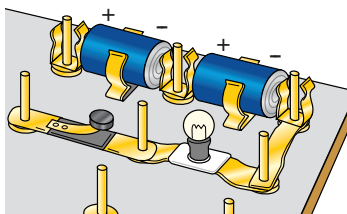
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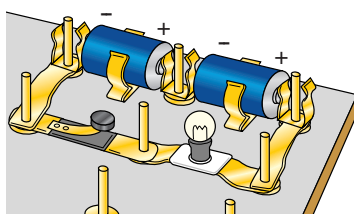
Winnie tries different connections. The following shows her trials.



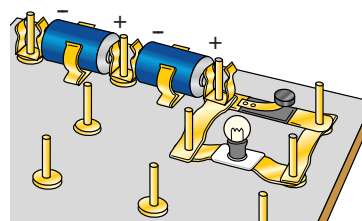
Trial A



Trial B



Trial C



Trial D

Question

In which trial do you think the bulb will light up?



Experiment Centre 8.1

Making a model table lamp

Apparatus and materials per group

circuit board	1	switch	1
electric cells	2	electric connectors	several
light bulb	1		

Let's do an experiment to test if your answer to the question in Activity Corner A is correct. This would help Winnie make the model table lamp.

- 1 Connect the components as shown in trial A on the top of this page.
- 2 Close the switch and observe if the bulb lights up.
- 3 Repeat steps 1 and 2 with trials B, C and D on the top of this page. Complete the following table.

	Trial A	Trial B	Trial C	Trial D
Does the bulb light up?				

...cont'd

Questions

- 1 What is the difference in set-up among trials A, B and C?

- 2 What is the difference in set-up between trials C and D?

A _____ path and an _____ source are needed for electricity to pass through.

Energy source

In the above experiment, the energy source is the electric cells. Electric cells store chemical energy. When they light up the bulb, **chemical energy changes into electrical energy**. One or more cells connected together make up a battery.

In our homes, we do not usually use electric cells to provide electrical energy, especially when the amount required is large. We get electrical energy from the sockets (插座) on the wall. These sockets are connected to the power stations of electric companies. In such a case, the power station is the energy source.



Fig 8.3 Electrical appliances in daily life need an energy source

Closed circuit and open circuit

How is energy carried from the energy source to the bulb? There are **electrons** (電子) flowing around that carry energy from the battery to the bulb. The flow of electrons needs a complete path. We call the path a **circuit** (電路).

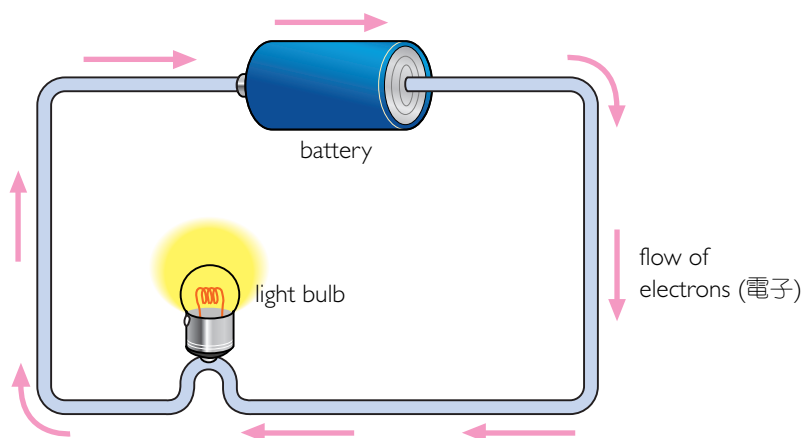


Fig 8.4 The flow of electrons needs a complete path and a source of electrical energy

Consider trials A and B in Activity Corner A. Electrons cannot flow around the circuit because it is incomplete. We call the incomplete circuit an **open circuit** (斷路).

For trial C, electrons can flow around the circuit when the switch is closed. The circuit is complete. We call the complete circuit a **closed circuit** (閉合電路).

For trial D, although the circuit is closed, it has no energy source (the electric cell). Therefore, they do not have an energy source and the bulb does not light up.

Conditions to light up a bulb:

- ▶ the circuit is _____ (a closed/an open) circuit
- ▶ the circuit has an _____

Conductors and insulators

A **conductor** (導體) is a material which allows electricity to flow through. An **insulator** (絕緣體) is a material which does not allow electricity to flow through. Do you know how electrons flow in conductors?



Extension Bk

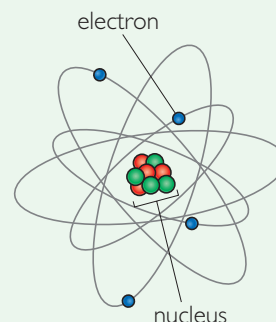
Go for more



Electrons in conductors

All matters are made up of atoms (原子). An atom consists of a nucleus and a number of electrons. The electrons move around the nucleus.

It means that there are electrons inside the conductors. How do these electrons conduct electricity? You can find this out from the library and the internet.





Experiment Centre 8.2

Identifying conductors and insulators

Apparatus and materials per group

circuit board	1	electric connectors	several
electric cells	2	wires with crocodile clips	2
light bulb	1		
test materials (nylon string (尼龍繩), copper wire, wooden ruler, plastic straw, iron pin (鐵針), glass rod)			

- 1 Design an experiment to test if the materials are conductors or insulators. Draw the experimental set-up in the following space.

- 2 Complete the following table to show your findings.

	Conductor	Insulator
Name of the materials		

- 3 What is the common feature of the conductors?

_____ are conductors of electricity.



Check-point 1

Consider trial C of the model table lamp in Activity Corner A and fill in the blanks.

- 1 When we open the switch, it is _____ (an open circuit/a closed circuit). Electrons _____ (can/cannot) flow through the circuit. No energy can be carried from the battery to the bulb.
- 2 When we close the switch, it is _____ (an open circuit/a closed circuit). Electrons _____ (can/cannot) flow through the circuit. Energy can be carried from the battery to the bulb.

8.2 Current, voltage and resistance

What to learn

- ▶ How does electricity flow?
- ▶ What are current, voltage and resistance?
- ▶ What are the factors that affect resistance?

Current

In a closed electric circuit, the electrons transfer energy from one place to another. The flow of electrons is called an **electric current** (電流).

Consider the circuit of the model table lamp. When the bulb lights up, it means there is a current in the circuit. If the current passing through the bulb is larger, the bulb is brighter. The unit of current is the **ampere (A)** (安培). We use an **ammeter** (安培計) to measure the current. When we measure current, the circuit must be broken to allow the ammeter to be part of it. The knob of black colour is connected near the negative pole of battery and the red near the positive.

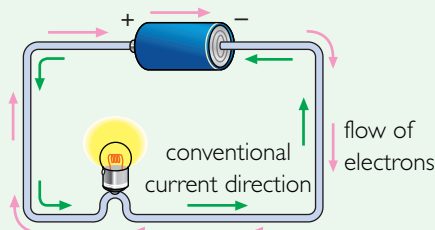


Fig 8.5 Ammeter

Do you know?



Scientists first thought that particles flow from positive pole of a cell to the negative pole. This is called the **conventional current direction** (傳統電流方向). However, in the early 20th century, it was found that electrons flow in the opposite direction. However, for practical purposes, the conventional current is still used.



In an electric circuit, electrons flow around. The connectors provide the path for the electrons to flow through. When the electrons pass through the battery, they get electrical energy. When they pass through the light bulb, they give energy to it and light it up. Then the electrons return to the battery to get energy again.

