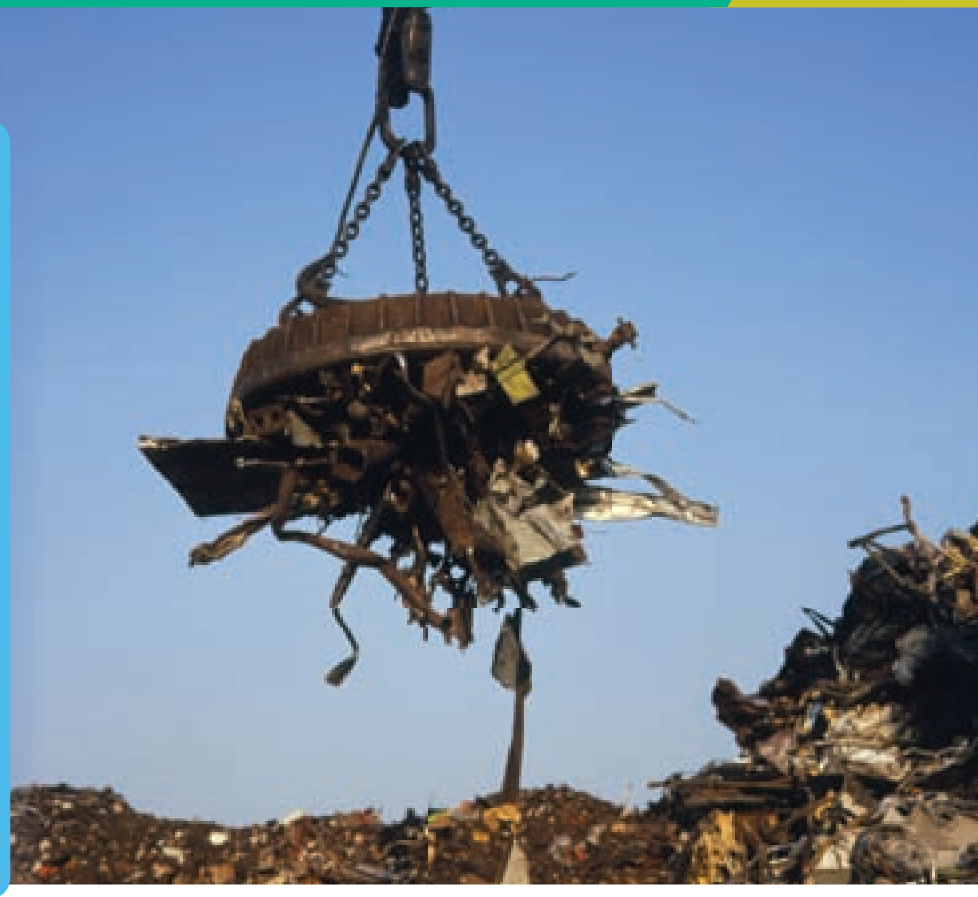
7.4 Magnetic and electric fields



A non-contact force acts through a region of space called a force field. If you drop an object, it is pulled towards the Earth due to the Earth's gravitational force field. A balloon can be charged and attract a thin stream of water that lies within its electric field. A magnet can attract a tub of nails if they lie within its magnetic field. Powerful electromagnets can lift heavy steel.

INQUIRY science 4 fun

What do magnets attract?

Can you guess which materials around you are attracted by a magnet?

Collect this …

Yes

- bar magnet or fridge magnets
- selection of objects such as paper clips, thumb tacks, nails, plastic spoons, cans, coins, chalk, marbles, safety pins, pens, toothpicks

Do this …

1 Draw up a table with three columns, as shown above.

Object tested	My prediction (will attract/ won't attract)	What happened

2 **Predict** which items you think will be attracted by the magnet.

3 Test to see which objects are attracted and complete the table.

Record this …

Describe whether most of your predictions were correct.

Explain which types of substances are more likely to be attracted to a magnet.

Magnetic fields

A magnet pulls, or attracts, materials containing the metals iron, cobalt or nickel. Steel is made from iron, and so steel is also attracted to a magnet. The horseshoe magnet shown in Figure 7.4.1 attracts the steel filings from a distance away. This happens because the steel filings were positioned within its magnetic field. A **magnetic field** is the space around a magnet where a magnetic force is experienced. The steel filings were pulled by a magnetic force in the direction of the magnetic field.

Figure 7.4.1 This horseshoe magnet is placed near a mixture of steel and copper filings. Only the steel filings are attracted to the magnet, with the copper remaining in the pile below. Magnets can be used to separate magnetic metals from a mixture of substances.

The ends of a magnet are called **poles**. If a magnet floats in water, then one end spins to face the Earth's north pole. This end is the north pole of the magnet. The opposite pole of the magnet is the south pole. If a magnet is cut in half, it still has a north and a south pole. The magnetic field is strongest at the poles of a magnet.

A magnetic field is normally invisible to us. Its shape and strength can be determined either by passing a compass around a magnet, or by examining a sprinkling of iron filings around a magnet. Figure 7.4.2 shows that magnetic field lines point from the north to the south pole.

INQUIRY science 4 fun

Seeing magnetic field lines

No

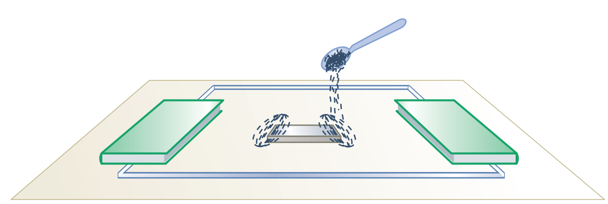
Can you see a magnetic field?

Collect this …

- collection of magnets
- thin books
- stiff, transparent plastic
- white paper
- iron filings

Do this …

1. Place a bar magnet on a sheet of paper.
2. Put the plastic sheet over this and flatten its edges with some books.
3. Sprinkle about a teaspoon of iron filings onto the plastic sheet.
4. Lightly tap the sheet to spread these. What pattern can you see?
5. Gather up all the iron filings and then test a different magnet.



Record this …

Describe each pattern you saw.
Explain why you think these formed.

