Forces Key Notes

Forces & Speed

A force is a push or a pull on an object

Contact forces - two objects in contact with each other

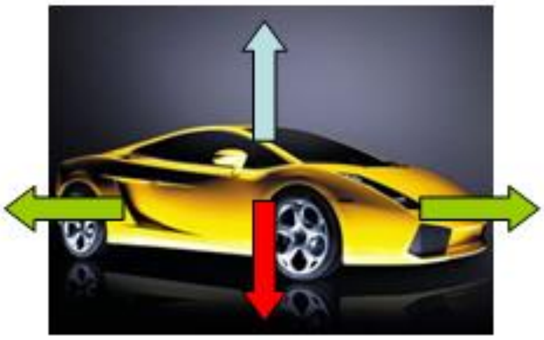
Non-contact forces - a force that acts over a distance

Types of force: -

- Gravitational Force - acting straight downwards
- Magnetic Force - push / pull exerted by a magnet
- Electrical Force - a force between two charged objects
- Reaction Force - force from the surface, usually acting straight upwards
- Contact Force (push / pull forces) - force which results in the object speeding up, for example, due to an engine / rocket
- Friction - friction between surfaces slowing an object down. This can include air resistance - (special type of frictional force) where air in the atmosphere slows down a moving object
- Tension Force - pulling of a rope / cable from opposite ends
- Elastic Force - compression / extension of a spring or elastic product

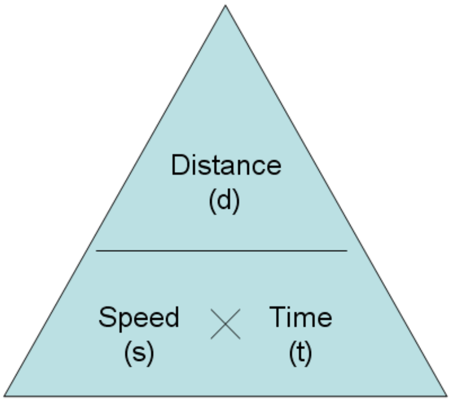
We represent forces using arrows - the arrow points the way the force is working

The arrow also represents the size of the force - the **bigger** the arrow, the greater the force is - these arrows always come in pairs…



Speed is a measurement of how quickly something is traveling at, which can be in m/s; km/h; mph; cm/year etc…

To work out the speed of something, you need to know the distance covered and the time it took to get there

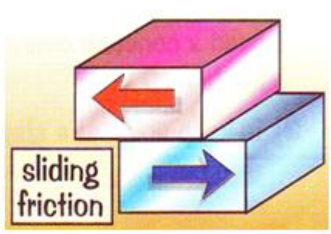


Friction is a force which occurs when two objects interact

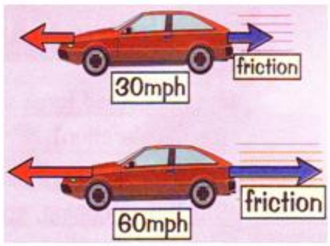
If an object has no force propelling it, it will slow down and eventually stop due to friction. Friction occurs between solid surfaces which are gripping / sliding past each other (e.g. a tyre on the road / marble down a ramp)

Resistance (drag) from the air or liquid - as you move air or liquid particles collide into you (this is why a parachute slows you down and to go very fast cars need to become streamlined)

Friction increases as speed increases - more speed = more air particles colliding into you



Friction between two surfaces



Friction increases as speed does

Air resistance - example of friction

Distance-time graphs

You should be able to draw and explain distance-time graphs for objects moving at steady speeds or standing still.