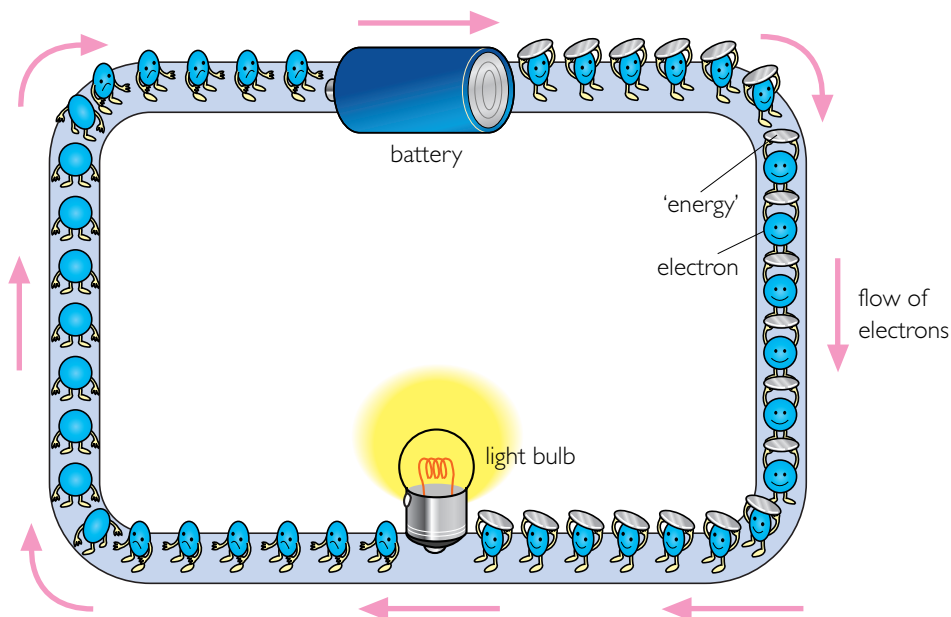


Fig 8.6 Electrons flowing around an electric circuit



Activity Corner B

Lorry model and electric circuit

Each component in the electric circuit is represented by one concept in the lorry model. Complete the following table. The first one has been done for you.

Electric circuit	Lorry model
Electrons	Lorry
Bulb	
Electric cell	
Electric connector	
Electrical energy	



Go for more



Analogy of electric circuit

There are other analogies for explaining the flow of electrons around a circuit, e.g. the 'water flow model'. Find out more about the 'water flow model' and state the features that represent electrons, bulb, electric cell, electric connector and electrical energy.

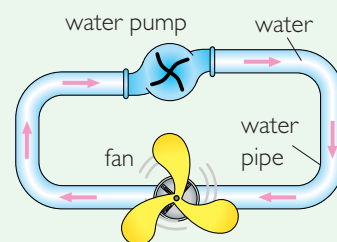


Fig 8.7 Water flow model



Experiment Centre 8.3

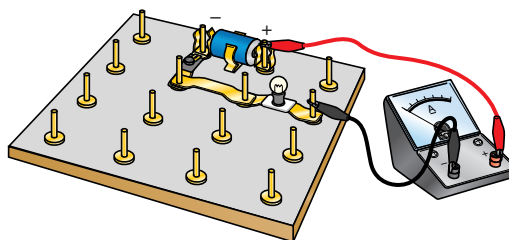
Measuring current

Apparatus and materials per group

circuit board	1	electric cells	3
ammeter	1	light bulb	1
electric connectors	several	switch	1

- 1 Connect the circuit as shown on the right. Make sure that the knobs of the ammeter are connected to the circuit properly.

Close the switch. What is the reading of the ammeter?



- 2 Repeat step 1 using two cells and three cells respectively. Complete the following table.

Number of cells	1	2	3
Reading of the ammeter			

- 3 What happens to the current when more cells are used?

Adding more cells to the circuit _____ (increases/reduces) the current.

Voltage

A battery supplies energy for the electrons to flow around the circuit.

The electrical energy given to the electrons is called **voltage** (電壓). The unit of voltage is the **volt (V)** (伏特). A 9 V battery supplies more energy to each electron than a 1.5 V battery.

The voltage of a source of electrical energy can be measured by a **voltmeter** (伏特計). There are knobs on the voltmeter to connect the battery to be measured. The knob of black colour is connected to the negative pole of the battery and the red to the positive.



Fig 8.8 Voltmeter



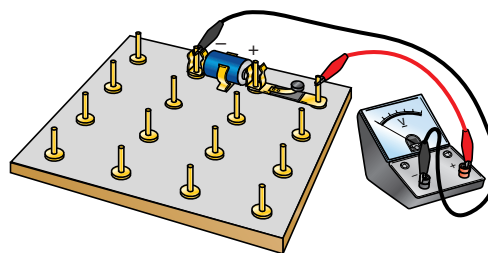
Experiment Centre 8.4

Measuring voltage

Apparatus and materials per group

circuit board		electric connectors	2
voltmeter		electric cells	3
switch			

- Connect an electric cell to a voltmeter as shown. Make sure that the knobs of the voltmeter are connected to the poles of the circuit properly.
Close the switch. What is the reading of the voltmeter?



- Repeat step 1 using two cells and three cells respectively. Complete the following table.

Number of cells	1	2	3
Reading of the voltmeter			

Adding more cells to the circuit _____ (increases/reduces) the voltage.

If a battery has a higher voltage, it delivers more energy to the electrons in the circuit.

Resistance

Metals are conductors of electricity. However, some metals conduct electricity better than others. The opposition of a conductor to current is called **resistance** (電阻). A good conductor has a low resistance and a poor conductor has a high resistance. The unit of resistance is the **ohm** (Ω)(歐姆).



Experiment Centre 8.5

Comparing resistance

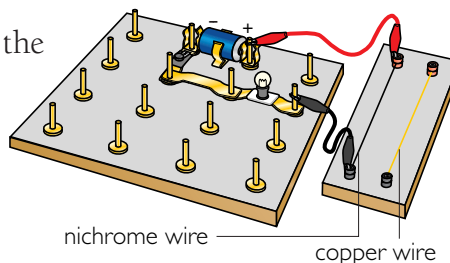
Apparatus and materials per group

circuit board		switch	
light bulb		electric connectors	several
electric cell		wooden board mounted with copper wire and nichrome wire	

- 1 Connect the nichrome wire in the circuit as shown on the right.
- 2 Close the switch. Observe the brightness of the bulb.
- 3 Repeat steps 1 and 2 with the copper wire.
- 4 **a** In which case is the bulb brighter?

- b** In which case is the current larger?

- 5 Which wire has a higher resistance?



Factors affecting resistance

Extension

In section 8.1, we learnt that metals are conductors. However, some metal wires conduct electricity better than others. If a wire has a lower resistance, it allows larger current to pass through.

What are the factors affecting the resistance of a metal wire?

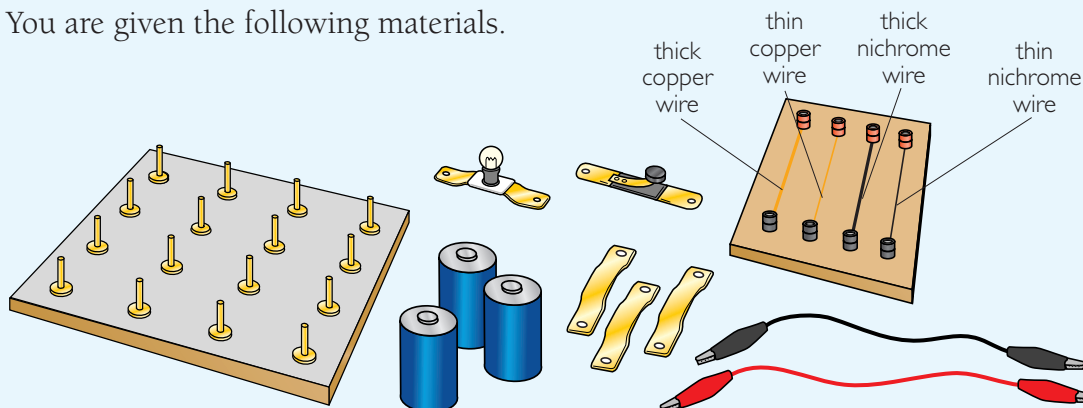


Experiment Centre 8.6

Extension

Investigating the factors affecting the resistance of a wire

You are given the following materials.