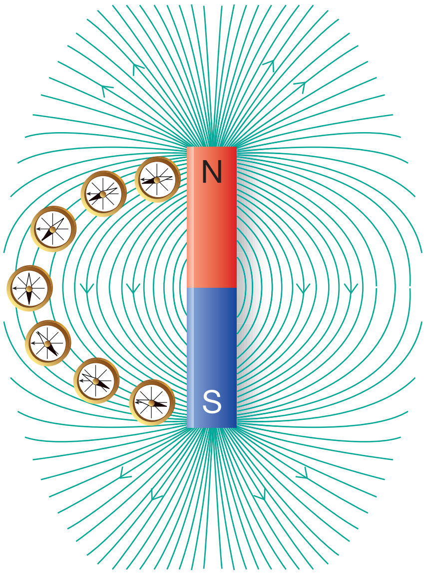


Figure 7.4.2

Magnetic field lines do not cross, and always run from the north to the south pole of a magnet.

Magnetic field lines:

- show the direction that a compass would point
- always run from the north pole to the south pole
- do not cross
- represent a strong magnetic field when they are bunched closely together
- represent a weak magnetic field when they are spaced further apart.

The Earth's magnetic field

The Earth itself has a magnetic field. It behaves as though it has a huge bar magnet in its centre like that shown in Figure 7.4.3. Scientists believe the Earth's magnetic field is generated by moving molten rock inside the Earth's core.

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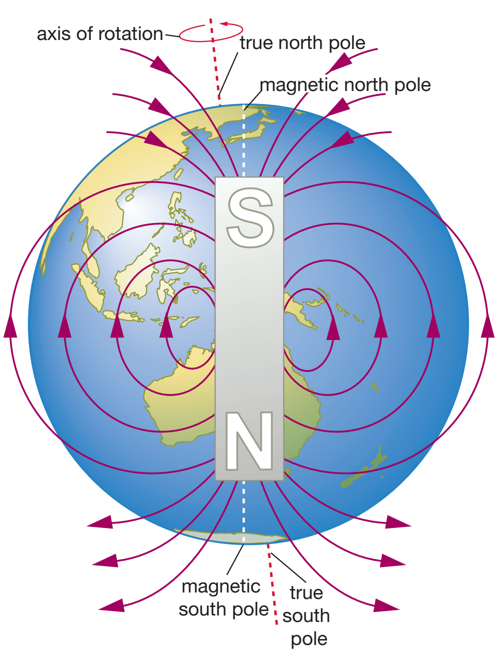

Figure 7.4.3

The Earth is surrounded by a magnetic field. The poles of the imaginary bar magnet inside the Earth lie about 3000 km from the geographical north and south poles.

The Earth's magnetic field does more than direct our compasses. The Sun produces solar wind. These are high-energy particles that can damage living things. The Earth's magnetic field and the atmosphere slows these charged particles down as they travel towards Earth. It directs their path towards the magnetic poles. Collisions between these particles and those in the upper atmosphere can produce spectacular light shows called auroras, as seen in Figure 7.4.4.

Figure 7.4.4

The first stunning light display shown here was photographed in Alaska. It shows the Aurora Borealis, or Northern Lights. The Southern Lights, or Aurora Australis, can be seen in the lower image. It appears in the southern hemisphere at times during the Antarctic winter.

SciFile

In-built navigation

Over 800 years ago, Chinese sailors used lodestone as a compass. Lodestone is a naturally occurring magnetic material. Many animals, such as honeybees, dolphins, tuna, whales and pigeons, contain tiny crystals of magnetite (which makes up lodestone) in their brains or stomachs. These act as tiny internal compasses, preventing the animal from getting lost and helping them find their homes.

Attraction and repulsion of poles

Magnetic poles may be attracted to each other, or repelled by a magnetic force. Poles that are the same are called like poles. Like poles will push away, or repel each other. Poles that are different are called unlike poles. Unlike poles pull together, or attract each other. These situations are shown in Figure 7.4.5.

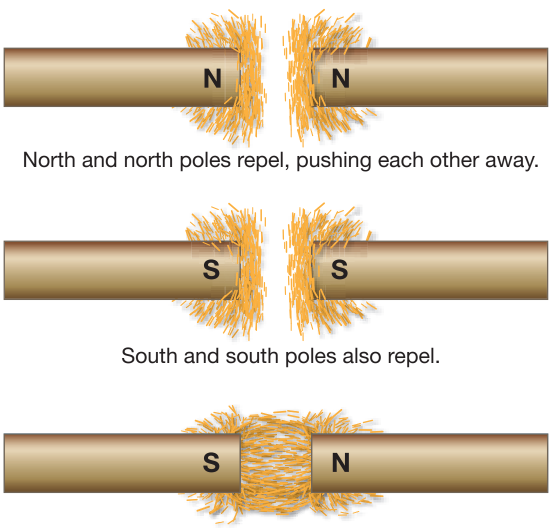

Figure 7.4.5 Magnetic poles that are like (NN or SS) will repel, whereas magnetic poles that are unlike (NS) will attract. We can then say that unlike poles attract while like poles repel each other.

Floating on air

SciFile

The repulsion of magnetic poles can make things float. This is called magnetic levitation. Maglev trains float about 10 cm above their track. They can reach speeds of 500 km/h because they operate with very little friction. Magnetic bearings used in machinery can support moving parts without touching them. They are complex to build, but offer great potential in reducing friction in a machine.

Magnetic domains

The metals iron, nickel and cobalt are attracted to magnets, while all other substances are not. Scientists believe that inside each of these metals are tiny magnetic particles called **domains**. Each of these acts like a mini-magnet, and has a north and a south pole. In a piece of magnetised iron, the domains all point in the same direction. This makes the domain act like a magnet. The domains in a piece of unmagnetised iron point in random directions, as shown in Figure 7.4.6.

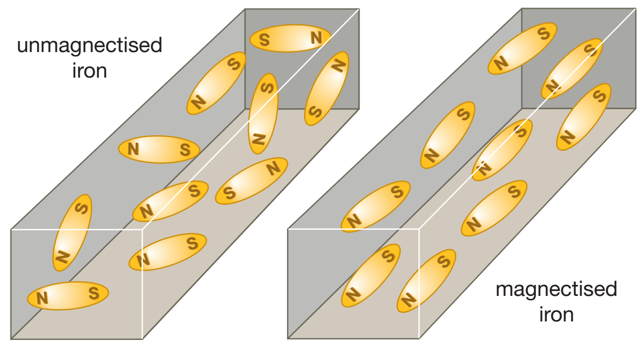

Figure 7.4.6 Domains are like mini-magnets. When they line up, they form a magnet with a north and a south pole. When they point in random directions, the metal has no magnetic properties.

