Electricity

Before you read

Discuss these questions with your partner.

- What household appliances use electricity?
- Where does electricity come from?
- What does a magnet do?

A Vocabulary

Choose the correct word to complete the sentences.

1 ..... is something through which electricity can pass.

2 An electrical ..... supplies power in our home.

3 The electromagnetic field ..... a force on the particles.

4 To ..... power you need a way to control electricity.

5 Normally, electricity is carried through homes by ..... .

6 Is 6 o'clock a ..... time for your meeting?

1	**A** A conductor	**B** A magnet	**C** Static
2	**A** bulb	**B** current	**C** particle
3	**A** put	**B** exerted	**C** applied
4	**A** attract	**B** exert	**C** generate
5	**A** wires	**B** charges	**C** forces
6	**A** comfortable	**B** fitting	**C** convenient

Reading 1

Electricity and magnetism

Electromagnetism is everywhere. It is a field that exists throughout space. When particles are electrically charged, the electromagnetic field exerts a force on them. These particles then move and exert a force on the electromagnetic field. By generating these fields when and where we want them and by controlling these forces, we have electricity. This gives us the power we use in the modern world. All our TVs, phones, street lights and cars depend on electromagnetism.

So what is electromagnetism? Actually, it is two things, but they are so closely connected that it is convenient for us to think of them as one, as two sides of the same coin. There are two types of field: electric and magnetic. Electrically-charged particles result in an electric field, static electricity. When there is a conductor, a material which will allow electric field to pass through it, then we can create an electric current. In our homes, the conductors are the wires that run through our house to the light bulbs or the TV. A magnetic field results from the motion of an electric current and is used to generate the electricity we use.

In the 19th century, James Clerk Maxwell, the Scottish physicist, produced the equations that proved the two forces acted as one. One effect of this was for physicists all over the world to hurry back to their libraries and laboratories to rewrite the theories on the motion of objects. Maxwell's equations showed that what physicists had believed for centuries was in fact not correct. It was not until Einstein, in the 20th century, that the theory of motion was put right – at least for now.

How do we know the two things are one? Well, sailors had known for centuries that lightning affected the magnetic compasses on their ships. No one, however, made the connection between lightning and electricity until Benjamin Franklin, the American politician and scientist, flew a kite in a thunderstorm to attract the lightning. In other parts of the world, physicists were experimenting with magnets and electricity. Most passed a current across a magnetic needle and watched it move. The Frenchman André Marie Ampère eventually applied mathematics to electromagnetism. It is from his work that we have our modern understanding of electromagnetism.

One piece of the jigsaw remained. No one had discovered a way of generating electricity. True, there were batteries. Alessandro Volta invented the Voltaic pile in 1800, but it was of limited use. Certainly no battery could provide enough electrical power to operate a machine. For that the world would have to wait for Michael Faraday to find a way of creating an electrical current, when and where it was needed.

Pronunciation guide

Ampère /ˈæmpeə/
Voltaic Pile /vɔlˈteɪɪk paɪl/

B Comprehension

Read the text and choose the correct answer.

1 We can make electricity by
A exerting a force.
B creating electromagnetic fields.
C charging particles.
D moving particles.

2 Electrical and magnetic fields
A are opposites.
B are two different things.
C are very closely related.
D need a conductor.

3 Maxwell's equations
A corrected the theory of motion.
B caused scientists to rethink.
C rewrote older theories.
D have completely ensured the theory of motion now.

4 Our modern knowledge of electromagnetism comes from
A Ampère.
B lightning.
C Benjamin Franklin.
D experiments with magnets.

5 The electric battery
A could operate a machine.
B could create an electric current.
C was invented by Faraday.
D was invented in 1800.

Before you listen

Discuss these questions with your partner.

→ Can you think of some different ways of generating electricity?
→ What are the advantages and disadvantages of each?

C Listening

Listen to the extract from a lecture on generating electricity. Then listen again and complete the table.