Find out what factors affect the resistance of a wire. Make sure your test is fair. Complete the investigation planner below:

Aim of investigation

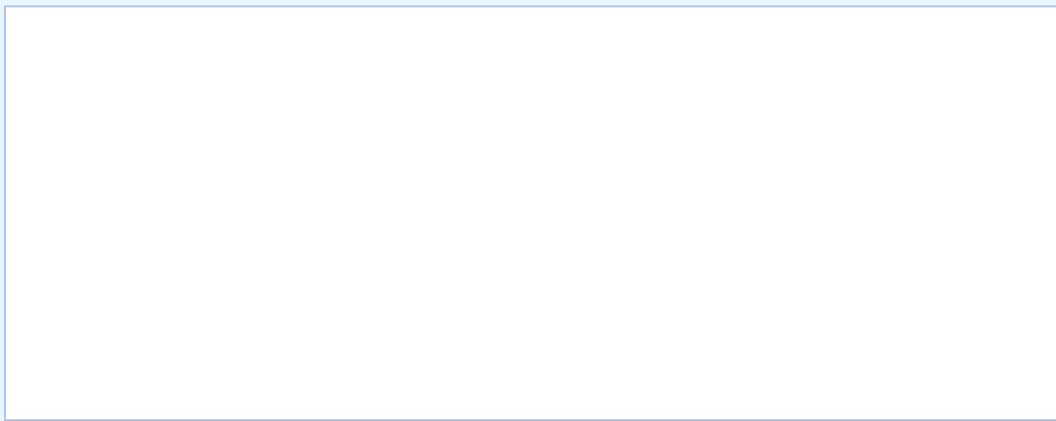
To find out _____

Apparatus and materials

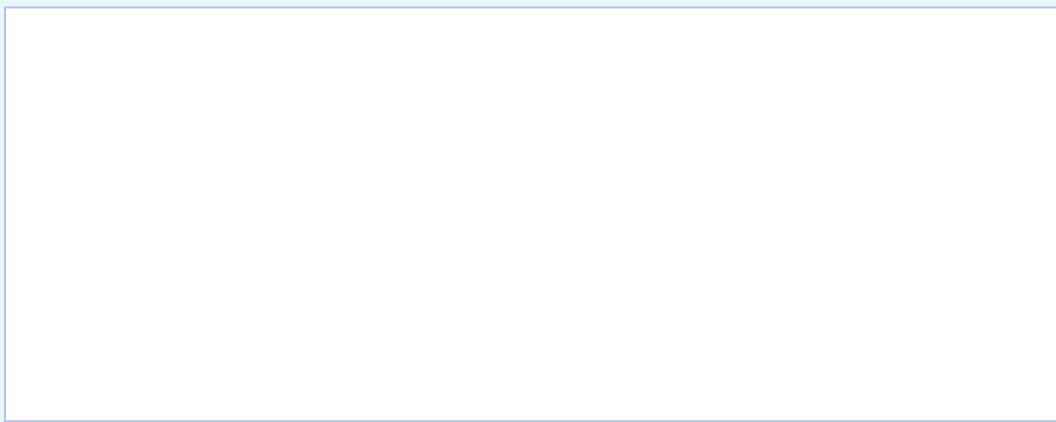
1 _____	4 _____
2 _____	5 _____
3 _____	6 _____

Method

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

A labelled drawing of the set-up**Safety precautions**

Show your plan to the teacher before you go on. Carry out your investigation after getting your teacher's permission. Record your results in the form of drawing in the space below:

Results**Conclusion**

The resistance of a wire depends on the material used. It also depends on its length and thickness. _____ (Thicker/Thinner) and _____ (longer/shorter) wire has a lower resistance.



Check – point 2

- 1 Using the lorry model, explain why the trials A, B and D in Activity Corner A (p.62) fail to light up the bulb.

Trial A: _____

Trial B: _____

Trial D: _____

- 2 Voltmeter and ammeter are very useful in studying electricity.

Connect the meters to the other electric components by drawing lines.

	How do you connect them?
Voltmeter	
Ammeter	

- 3 Fill in the following table.

	Unit	Unit in short form
Voltage		V
Current		A
Resistance	ohm	



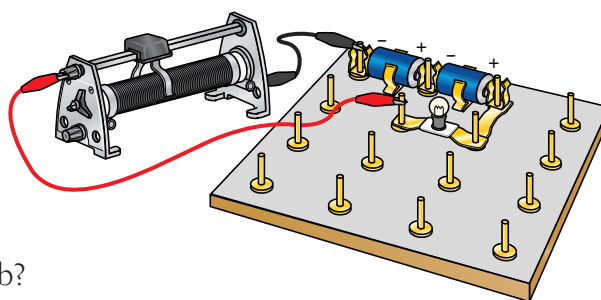
Experiment Centre 8.7

Using a rheostat to control current

Apparatus and materials per group

circuit board	1	rheostat	1
electric cells	2	light bulb	1
electric connectors	several		

- 1 Connect the circuit as shown on the right.
- 2 Slide the contact of the rheostat from one side to another.
 - a What happens to the brightness of the bulb?



- b Explain your answer in a.

By moving the sliding contact, we change the _____ of the rheostat. _____ resistance allows larger current to pass through and vice versa. Thus the _____ passing through the bulb also changes. _____ current makes the bulb brighter.

From the above experiment, we learnt that the rheostat can control the size of current passing through a circuit. In daily life, a rheostat can be put to different uses. One example is the **dimmer switch** (光暗調節器). It uses rheostat to control the brightness of lamps. Another example is the **volume controller** (音量控制器). It uses a rheostat to control the volume of audio equipment.



(a) Control panel



(b) Dimmer switch



(c) Volume controller

Fig 8.25 A rheostat can be put to different uses

There are some tips for drawing a circuit diagram:

- ▶ Make sure you use the correct symbol for each component.
- ▶ Draw connecting wires as straight lines (use a ruler).
- ▶ Label components such as resistors with their values.

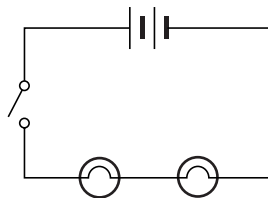
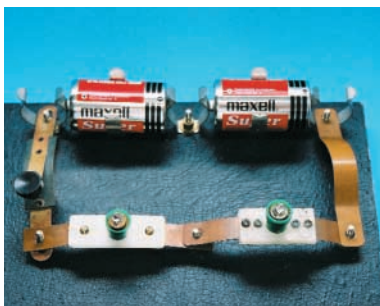


Fig 8.26 A simple electric circuit and its circuit diagram



Check-point 3

Draw the circuit diagrams for the set-ups A to C.

Circuit A	Circuit B	Circuit C
Circuit diagram A	Circuit diagram B	Circuit diagram C

8.4 Electric circuits

What to learn

- ▶ How do we connect two electric bulbs in series?
- ▶ How do we connect two electric bulbs in parallel?

Can you make a circuit to light up two bulbs?

Jimmy gives Winnie two identical bulbs and a battery. He asks Winnie to make a circuit to light up the two bulbs at the same time. Do you have any suggestion for Winnie?



Activity Corner C

Two ways to connect two bulbs

- 1 Draw the circuit diagrams for the two arrangements. How many paths can the current pass through?

	Arrangement I	Arrangement II
Arrangement on circuit board		
Circuit diagram		
How many paths can the current pass through?		

- 2 Which of the arrangements is better, I or II? Explain briefly.

Series circuit

In arrangement I in Activity Corner C, the current from the battery passes through bulb A, then bulb B and returns to the battery. Thus current passes through one path only. This kind of circuit is called a **series circuit** (串聯電路).



Experiment Centre 8.8

Bulbs in series circuit

Apparatus and materials per group

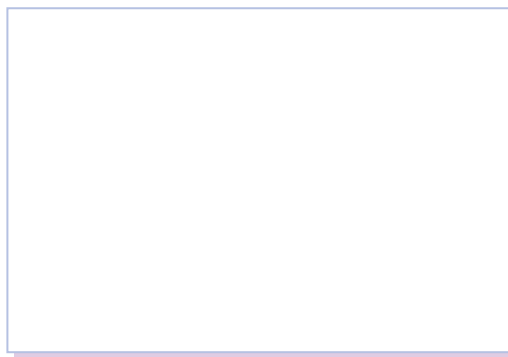
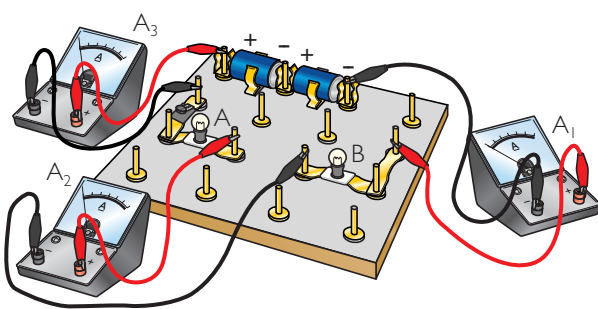
circuit board	1	ammeters	3
electric cells	2	switch	1
light bulbs (identical)	2	electric connectors	several

1 Connect the circuit as shown.

2 Which bulb is brighter, bulb A or B?

3 Unscrew bulb A. What happens to the brightness of bulb B?

4 Insert three ammeters into the circuit as shown in the diagram. Draw the circuit diagram on the right.



a What are the readings of the three ammeters?