Types of magnets

Temporary and permanent magnets

If you stroke an iron nail many times in the same direction with a bar magnet, then the nail begins to act like a magnet itself. This happens because you have pulled all of its domains into line. After a while, the effect wears off and the domains point in random directions once again. In this case, the nail is called a **temporary magnet** because it only acts like a magnet for a short period of time. **Permanent magnets** can be made by hitting or heating the metal to make the domains stay in this arrangement.

Magnets made from soft iron lose their magnetism more easily than magnets made from cast iron. Data stored on the magnetic strip on a credit card can be lost when placed near a strong magnetic field. If a magnet is heated or dropped, its domains may be knocked out of alignment, destroying its magnetism.

Electromagnets

In 1820, the Danish scientist Hans Oersted made an unexpected discovery. While explaining to his students that he did not believe there was any link between magnetism and electricity, he placed a compass near a wire through which an electric current was flowing. To his surprise, he saw the compass needle move. Oersted realised that electricity flowing through a wire creates a magnetic field around it. If the wire is wound into a coil, it produces a much stronger magnetic field. Inserting a piece of iron inside the coil increases its strength even further. Such a device is called an electromagnet and is shown in Figure 7.4.7. It acts like a bar magnet.

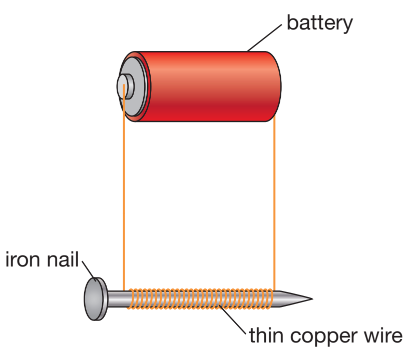

Figure 7.4.7 An electric current in the wire creates a magnetic field. This field can be turned on and off with the current. Coiling the wire and adding an iron insert increases the strength of the electromagnet.

An electromagnet is a temporary magnet, because when the electricity in the wire is switched off, the magnetic field is also switched off. Electromagnets are used within the speakers of our radios, TVs and sound systems. Household appliances such as hairdryers and power tools use electromagnets inside electric motors.

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7.7

Electric fields

Force fields also exist around electric charges. To understand **electric fields**, you first need an understanding of the atom and its internal structure.

What is an atom?

Everything around us is made up of tiny particles called **atoms**. Atoms themselves are made up of even smaller particles, called protons, neutrons and electrons. Neutrons are found deep within an atom in a region called the nucleus. They have no charge. Protons are also found in the nucleus and have a positive charge (+). Electrons move in the space around the nucleus as shown in Figure 7.4.8. They have a negative charge (–).

Usually an object has equal numbers of protons and electrons. It has no overall charge and is said to be neutral.

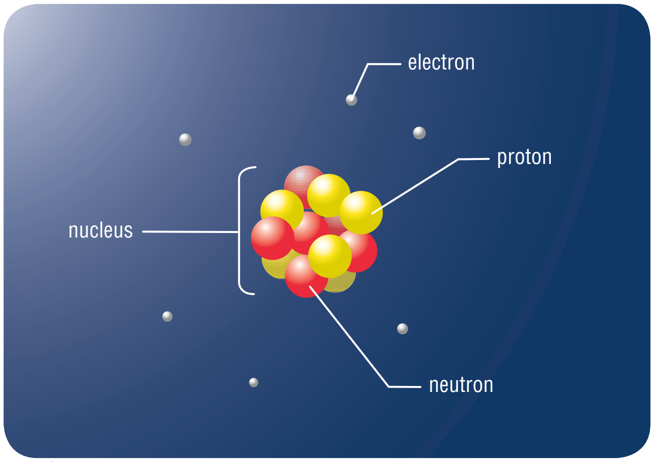

Figure 7.4.8 An atom consists of three types of smaller (subatomic) particles, called protons, neutrons and electrons.

SciFile

Splitting hairs

The atoms that make up everything around you are so small that you would need to line up about one million of them to stretch the width of a human hair.

Charging up

If one material is rubbed against another, electrons may move from one substance onto the other. If this happens, the number of protons and electrons in each is no longer balanced. Some materials, such as plastic, rubber and wood, will build up charge when rubbed with another substance. Such materials are called electrical **insulators**. Electrons cannot flow freely through them. The reason electrical wires are covered with plastic is because plastic is an effective electrical insulator. Metallic objects do not build up a static charge, because electrons can flow through them. These materials, such as a copper electrical wire, are called electrical **conductors**.

Figure 7.4.9 on page 278 shows that when a glass rod is rubbed with a silk cloth, electrons move from the glass rod onto the silk cloth. The glass rod has lost electrons and is now **positively charged**, because it has more protons than electrons. The silk cloth has gained electrons and is **negatively charged**, having more electrons than protons. When an object becomes charged (has unequal numbers of protons and electrons), we say that it has **static electricity**.

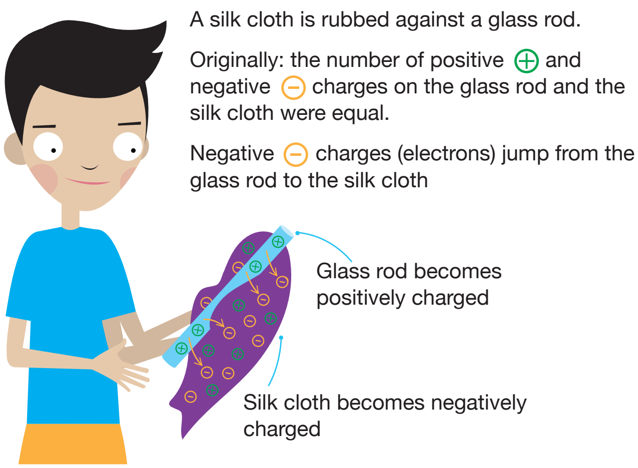

Figure 7.4.9 Electrons are rubbed from the glass rod and jump onto the silk cloth. As a result, the glass rod becomes positively charged and the silk cloth is negatively charged.