Ways of generating electricity

Advantages	Disadvantages
Fuel	
1	2 .....
Nuclear power	
3	4 .....
Hydroelectricity	
5	6 .....
Wind power	
7	8 .....

Before you read

Discuss these questions with your partner.

→ What do you think is the most important invention

A of all time?
B in the last century?
C in the last 20 years?

D Vocabulary

a. Match these words with their definitions.

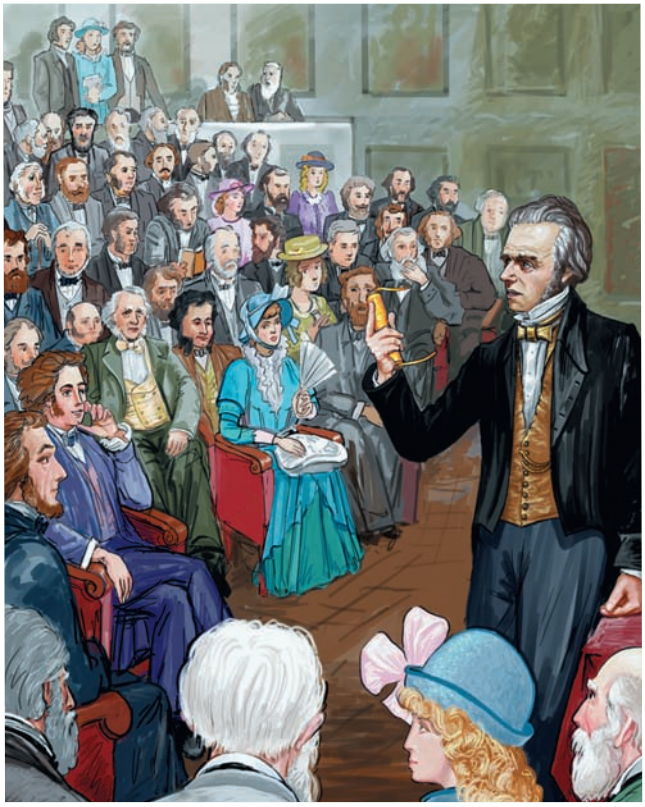
1 loop	A not proud
2 entirely	B round shape
3 device	C machine
4 modest	D completely
5 coach	E vehicle pulled by horse
6 status	F revolve, go round
7 rotate	G position

b. Match the words to make phrases.

1 receive	A experiments
2 attend	B a job
3 offer	C electricity
4 be	D on a tour
5 go	E to work
6 carry out	F an education
7 set	G of something
8 build	H lectures
9 generate	I a device
10 make use	J low born

c. Match the adjectives to the nouns.

1 leading	A motor
2 scientific	B current
3 electrical	C field
4 electrical	D physicist
5 magnetic	E community



Reading 2

Michael Faraday

Faraday (1791-1867) was unusual among famous men in the 19th century. His family did not have a high status in Victorian society. He was born in London to a poor family. He received little more than a primary school education, but educated himself. He did not have the support and encouragement of famous teachers. Instead, he worked making and repairing the covers of books in the daytime and attending public lectures at the Royal Institution in the evenings.

One series of lectures was given by Humphry Davy, one of the leading physicists of the time, and Faraday wrote to him, hoping to become accepted into the scientific community. Davy wrote back, recommending that Faraday continue to be a bookbinder. Faraday's chance came soon after that. Davy injured his eyes in an explosion in his laboratory, and offered Faraday a job as his secretary. The years which followed were not entirely happy ones for Faraday. He was not considered to be a

gentleman, his family were too low born for that. Even when he went with Davy on a tour of Europe, Faraday had to wash Davy's clothes, eat with the servants and ride on the roof of the coach rather than inside it. For a time, Faraday thought about giving up science altogether.