The reading of A_1 is _____, A_2 is _____, A_3 is _____.

b What is the relationship between these readings at different points of the series circuit?

Parallel circuit

In arrangement II in Activity Corner C, the current from the battery can pass through bulb A and then return to the battery. The current can also pass through bulb B and then return to the battery. Thus current passes through two paths. The two paths through the bulbs are called **branches** (分支). This kind of circuit is called **parallel circuit** (並聯電路).



Experiment Centre 8.9

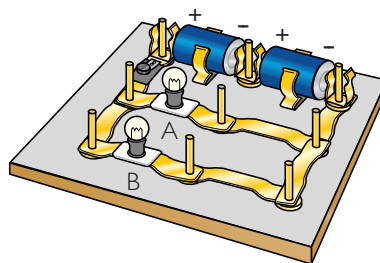
Bulbs in parallel circuit

Apparatus and materials per group

circuit board	1	ammeters	3
electric cells	2	switch	1
light bulbs (identical)	2	electric connectors	several

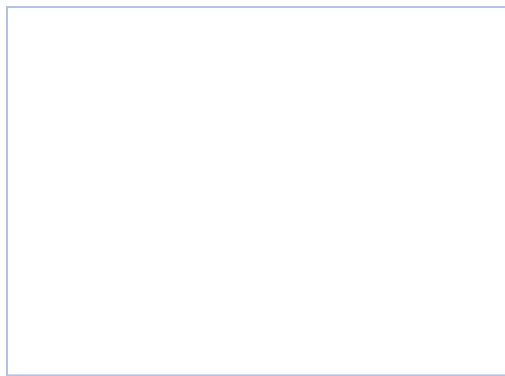
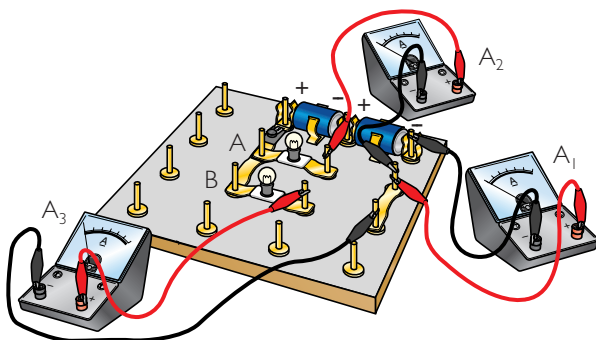
- 1 Connect the circuit as shown.
- 2 Which bulb is brighter, bulb A or B?

- 3 Unscrew bulb A. What happens to the brightness of bulb B?



In a parallel circuit, if one of the branches is broken, electric current will still flow in other branches. If one of the bulbs is damaged, the other bulbs are still lit.

- 4 Insert three ammeters into the circuit as shown in the diagram. Draw the circuit diagram on the right.



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- a** What are the readings of the three ammeters?

The reading of A_1 is _____, A_2 is _____, A_3 is _____.

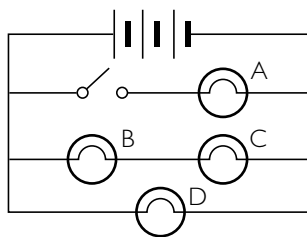
- b** What is the relationship between the readings at different points of the parallel circuit?

In a series circuit, the current is the same at all points. In a parallel circuit, the current passing through the battery is the sum of currents in the branches.



Check – point 4

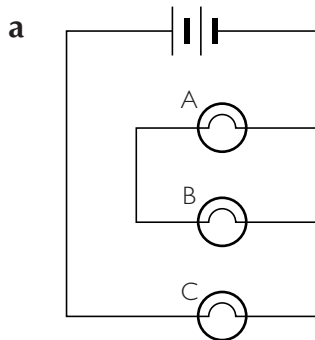
- 1** Look at the circuit diagram below. All the bulbs are identical. The switch is opened.

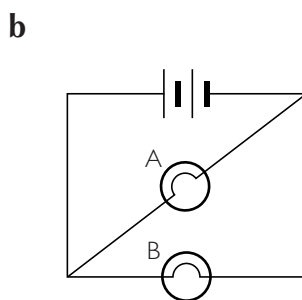


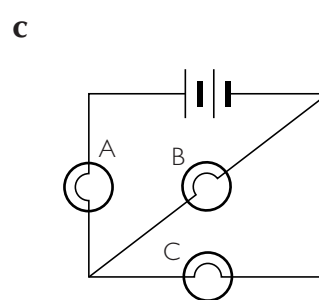
- a** Which bulb(s) does/do not light up?

- b** Which bulb(s) is/are the brightest?

- 2** Label the following circuits with 'bulbs in-series' or 'bulbs in-parallel'.







- 2 Turn the power supply on. Set the current to the smallest. Feel the heat of the wire **without touching** it.
- 3 Increase the current gradually. Note the change in ammeter reading.
- 4 Record the ammeter reading when the coil becomes red hot. The ammeter reading is _____.

When a current passes through a conductor, electrical energy will change into _____ energy and _____ energy.

From Experiment Centre 8.10, we find that **heating effect** (熱效應) occurs when current passes through a conductor. This also happens in a light bulb.

There is a **filament** (燈絲) in a light bulb. When a current passes through it, the filament becomes very hot. The filament **glows** at high temperature. Thus the bulb lights up. It is the heating effect of current that makes the bulb light up.

Fig 8.27 Do not touch the light bulb when it lights up. The filament of the bulb can be heated up to 2200 °C!

Use of heating effect of current in electrical appliances

Extension

Many home appliances change electrical energy to heat energy. These appliances contain **resistance wires** (電阻線) that produce heat energy when an electric current passes through it. We should handle them carefully.

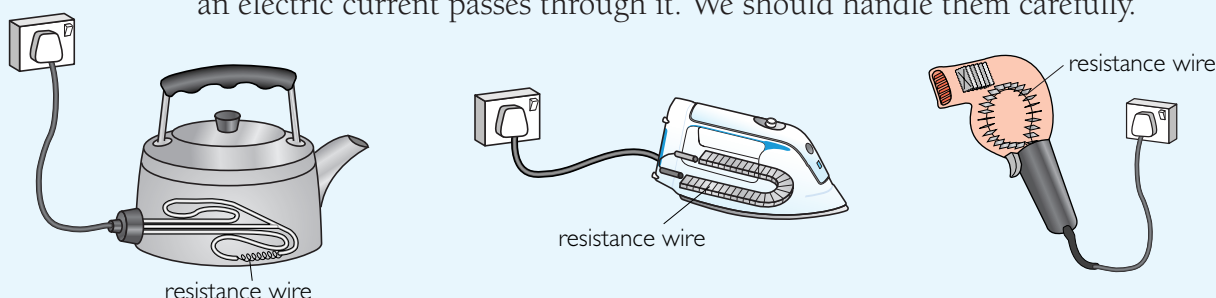


Fig 8.28 Some electrical appliances contain resistance wires

3 Keep the switch closed. Increase the current gradually until the bulb goes out.

a What is the reading of the ammeter when the bulb goes out?

b What happens to the fuse when the bulb goes out?

4 Repeat steps **1** to **3** using fuses B (rating as 0.5 A) and C (rating as 1 A).

What is the reading of the ammeter just when the bulb goes out?

Fuse B: _____ Fuse C: _____

There is a number printed on each fuse. We call this number the **fuse rating** (保險絲額定值). The rating of a fuse is the maximum current it can stand without melting. When the current exceeds the rating, the fuse melts. The fuse is said to have ‘blown’. The electric circuit becomes open. Therefore, it is important to choose a fuse of correct rating.



Fig 8.31 The rating of this fuse is 13 A

A fuse is used to protect a circuit from overheating. When a current exceeds the _____, the fuse blows and cuts off the electricity supply.