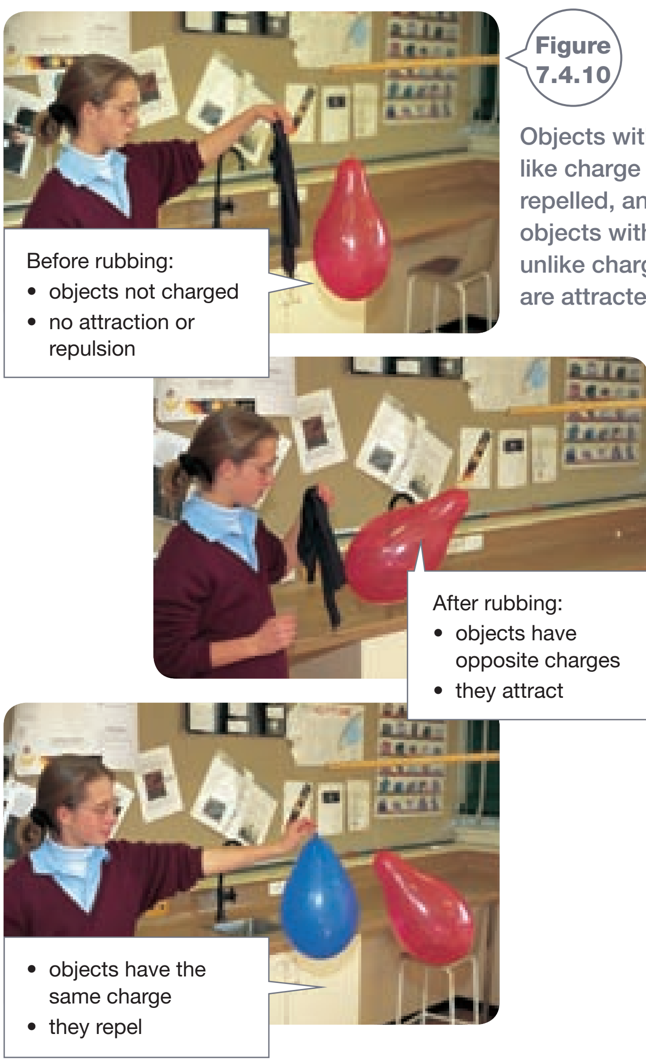

Figure 7.4.10 Objects with like charge are repelled, and objects with unlike charge are attracted.

A force field called an electric field exists around any object that is charged. Any charged object positioned within this field will experience a force, called an **electrostatic force** (or an electric force). If we rub a balloon with a silk cloth, electrons rub off the silk and onto the balloon. Both the silk cloth and the balloon are now charged, and are surrounded by an electric field. Figure 7.4.10 shows what happens when these charged objects are placed next to each other. If placed inside an electric field, two objects with different types of charge will attract each other, while those with the same type of charge will repel. Note that a charged object may also attract a neutral object.

A machine called a Van de Graaff generator separates charge by friction between a moving rubber belt and a plastic pulley. Negative charges are released to flow through to the ground, while positive charges are transferred onto the dome of the generator. The girl touching the generator in Figure 7.4.11 becomes positively charged. Her hair stands up because each strand of hair is repelling the hair around it!

Figure 7.4.11 Each strand of this girl's hair is positively charged and is repelling all of the hair around it.

How is electric charge discharged?

Static electricity describes a build-up of charge. If you walk across carpet on a dry day and touch a metal door handle, you could get a shock. Friction between your feet and the carpet rub electrons from the carpet onto you, making you and the carpet both charged. Normally, this charge gradually leaks back out of your shoes to the ground, or into the air, and you become neutral once more. If there is a big build-up of charge, or if you wear rubber-soled shoes that stop the charge from escaping, extra electrons can jump from you to the metal door handle as a spark. You feel this as a small electric shock. If you were to touch another person while charged, electrons would jump onto this person and you would both feel a static shock.

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> **SciFile**
>
> **Dazzling fashion**
>
> The Sp4rkl3 skirt is a piece of clothing with a difference: it really shines! Designed by a team at the Massachusetts Institute of Technology, the skirt contains circuitry and layers of Teflon and nylon. As the wearer moves around, these layers generate static electricity which can be discharged to power rows of LEDs that are studded into the fabric.

Much larger and more dangerous electric shocks can be received if you are struck by lightning. Lightning itself is a giant spark that is the result of charge build-up within a thundercloud.

The movement of water droplets in storm clouds can cause charges to separate within a cloud. The top becomes strongly positive as it loses electrons, and the bottom becomes strongly negative due to a build up of electrons. If enough static electricity builds up, electrons can jump to another region of the cloud, to another cloud or to the ground. This process is shown in Figure 7.4.12.

7.8

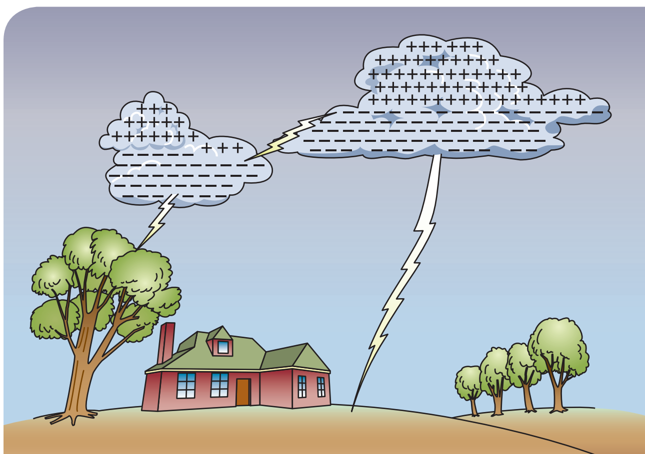


Figure 7.4.12 This flow of electrons is lightning. The heat produced by lightning makes the surrounding air expand rapidly, which we hear as thunder.