Now, however, Faraday had time to carry out experiments at the Royal Institution of Great Britain, though he was still Davy's assistant. Davy tried and failed to make an electric motor and discussed his failure with his assistant. Faraday set to work, and produced what he called a homopolar motor. It was simply a wire, rotating around a magnet when an electric current from a battery was applied. It seems though that somehow Faraday upset Davy. The following years saw Faraday working on Davy's experiments with glass. Whatever Faraday did, Davy seemed determined to prevent him from succeeding with electricity.

In 1829 Davy died, and soon after Faraday began the series of experiments that would make him one of the most important scientists of all time. He managed to build a device which moved a magnet through a loop of wire. This motion of the magnet through the wire created an electric current. He demonstrated that a changing magnetic field produces an electrical field. He was helped by James Clerk Maxwell to state the process mathematically (maths had always been Faraday's weakness), and this is now known as Faraday's Law of Induction. It is one of the foundations of electromagnetism and of modern technology. Later, Faraday built the first dynamo, a way of generating electricity. What Faraday did was to discover a way both of making electricity and of making use of it. Without his discoveries we would not be able to enjoy the modern lifestyle that we have now.

Although now famous, Faraday remained modest. He was offered honours by the Queen, but refused to accept them. Nearly 150 years after his death, however, he was honoured in another way. Between 1991 and 2001 his face appeared on a Bank of England £20 note.

Pronunciation guide

dynamo /ˈdaɪnəməʊ/
encouragement /ɪnˈkʌrɪdʒmənt/
homopolar /ˌhəʊməʊˈpəʊlə/
Humphry /ˈhʌmfrɪ/
injure /ˈɪndʒə/
Law of induction /lɔːˈfəv ɪnˈdʌkʃən/

E Comprehension

Read the text and answer the questions in your own words.

1 How did Faraday get his education?
2 What was Faraday's second job?
3 Why did Faraday experiment with glass?
4 How did Maxwell assist Faraday?
5 How were Faraday's achievements recognized?

Before you listen

Discuss these questions with your partner.

→ How does a candle work?
→ How does a torch work?
→ How does an electric light work?

F Listening

Listen to the conversation and fill in the gaps in the notes.

1 A hairdryer works with ..... .
2 The electric ..... operates a fan.
3 The electric ..... warms the heating element.
4 Air is ..... the element.
5 A ..... controls the heat in the element.

G Speaking

Discuss these questions with your partner.

→ Can you live without

A a TV?

B a CD player?

C a fridge?

Task

Discuss with your partner the following topic. 'How would life be different without electricity?'

Talk about:

- things we use electricity for (lighting, cooking, refrigeration, your ideas)
- things we don't need electricity for (play games, reading/writing, do sports, your ideas)
- places that use electricity (homes, hospitals, factories, your ideas)
- luxury items that use electricity (TV, music, video games, your ideas)

Remember to:

- say what you think
  I (don't) think/feel/believe (that); in my opinion; as far as I'm concerned
- give your reasons
  I say this because, due to, because of
- agree/disagree politely
  Quite right; I'm not sure I agree …

Speaking tips

✓ Ask questions.

✓ Let your partner finish their sentences.

✓ Ask for explanations if you don't understand.

H Writing

Write a short essay to answer this question:

'How did Faraday's personal life affect his scientific work?'

First read text 2 again and look at these notes. Then plan your essay.

PARAGRAPH 1

Early life:
poor family, not educated at school, worked with books

Vocabulary:
family background, bookbinder, no encouragement

PARAGRAPH 2

Entry into science:
evening lectures, wrote to famous scientist, assistant

Vocabulary:
Royal Institution, scientific community, secretary

PARAGRAPH 3

Relationships:
not a gentleman, treated like a servant, unhappy, problem with Davy

Vocabulary:
status, unhappy, think about

PARAGRAPH 4

Private life:
modest, hard-working, refused honours

Vocabulary:
discoveries, honours, banknote

Write 200-250 words.