Circuit breaker

Another common electrical safety device is the **circuit breaker** (斷路器). The function of the circuit breaker is similar to that of fuse. It also has a rating. When a current exceeds the rating of a circuit breaker, the circuit breaker turns to ‘OFF’ position automatically. Electricity is then cut off.

When the circuit breaker cuts off electricity, we can reset it easily. If it cuts off electricity again, we should call a registered electrician for help.

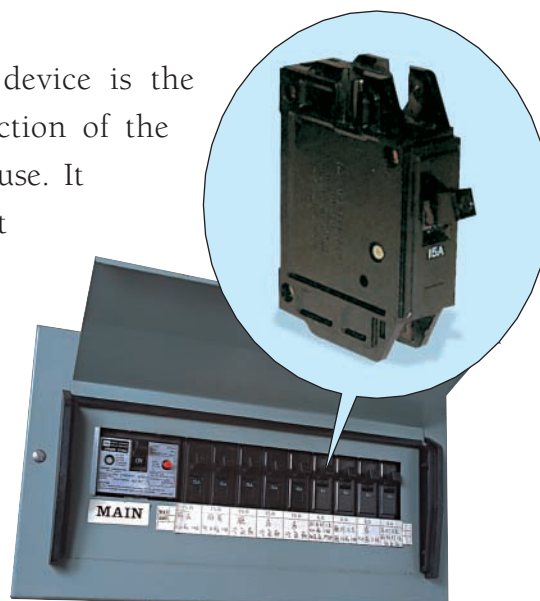


Fig 8.32 Circuit breaker



Check-point 5

- Many electrical appliances make use of the heating effect of current. Give two examples.

- A fuse is used to protect a heater. The current passing through the heater is 4 A. Which of the following fuse ratings should you choose?

A 1 A	C 13 A
B 5 A	D 15 A



8.6 Household electricity

What to learn

- ▶ What is the mains voltage in Hong Kong?
- ▶ What are the names of the pins in an electric plug?
- ▶ Why is earthing of electrical appliances so important?
- ▶ What will happen when there is a short circuit?

Rating of electrical appliances

There are two values marked on an electrical appliance — **voltage rating** (電壓額定值) and **electrical power rating** (電功率額定值). Voltage rating will be discussed in this section first. The picture on the right shows the voltage rating of an electric iron. The value is 220 V. This means that the electric iron should be connected to the **mains** (市電電源) voltage of 220 V. The mains is the source of electricity supply. In Hong Kong, the mains voltage is 220 V.

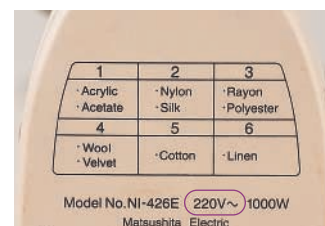


Fig 8.33 Voltage rating

Science in life



Different countries have different mains voltages as follows.

Country	Australia	Canada	China	Japan	Singapore	U.K.	U.S.A.
Mains voltage	240 V	110 V	220 V	110 V	230 V	240 V	110 V



Activity Corner D

Studying a plug

Apparatus and materials per group

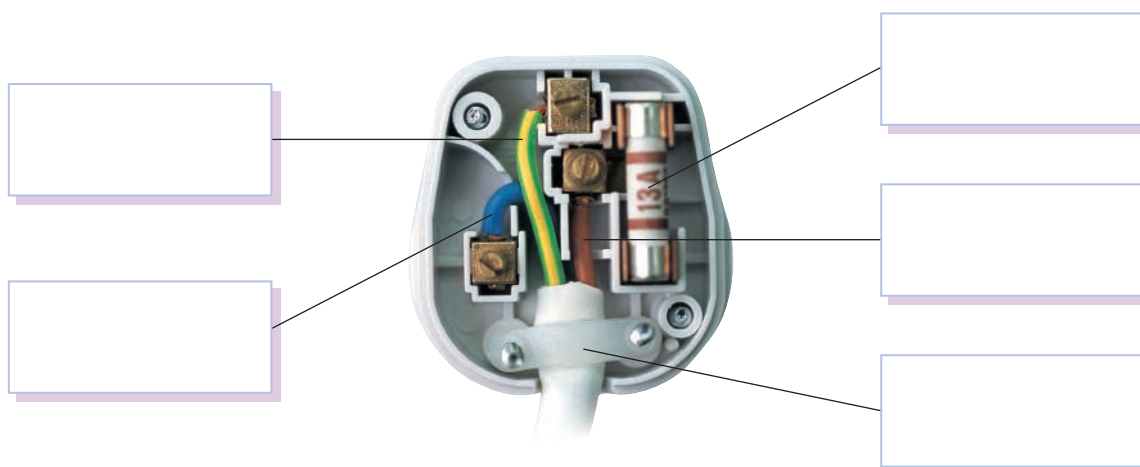
plug (with three-cord flex) |
screwdriver |

Watch out !

- ▶ The socket is at a high voltage (220V). It can be very dangerous.
- ▶ Do not put the test plug into a socket.

- 1 Open the plug using a screwdriver. Look at the plug carefully.
- 2 In the diagram below, label the parts of the plug using the following words:

neutral wire earth wire live wire fuse flex grip



- 3 Unscrew all the wires from the plug. Then remove the flex grip.

- 4 What are the colours of the wires?

- 5 What is the fuse used for? To which wire is it connected?

- 6 What is the flex grip used for?

- 7 Twist the head of the bare wires.

- 8 Connect the wires back to the plug and tighten the screws.

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- 9 Fix the flex grip on the plug.
- 10 Ask your teacher to check the connection.

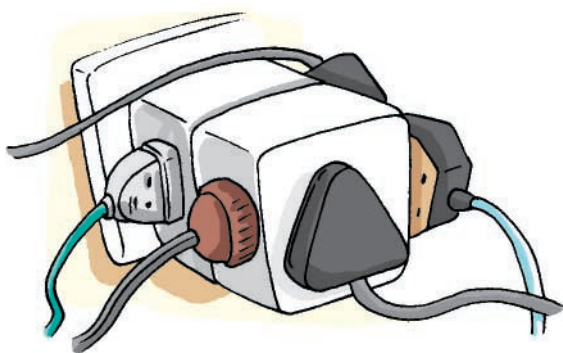
A plug has three pins: _____ (connected to green and yellow wire), _____ (connected to brown wire) and _____ (connected to blue wire).

Using plug and socket safely

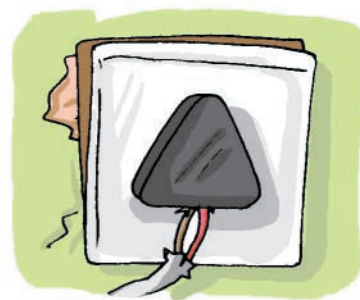
We get electricity from the mains by plugging in an appliance to a socket.

However, it can be very dangerous if we do not use the plugs and sockets properly. The following shows some improper uses of plugs and sockets that we should avoid.

- 1 Do not overload the socket.



- 2 Do not use cracked plugs and sockets.



- 3 Do not pull off the plug when the switch is on.



- 4 Do not pull off the plug by holding the cord.



Ring circuit — studying the live and neutral wires

Electrical energy is supplied to homes by a cable containing two wires — the live wire and the neutral wire. When we plug in an appliance, a current flows to it through either wire. The other wire provides a return path for the current.

Live and neutral wires are connected to a **consumer unit** ('fuse box'). They then branch out into several **parallel circuits**. There are different kinds of electrical appliances in the parallel branches, e.g. lamps, air-conditioners, etc.

Most homes have a **ring circuit** (環形電路) round the walls of each room. In a ring circuit, each of the live wire and neutral wire branch into two paths. Current can flow through the two paths to each socket. In this way, a smaller current is flowing through the cables. The cables can be thinner, hence cheaper.