> **SciFile**
>
> **When lightning strikes**
>
> Lightning hits the tallest objects around, so never shelter under a big tree if you are caught outside during a thunderstorm. Seek shelter inside a house or in an enclosed car. The electrical current of a lightning flash can travel through house wiring or plumbing, so keep your distance from electrical appliances, sinks and showers during a thunderstorm.

7.4 Unit review

Remembering

1 Copy each statement, and **state** which term in italics correctly completes each sentence.
 a A magnetic force is a *contact/non-contact* force.
 b As you get closer to a magnet, the size of the magnetic force *increases/decreases*.
 c A north pole of one magnet is attracted to the *north/south* pole of another magnet.
 d A magnet is *strongest/weakest* at its poles.

2 **List** five places you could find a magnet in your home.

3 Atoms consist of two types of charged particles.
 a **State** the name of a positively charged particle.
 b **State** the name of a negatively charged particle.

4 If a plastic ruler loses electrons when it is rubbed on a piece of woollen fabric, **state** whether it has become positively or negatively charged.

Understanding

5 **Explain** how Oersted realised that an electric current could create a magnetic field.

6 **Explain** why a steel ball bearing is attracted to a magnet.

Applying

7 **Identify** whether the magnets in Figure 7.4.13 will attract or repel in each case.

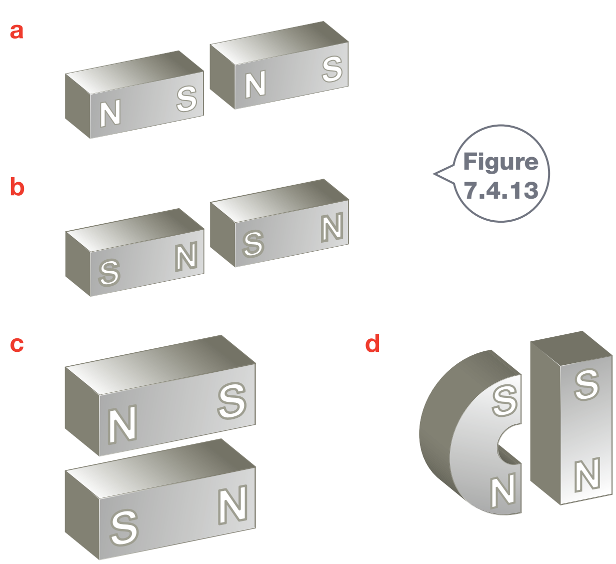


Figure 7.4.13

8 **Use** the magnetic field shown in Figure 7.4.14 for the following questions.

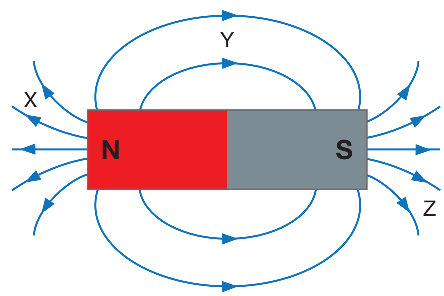


Figure 7.4.14

 a Would a compass placed at X point to the left or right?
 b In which position, X, Y or Z, would an iron nail be attracted to the magnet with the most force?
  i In which of these positions is the magnetic field strongest?
  ii How do you know this from the diagram?

9 In Figure 7.4.15, **identify** a:
 a positively charged object
 b negatively charged object
 c neutral object.

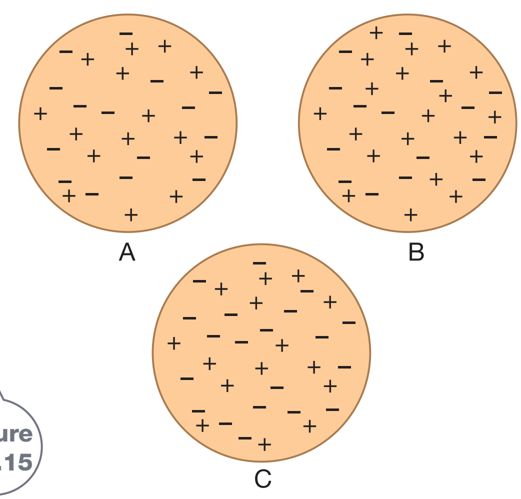


Figure 7.4.15

10 In each situation, **identify** which two surfaces are rubbing together to produce static electricity.
 a Hundreds-and-thousands stick to the walls of the plastic bottle in which they are stored.
 b After driving to a shop, you get a shock as you close the car door.
 c Your clothes crackle as you lift them out of the clothes dryer.

Analysing

11 The bar magnet and the horseshoe magnet shown in Figure 7.4.16 are attracted to each other.

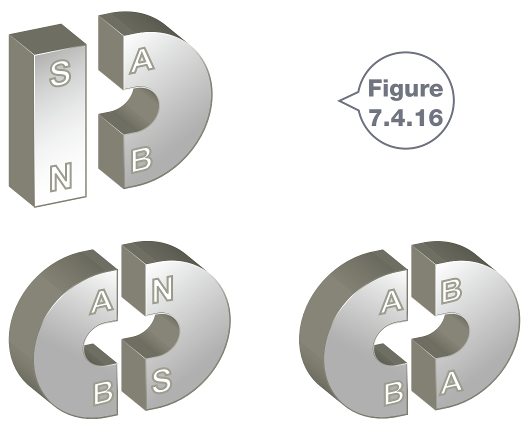


Figure 7.4.16

Combination A

Combination B

Analyse this diagram to:

a **identify** whether each of the combinations A and B will attract or repel

b **explain** whether you have been able to answer for combination B without any other information.

12 **Classify** each of the following materials as an electrical conductor or an electrical insulator.

a aluminium foil

b polystyrene cup

c plastic ruler

d glass rod

e copper pipe

f rubber hose

Evaluating

13 Sometimes you can hear a crackle when pulling on a nylon jumper. **Propose** what makes this sound.

14 **Propose** why you are asked to turn off mobile phones while putting petrol in a car.

15 Ralph and Julia are walking along the red carpet to an Academy Awards ceremony. Upon touching a gold banister, Julia receives a nasty static shock.

a **Analyse** why Julia got a shock.

b **Propose** how she could prevent this from happening again.

