

1.8 Using electromagnets

P2 Chapter 1: Electricity and magnetism

Learning objectives

After this topic you will be able to:

- describe some uses of electromagnets
- describe how a simple motor works.

Have you ever travelled on a high-speed train? Trains that use electromagnets can go faster than a Formula 1 car. They don't have an engine. How do they work?

Lifting off

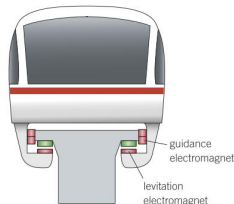
You have learned that magnets can repel each other. Engineers use this fact to build trains that use magnetic levitation. This means the train is lifted up using magnets.

Very powerful electromagnets on the track repel magnets on the train. There is no friction between the train and the track. This means the train can travel much faster than normal trains.

That's not all. The train is pushed forward by other electromagnets called guidance electromagnets. It does not need an engine.



▲ You can travel at over 200 mph on a maglev train.



▲ Electromagnets lift a maglev train and push it forward.

Key Words

relay, motor

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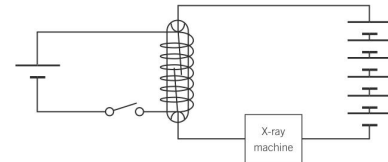
A State the type of magnet used to levitate a train.

Switching on

An X-ray machine can be very dangerous. It uses a very high potential difference. The radiographer using the machine uses a **relay** to turn the machine on, instead of a normal on/off switch.

What is a relay?

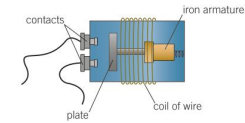
A relay uses a small current in one circuit to operate a switch in another circuit. When the switch is closed the coil becomes an electromagnet. The two pieces of iron inside are magnetised. They attract each other and turn on the X-ray machine.



▲ A small current can turn on a much bigger current in a separate circuit.

How do you start a car?

A car battery produces a large current that can be very dangerous. The driver switches on the circuit in the battery to start the car. They can do this safely using an electromagnet switch.



▲ A starter motor uses an electromagnetic switch.

How do you lift a car?

You can use an electromagnet to move large pieces of iron or steel in a factory, or to move cars in a scrap yard.



▲ Electromagnets can lift cars.

How do you sort metal?

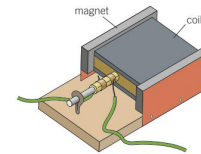
You can use an electromagnet to sort out scrap metal. Iron and steel will be attracted to the electromagnet. Other metals, such as aluminium, will not.

B State one use of an electromagnet in a scrap yard.

Moving and spinning

The turntable in a microwave needs to turn so that your food cooks evenly. The **motor** that makes it move is just one of many motors in your home. You can make a simple motor using two magnets and a coil of wire.

When you connect the coil to a battery a current flows in the coil. The coil becomes an electromagnet. The forces between the coil and the permanent magnet make the coil spin.



▲ A simple motor.

Fantastic Fact

There are more than 50 electric motors in the average family home.

Recycle those cans!

Write a letter to the manager of your school's kitchen explaining how they could use electromagnets to sort the soft drinks cans for recycling.

Summary Questions

- Copy and complete the sentences below.
Electromagnets can be used to levitate _____ and push them forward. A _____ acts like a switch to turn on circuits that can be dangerous. When a _____ flows in a coil of wire between two magnets then the coil _____ works.
(5 marks)
- State the parts of an electric motor and how a motor works.
(4 marks)
- Design a system that uses electromagnets to hold open fire doors. The fire doors should close automatically when the fire alarm button is pressed. Explain in detail how your system works.
(6 marks)

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