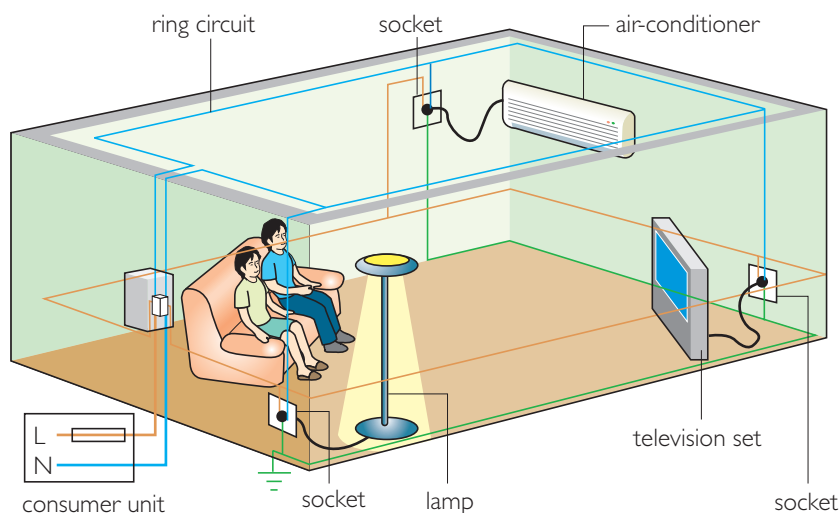


Fig 8.37 In the ring circuit, the live wire and neutral wire each forms a large 'ring'

Wiring of an electrical appliance

Look at the wiring of an electrical appliance. The switch is connected to the circuit for safety purpose. When there is a fault, a large current flows to the appliance. The large current blows the fuse before damaging the appliance.

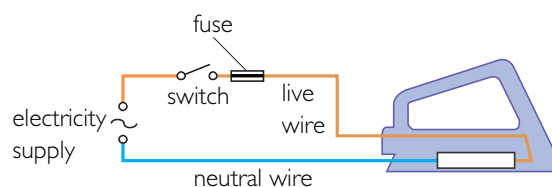


Fig 8.38 Wiring of an iron

A current flows to an appliance through the _____ wire and returns through the _____ wire. The switch and fuse are connected to the _____ wire.



Do you know?

A current of 1 mA produces a harmless tingle (刺痛). But, a current larger than 25 mA can kill people.

Earthing

When the wiring is in good condition, the circuit involves only the live and neutral wires. The earth wire does nothing. However, it would be very dangerous if there is no earth wire. Imagine that a damaged live wire touches the metal case of an appliance. When you touch the case, your body becomes part of the circuit. A current will pass through your body to the ground. You will get an **electric shock** (觸電) which can be fatal.

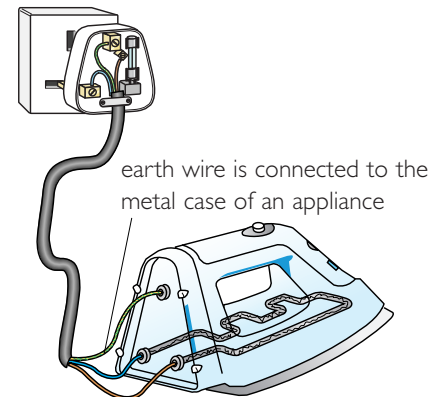


Fig 8.39 Earthing (接地) of an iron

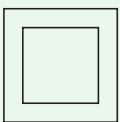


The earth wire connects the metal case of an appliance to the earth. When the damaged live wire touches the metal case, a closed circuit is formed. A large current flows to the ground through the earth wire and 'blows' the fuse. In this way, no current will pass through the body. Thus earth wire can protect us from electric shock.

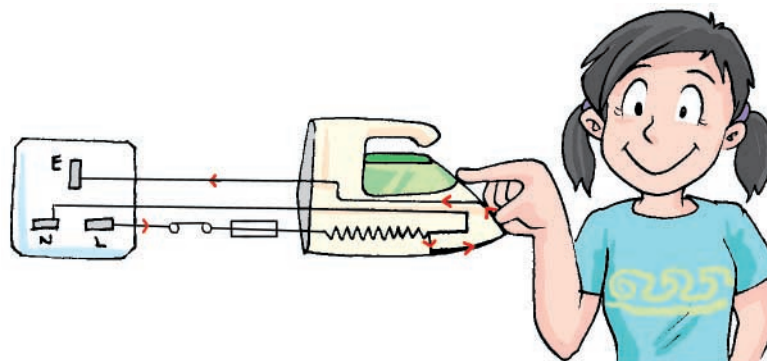


Do you know?

By law in Hong Kong, every electrical appliance should have an earth wire except those with an insulating plastic case. These appliances are said to have a double insulation.



Symbol for double insulation



_____ wire is connected to the metal case of an appliance. It protects us from _____ if the live wire gets damaged.

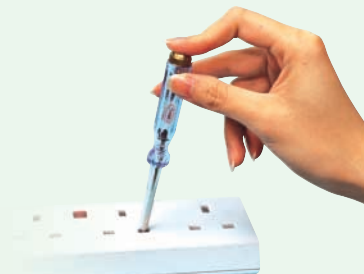
Science in life



'Live' probe

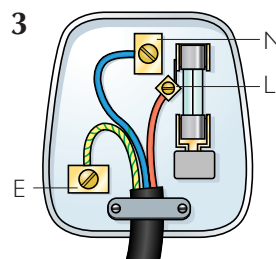
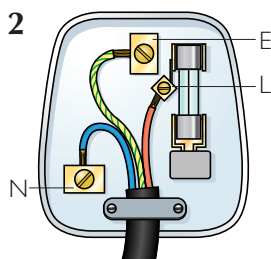
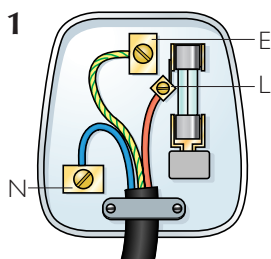
Electricians use the screwdriver on the right to test if something is 'live'. The neon lamp inside the screwdriver glows red if the object is 'live'.

To test if an object is 'live', an electrician presses the cap of the screwdriver. If the object is 'live', a small current will flow to the ground through the screwdriver and the body of the electrician. This lights up the neon lamp.



Check – point 6

Point out which plug(s) is/are wrongly connected.



Using electricity safely

Electrical leakage in VCD player

Appledaily, 2 March 2003

An accident caused by electrical leakage in a VCD player happened yesterday in On Ting Estate, Tuen Mun. The furniture of the flat was damaged. Firemen believe that the two-pin plug of the VCD player had been reassembled to three-pin plug before, and it did not have an earth wire installed. This is the main reason for the accident.



Besides electric shock, fire is another electrical hazard. Fire may result from large current due to **faulty wiring, overloading** (負荷過重) or **short circuit** (短路). Thus appliances with old and frayed (磨損) wires should not be used.

Overloading

What is overloading? Let's find it out from the following experiment.

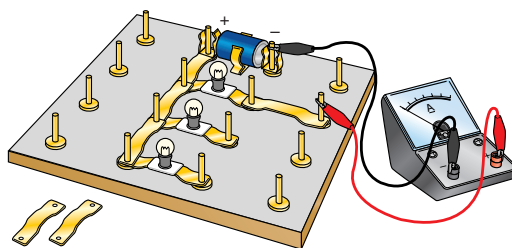


Experiment Centre 8.12

The effect of adding more parallel branches to a circuit

Apparatus and materials per group

circuit board	1	ammeter	1
electric cell	1	electric connectors	several
light bulbs	3		



- 1 Connect a circuit using one bulb only as shown above. Write down the ammeter reading in the table below.
- 2 Add one and then two parallel branches to the circuit. Complete the table below.

	One bulb	Two bulbs in parallel	Three bulbs in parallel
Ammeter reading			

As the number of branches increases, the current _____.

From Experiment Centre 8.12, we found that adding more branches into a circuit will draw a larger current. When this happens, we say the circuit is overloaded. The large current causes heating effect that may result in a fire.

Short circuit

Conductors of low resistance allow large current to pass through them. If there is very low resistance in a closed circuit, what will happen?