Creating

16 Lying on a bench in front of you is nail A, which is not magnetised, and nail B, which has been treated to become a temporary magnet.

a **Construct** a diagram to show how the domains inside nails A and B could be aligned at the moment.

b **Construct** another diagram to show how you would expect the domains of nails A and B to look tomorrow.

Inquiring

1 Naturally occurring magnetic materials have been used for centuries to guide sailors. Magnets have many other applications in the world today. Research and describe one aspect of modern use, such as that within:

- metal detectors
- magnetic strips on credit cards
- magnetic separators
- loudspeakers
- electric bells.

2 An MRI (magnetic resonance imaging) machine uses very strong magnetic fields to glimpse inside the body. Describe:

a what it is commonly used for

b any precautions associated with its use.

3 An induction cooktop uses electricity to focus a magnetic field where the food is to cook. Assess the advantages and disadvantages of this method of cooking.

4 Design and conduct an experiment in which you magnetise a nail by stroking it (in one direction) with a bar magnet. You could investigate one of the following.

- Whether the number of paper clips attracted vary depending on how many times the nail was stroked
- If the time the nail remains magnetic varies for the number of strokes made

1 Magnetic shielding

Purpose

To test which materials a magnetic field can pass through and which materials will block a magnetic field.

Materials

- 50 g mass
- paper clips
- cotton thread
- Blu Tack
- bar magnet
- retort stand and clamp
- sheets of different materials such as cardboard, plastic, aluminium foil, iron, steel, tin, wood, glass, copper

Procedure

1 Set up the equipment as shown in Figure 7.4.17.

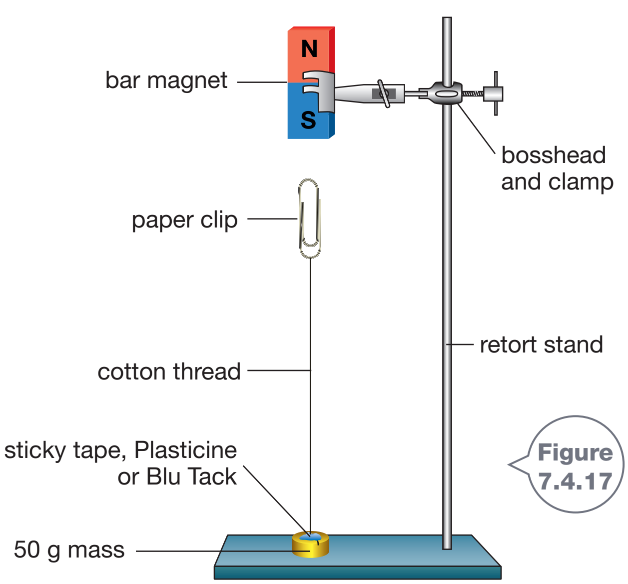


Figure 7.4.17

2 Find the maximum distance that can be left between the paper clip and the magnet before the paper clip falls.

3 Insert each different sheet between the paper clip and the magnet and record what happens in your results table.

Results

In your workbook, construct a table like that shown below to record your observations.

Material	Paper clip stayed/dropped

Discussion

1 In terms of the strength of a magnetic field, **explain** why the paper clip fell when it was moved further from the bar magnet.

2 **List** the materials that allowed a magnetic field to pass through them.

3 **List** which materials acted as a magnetic shield.

4 Magnetic fields can damage sensitive electronic equipment. **Propose** a use for materials that act as magnetic shields.

2 Making an electromagnet

Purpose

To make an electromagnet and test how its strength can be increased.

SAFETY

Take care when connecting your circuits.

Materials

- 6V lantern battery or a power pack
- large nail or bolt (at least 7 cm long)
- compass
- paper clips
- switch
- 2 insulated wires (one long) with alligator clips

Procedure

1 Test to see if the nail on its own will pick up any paper clips.

2 Connect the shorter wire from the battery/power pack to the switch.

3 Carefully wind the long wire 10 times around the nail as neatly as you can.

4 Connect one end to the switch and the other to the power supply as shown in Figure 7.4.18.

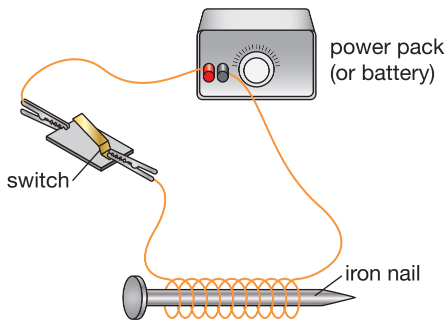


Figure 7.4.18 Setting up your circuit with the electromagnet

Results

1 Copy the table below into your workbook.

2 Set the power pack to 6 volts DC.

3 Press the switch down and record the number of paper clips raised for each number of turns of the wire.

4 Test which end of the nail is the north and south pole using a compass.

5 Reverse the connections to the power supply and repeat step 4.

Number of turns on wire	Number of paper clips picked up
0	
10	
20	
30	
40	
50	

Discussion

1 **State** the effect of the number of turns of the wire on the number of paper clips picked up.

2 **Describe** what happened to the poles of the electromagnet when the connections were reversed.

3 Investigating static electricity

Purpose

To explore static electricity.

Materials

- plastic comb
- sheet of paper
- woollen material
- balloons
- string
- retort stand and clamp

Procedure

1 Rub the plastic comb vigorously on the woollen material. Bring it close to some tiny pieces of paper. Write down what happens.

2 Turn a water tap on and carefully turn it down to get the finest stream that you can of steadily flowing water. Rub the comb with the woollen material and hold it close to the stream of water. Draw a diagram to show what you observe.

3 Blow up a balloon and rub it with the woollen material. See if you can make the balloon 'stick' to the wall.

4 Blow up a second balloon. Attach a piece of string to each of the balloons and then tie these to a retort stand. Rub both balloons with the woollen material. Draw a diagram to show what happened.

Discussion

1 **Explain** why you could pick up the pieces of paper with the comb.

2 **Describe** what happened to the stream of water when the charged comb was brought near to it.

3 **Explain** why the water behaved in this way.

4 **Propose** an explanation for your observations in the two balloon activities.

7 Chapter review

Remembering

1 **State** whether the following are true or false.
- **a** An elephant has greater inertia than a mouse.
- **b** A person inside a bus that is turning left will lean to their left side.
- **c** Gravity is a contact force.
- **d** Weight is measured in kilograms.
- **e** The north pole of a magnet will attract the north pole of another magnet.
- **f** The magnetic field of a magnet is strongest at its poles.
- **g** A proton has a negative charge.
- **h** An electric field exists around a charged particle.

2 **List** four examples of a pushing force.

3 **Name** a surface that has little friction.

4 **Name** the three metals that are attracted to magnets.

5 **State** whether an electromagnet is a temporary or a permanent magnet.

Understanding

6 **Explain** the difference between a contact force and a non-contact force. Give an example of each type.

7 Su-Lin washes some lettuce and spins it in a salad spinner. When she opens the spinner, she finds the lettuce is almost dry in the meshed insert, but the outside container contains droplets of water. In terms of inertia, **explain** how the salad spinner dries the lettuce.

8 **Describe** what the Bernoulli effect refers to and give an example.

9 **Explain** how dropping a magnet could destroy its magnetism.

10 If a comb pulled through your hair becomes negatively charged, then **predict** the charge of your hair.

11 If you rub a CD with a cloth to clean it, you may notice dust drifting towards it and landing on its surface. **Describe** why this happens.

Applying

12 **Use** the diagrams in Figure 7.5.1 to **identify** which direction (not at all, up, down, left or right) each object shown will move when acted upon by the forces shown.

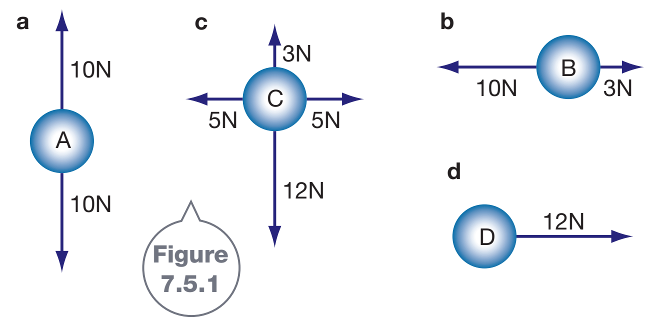


Figure 7.5.1

13 Figure 7.5.2 shows a graph that compares the braking distances of new and old tyres for different road surfaces and weather conditions. **Use** it to answer the questions that follow.

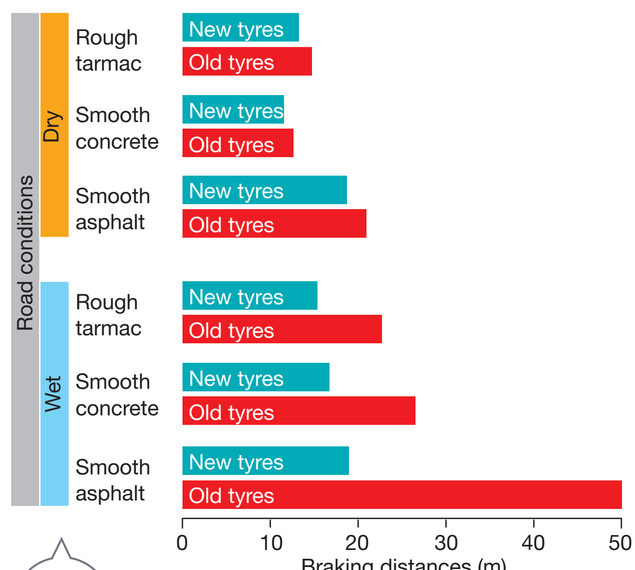


Figure 7.5.2

- **a** **State** which combination of factors produces the longest braking distance.
- **b** **State** reasons for the result in terms of forces.
- **c** **Describe** the weather conditions under which tyre performance varies the most.
- **d** **State** whether new or old tyres vary the most in performance.
- **e** **Explain** why old tyres are not as effective in stopping a car as new tyres.

Analysing

14 **Analyse** the force diagram in Figure 7.5.3.

a **State** in which direction the boat is moving.

b **Predict** what will happen to the speed of the boat when many fish have been caught in the net.

c If the boat is travelling at a constant speed, **compare** the size of the thrust and drag forces acting on the boat.

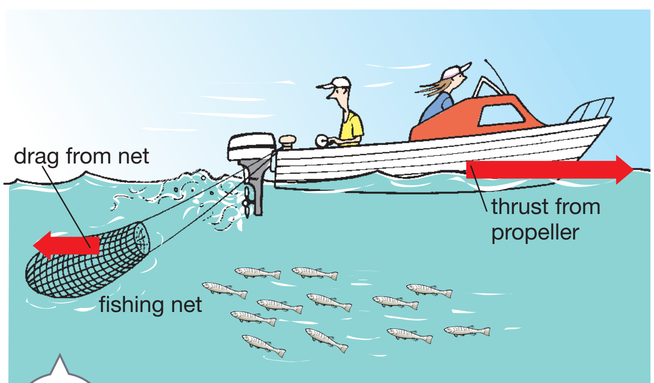


Figure 7.5.3

Evaluating

15 Mariah flicks a coin across the stone benchtop in her kitchen. Later that day, she tries to flick the same coin across sand at the beach.

a **Predict** which coin would travel the greater distance.

b **Justify** your prediction.

16 Figure 7.5.4 shows three blocks of wood resting on different surfaces. If you were to pull each by its hook, **propose** which block would move with the least friction and which block would move with the most friction.