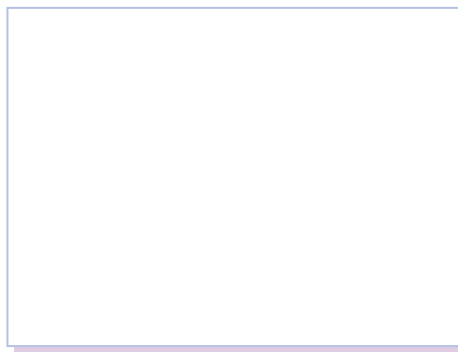
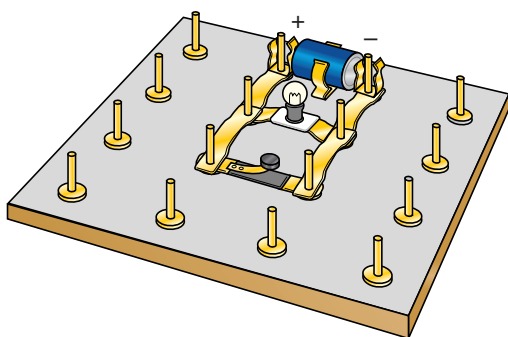
Experiment Centre 8.13

Short circuit

Apparatus and materials per group

circuit board		switch	
electric cell		electric connectors	several
light bulbs			

- 1 Connect the circuit as shown below. Then draw the circuit diagram on the right.



- 2 When the switch is open, does the bulb light up? Explain your answer by drawing the path of current in the circuit diagram.
- 3 When the switch is closed, does the bulb light up?

Referring to Experiment Centre 8.13, if the switch is closed, the lower branch has a **much lower resistance** than the branch with the bulb. Therefore, nearly all the current passes through the lower branch. Due to the heating effect of current, the lower branch becomes very hot. We call this a **short circuit**. Only very small current passes through the bulb in the other branch. Thus the bulb does not light up.

Short circuit must be avoided. In a household circuit, short circuit overheats the cables and may cause a fire.

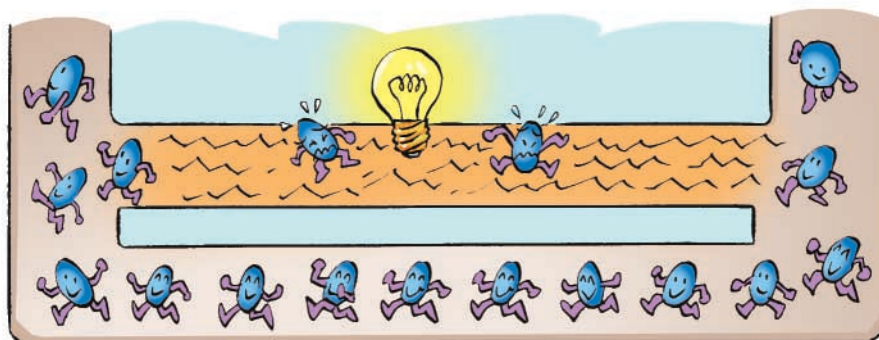


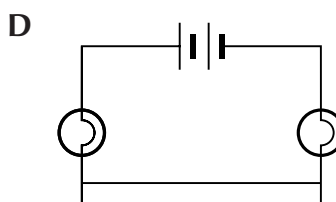
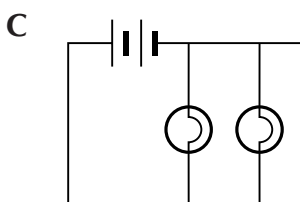
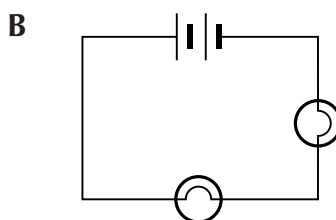
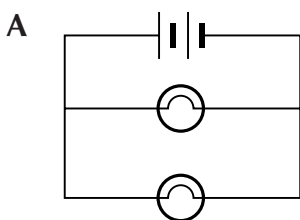
Fig 8.40 Because of the low resistance, nearly all the current passes through the short circuit

A very large current will _____ the appliances if it passes through a short circuit.



Check-point 7

Which of the following is a short circuit?



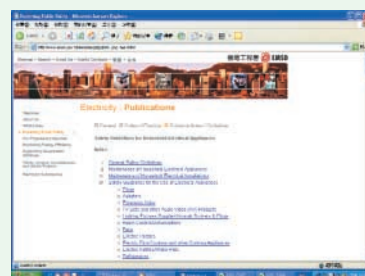
Extension Bk

Explore the web

Safety guidelines for using household electricity

Safety guidelines for using household electrical appliances issued by the Electrical and Mechanical Services Department (EMSD) can be found at:

http://www.emsd.gov.hk/emsd/eng/pps/pub_gng_heas.html





Activity Corner E

Dangers with electricity

The picture below shows some potential dangers which can be caused by electricity. Circle all the dangers.



We should pay attention to the following safety rules when using electricity.

Do's

- 1 Replace damaged cables, sockets and plugs immediately.
- 2 Use three-pin plugs with proper earthing.
- 3 Use the fuse with the correct fuse rating.
- 4 Keep cables away from water.

Don'ts

- 1 Do not pull the cable to remove the plug from a socket.
- 2 Do not overload a socket.
- 3 Do not switch appliances on and off with wet hands.
- 4 Do not replace fuse until the fault has been traced and put right.
- 5 Do not plug in an electrical appliance when the switch is 'ON'.
- 6 Do not drill the wall around a socket.

8.7 Electrical power

Extension

What to learn

- ▶ How is electrical energy related to electrical power?
- ▶ How can we measure electrical power?
- ▶ How do we calculate the cost of electricity?

When we compare the performance (性能) of electrical appliances, we use the idea of **electrical power** (電功率). Electrical power tells us how much electrical energy is transferred to the appliance in a second.

Electrical power is measured in **watt (W)** (瓦特). When the electrical power is 1000 W, a larger unit **kilowatt (kW)** (千瓦特) is used.



Activity Corner F

Extension

Which electrical appliance consumes more electrical power?

Do you know the power ratings of the electrical appliances in your home? Fill in the table and find out which electrical appliance consumes more electrical power.

Electrical appliance	Electric fan	Rice cooker	Refrigerator	Television	Air-conditioner	Table lamp
Electrical Power						

Which electrical appliance consumes the greatest electrical power?

Current in electrical appliances

At the same voltage, the bulb with greater power rating is brighter. In other words, a larger current passes through an appliance of greater power rating at the same voltage. The current passing through an appliance is directly proportional to its power rating at the same applied voltage, i.e.

$$\text{current} = \frac{\text{electrical power}}{\text{voltage}}$$

Cost of electricity

In Unit 4, we learnt that the CLP Hong Kong Limited and the Hongkong Electric Co. Ltd. supply electricity to the homes, offices and factories. We need to pay the electricity bills to these electric companies. For practical purpose, a **bigger unit of energy** is used to measure electrical energy when calculating the cost of electricity. It is called the **kilowatt-hour (kW h)**.

The electrical energy supplied is measured by a **kilowatt-hour meter**. The electric companies install a kilowatt-hour meter for every home, office and factory. From the readings on the meter, the electric companies work out the amount of electrical energy consumed and calculate the electricity bill.



Fig 8.41 A kilowatt-hour meter



Activity Corner G

Calculating the cost of electricity

Study the electricity bill carefully. It shows the amount of electricity used.

What is the cost of one unit of electricity on average?

Extension

METER NUMBER	METER READING & DATE PRESENT	PREVIOUS	UNITS CONSUMED	DESCRIPTION	AMOUNT HK\$
0123456	18/01/99	18/12/98	31 DAYS 449	BASIC CHARGE	416.15
LAST PAYMENT OF \$ 325.00				FUEL ADJ.	-8.500 6/UNIT -38.17
RECEIVED ON 04/01/99 THANK YOU				REBATE	-0.600 6/UNIT -2.69
SCHEDULED NEXT METER READING 19/02/99				PREVIOUS BALANCE	6.21
DEPOSIT NO. & AMOUNT HK\$1234-\$1000				BALANCE OF	-0.50
				PLEASE PAY THIS AMOUNT	\$375.00

the unit of electricity consumed

the amount charged



Check-point 8

Extension

- 1 What is the unit for
 - a energy? _____ or _____
 - b power? _____
- 2 The following pictures show some electrical appliances in Mr Wong's home. Answer the questions below.



200 W



1200 W



150 W



2000 W



100 W

- a Jimmy and Lily watch television for two hours. How much energy is consumed?

- b Mrs Wong uses the kettle to boil water for 15 minutes. How much energy is consumed?

- c Mr Wong uses the hair-dryer for 10 minutes. How much energy is consumed?

- d There are two 100 W bulbs in the dining room. On average, the two bulbs are lit up for six hours every day. Estimate the energy consumed by these two bulbs in one month (30 days)?

- e Assume the cost of one unit of electricity is 90 cents. Estimate the cost of electricity for the two bulbs each month?

8.8 Magnetic effect of current

Extension

What to learn

- ▶ What will happen if a current passes through a coil of wire?
- ▶ What are the household electrical appliances that make use of the magnetic effect of current?

In 1819, Oersted (奥斯特), a Danish scientist, accidentally discovered that a current passing through a wire made a nearby compass needle turn. In the months that followed he worked hard to study the magnetic effect of current. It has led to the invention of loudspeakers, electric bells and electric motors.



Experiment Centre 8.14

Magnetic effect of current

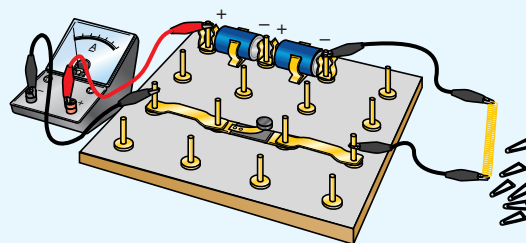
Extension

Apparatus and materials per group

circuit board	1	pencil	1
electric cells	3	iron nail	1
ammeter	1	paper clips	several
switch	1	electric connectors	several
insulated copper wire (about 60 cm)	1 piece	power supply	1
copper rods	3	magnets with U-shaped metal	1

I Magnetic effect of current

- 1 Wind a copper wire round a pencil for 30 turns. Then take the pencil out of the coil of copper wire.
- 2 Connect the coil to the circuit as shown on the right.
- 3 Put the coil near some paper clips. Press the switch. How many paper clips can the coil pick up?



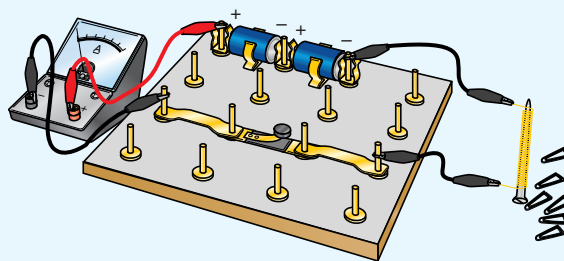
- 4 Add one more electric cell to the circuit. Press the switch.
 - a What happens to the reading of the ammeter?
 - b How many paper clips can the coil pick up now?

...cont'd

- 5 Remove one electric cell and wind the copper wire round the pencil for 30 turns more. Take the pencil out and press the switch.

How many paper clips can the coil pick up now?

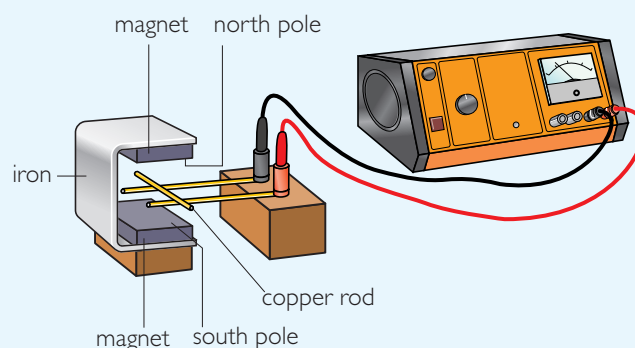
- 6 Now wind a copper wire round an iron nail. A coil of 30 turns is made.
- 7 Connect the iron nail with the coils to the circuit as shown on the right.



- 8 Put the coil near the paper clips. Press the switch.
- How many paper clips can the coil pick up now?

II Force produced by a magnet

- 9 Set up the apparatus as shown.
- 10 Switch on the power supply. Observe the motion of the copper rod.



- a What happens to the copper rod?

- b What does this experiment show?

From the above experiment, we find out that the magnetic effect of a coil can be increased by

- ▶ increasing the number of _____ in the coil
- ▶ increasing the _____ in the coil
- ▶ using a soft _____ core

Besides, a _____ can be produced by a magnet on a wire carrying an electric current.

e-Book
Unit 8

Summary check-point

8.1

chemical
complete circuit
electrical
electrons
energy source
metals

8.2

ammeter
amperes
current
ohms
resistance
thicker
voltage
voltmeter

8.3

electrical
heat
light
resistor
rheostat
switches

8.4

parallel
series

8.5

blows
fuse
fuse rating
heat

8.6

earth
live
neutral
overloading
ring
short

8.7

larger
power
watts

8.8

current
force
iron
magnetic

Use the above words to complete the sentences below. Some words can be used more than once.

8.1 Conditions of transferring electrical energy


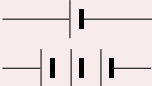
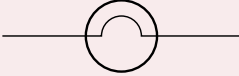
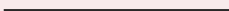
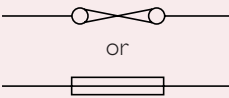
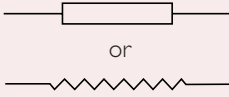
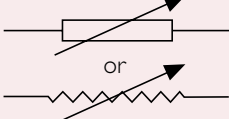
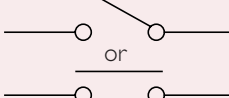

- 1 A battery is made up of one or more cells. When an electric cell is in use, _____^(a) energy is changed into _____^(b) energy.
- 2 A _____^(a) and an _____^(b) is needed for electricity to flow. _____^(c) cannot flow around an open circuit, but they can flow around a closed circuit.
- 3 Conductors allow electricity to flow through them. _____^(a) are conductors. Insulators do not allow electricity to flow through them.

8.2 Current, voltage and resistance

- 4 _____^(a) is the flow of electrons. It is measured in _____^(b) (A) using an _____^(c).
- 5 _____^(a) of a source of electrical energy is measured in volts (V) using a _____^(b). More cells result in a higher voltage and a larger current.
- 6 _____^(a) opposes the flow of electric current. It is measured in _____^(b) (Ω).
- 7 The resistance of a wire depends on the kind of material used. The _____^(a) and the shorter wire have lower resistance.

8.3 Electric components

- 8 ______(a) are used to open and close a circuit.
- 9 A bulb changes ______(a) energy to ______(b) energy and ______(c) energy when it is connected in a circuit.
- 10 A ______(a) has a certain resistance. It can decide the size of current in a circuit.
- 11 A ______(a) is a resistor with variable resistance. It can be used to control the size of current. It is commonly used as the volume controller in audio equipment and dimmer switch.
- 12 Scientists use different circuit symbols to represent different electric components to make a circuit diagram, as follows:

Name of electric component	Circuit symbol
Ammeter	
Battery/electric cell	
Bulb	
Electric connector	
Fuse	
Resistor	
Rheostat	
Switch	
Voltmeter	

8.4 Electric circuits

- 13 In a ______(a) circuit, the current is the same at all points.
- 14 In a ______(a) circuit, the total current is the sum of currents in the branches.

8.5 Heating effect of current

- 15 Current passing through a conductor produces ______(a).
- 16 A ______(a) is used to protect a circuit from overloading. When a current exceeds the ______(b), the fuse ______(c) and cuts off the electricity supply.

8.6 Household electricity

- 17 A plug has three pins: ______(a) (green and yellow), ______(b) (brown) and ______(c) (blue).
- 18 Current flows to an appliance through the ______(a) wire and returns through the ______(b) wire. The ______(c) wire protects us from electric shock.
- 19 In a ______(a) circuit, live wire and neutral wire branch into two paths. Therefore smaller current flows through the cables. It is a cheap way for wiring the home.
- 20 ______(a) results if too many appliances are connected to one socket. Very large current will flow through a ______(b) circuit and overheat the appliances.

8.7 Electrical power

- 21 The ______(a) of an appliance is the rate at which electrical energy is transferred to an appliance per second. It is measured in ______(b) (W) or kilowatts (kW) by using a kilowatt-hour meter.
- 22 The greater the electrical power of an appliance, the ______(a) the current passing through it for the same applied voltage.
$$\text{Current} = \frac{\text{electrical power}}{\text{voltage}}$$

8.8 Magnetic effect of current

- 23 The flow of current produces ______(a) effect.
- 24 An electromagnet can be made stronger by increasing the number of turns of wire in the coil, increasing the ______(a) in the coil, or using a soft ______(b) core.
- 25 A ______(a) can be produced by a magnet on a wire carrying an electric current.