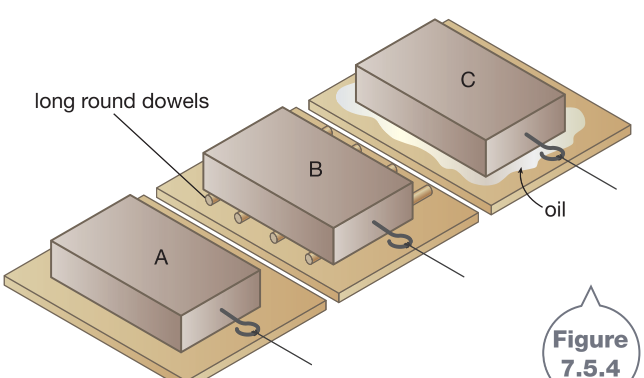


Figure 7.5.4

17 A length of wire is used to make coils A, B and C shown in Figure 7.5.5. An iron nail is inserted into Coil C.

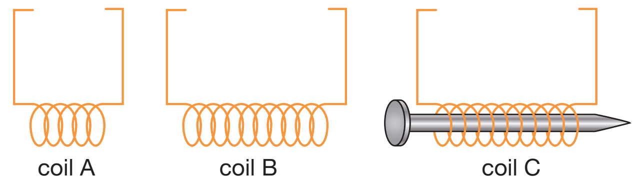


Figure 7.5.5

a **Propose** which of the three would produce the strongest electromagnet when connected to a power supply.

b **Justify** your response.

Creating

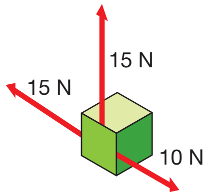
18 **Use** the following ten key terms to **construct** a visual chapter summary of the information presented in this chapter.

gravity	mass
weight	friction
inertia	force
force field	motion
magnetic field	electric field

7.9

Thinking scientifically

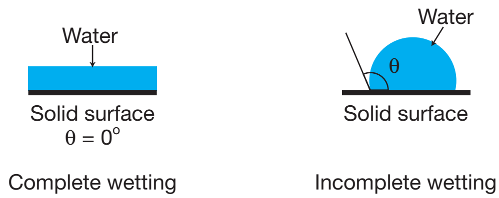
Q1 The total force acting on an object can be found by comparing the overall horizontal and overall vertical forces. A box is acted upon by three forces as shown below.



Which way will the box move as a result of these forces?

A Upwards and to the left
B Upwards and to the right
C Downwards and to the left
D Downwards and to the right

Q2 Water on a solid surface may form a droplet on the surface (with a particular angle of contact, θ), or completely wet the surface. This is shown in the diagram below.



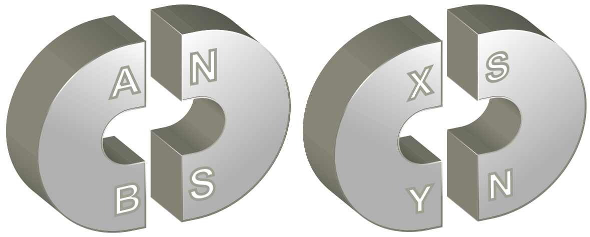
The table lists typical values of the contact angle measured between water and various surfaces.

Solid surface	Contact angle, θ (°)
Tooth enamel	36
Paraffin wax	110
Skin	80
Glass	0
Hair	90

The order in which water wets these surfaces, from the least to the greatest amount, is:

A glass, paraffin wax, hair, skin, tooth enamel
B paraffin wax, tooth enamel, glass, hair, skin
C glass, tooth enamel, skin, hair, paraffin wax
D paraffin wax, hair, skin, tooth enamel, glass

Q3 Siobhan finds two horseshoe magnets in her school laboratory that do not have their poles marked correctly. One has poles labelled A and B, while the other has poles labelled X and Y. She tests each using a third horseshoe magnet and finds the following combinations attract.



Knowing that opposite poles attract, select which of the following pairs of poles will attract.

A X and B; Y and A
B X and A; X and B
C Y and A; Y and B
D X and A; Y and B

Glossary

Unit 7.1

Acceleration: increase in speed (verb: accelerate)

Deceleration: decrease in speed (verb: decelerate)

Force: a push, pull or a twist that can change an object's motion

Inertia: the tendency of an object to resist any change in its motion

Newton (N): unit used to measure force

Force

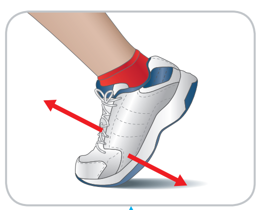
Unit 7.2

Air resistance: or drag: friction that acts on an object moving through the air

Contact force: force that acts between two objects that touch, or are in contact; for example friction

Friction: force that acts against an object's motion

Lubricants: fluid, such as oil, used to reduce friction between moving parts



Friction

Unit 7.3

Force field: region of space in which an object will experience a non-contact force

Gravitational field: region of space in which an object will experience a force due to gravity

Gravity: force of attraction between any two objects, for example the Earth and a person

Mass: the amount of matter in a substance (measured in kilograms)

Non-contact force: force that acts on an object from a distance

Terminal velocity: the point at which a falling body ceases to accelerate, but falls at constant speed, because its weight is balanced by air resistance

Weight: the force of gravity pulling on an object, measured in newtons

Terminal velocity

Unit 7.4

Atoms: tiny particles that make up all matter

Conductor: substance through which electrons can flow, such as metal

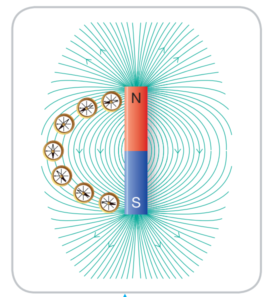
Domains: small regions inside a magnet that each behave as a mini-magnet, with a north and south pole

Electric field: region around a charged object in which another will experience a force

Electrostatic force: force experienced inside an electric field (also called electric force)

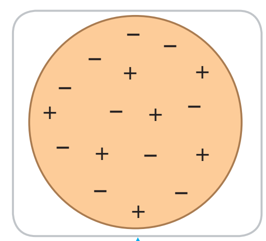
Insulator: substance through which electrons do not flow, such as plastic

Magnetic field: region around a magnet in which a magnetic force is experienced



Magnetic field

Negatively charged: having more negative charges (electrons) than positive charges (protons)



Negatively charged

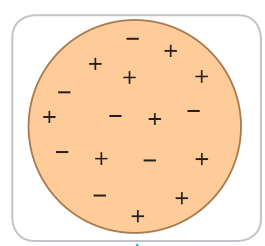
Permanent magnet: a material that remains magnetic for a long period of time

Poles: ends of a magnet, may be a north or a south pole

Positively charged: having more positive charges (protons) than negative charges (electrons)

Temporary magnet: a material that keeps its magnetism for a short period of time

Static electricity: a build-up of electric charge



Positively charged