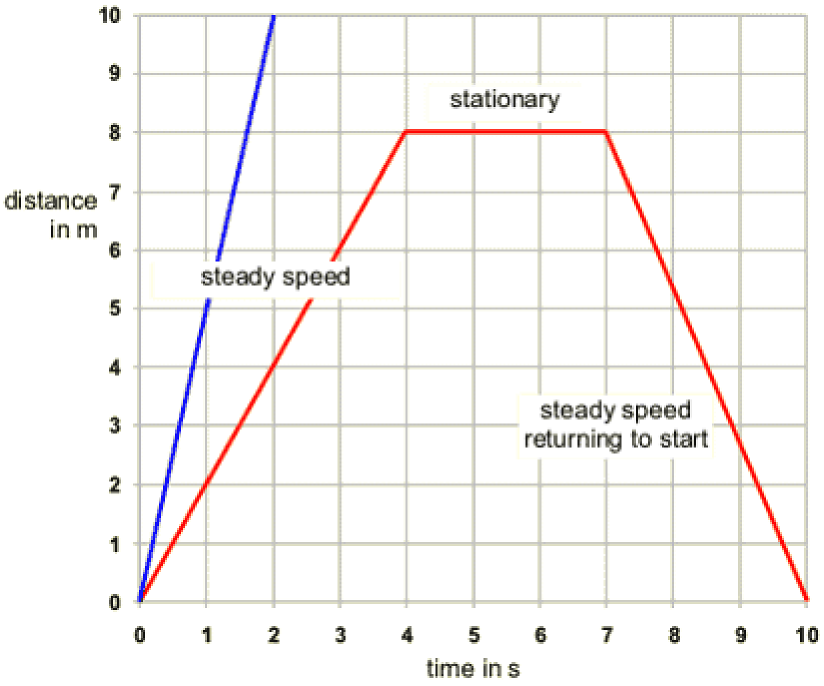
Background information

The vertical axis of a distance-time graph is the distance travelled from the start. The horizontal axis is the time from the start.

Features of the graphs

When an object is stationary, the line on the graph is horizontal. When an object is moving at a steady speed, the line on the graph is straight, but sloped.

The diagram shows some typical lines on a distance-time graph.



Distance - time graph

Note that the steeper the line, the greater the speed of the object. The blue line is steeper than the red because it represents an object moving faster than the one represented by the red line.

The red lines on the graph represent a typical journey where an object returns to the start again. Notice that the line representing the return journey slopes downwards.

Velocity (Acceleration) -time graphs

You should be able to explain velocity-time graphs for objects moving with a constant velocity or constant acceleration.

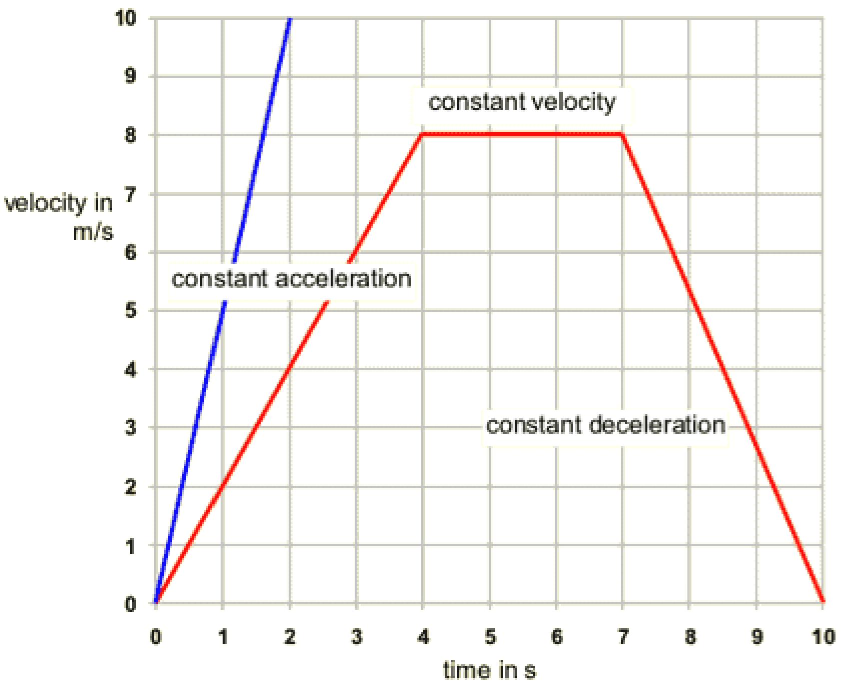
Background information

The velocity of an object is its speed in a particular direction. This means that two cars travelling at the same speed, but in opposite directions, have different velocities.

The vertical axis of a velocity-time graph is the velocity of the object. The horizontal axis is the time from the start.

Features of the graphs

When an object is moving with a constant velocity, the line on the graph is horizontal. When an object is moving with a constant acceleration, the line on the graph is straight, but sloped. The diagram shows some typical lines on a velocity-time graph.



Speed - time graph

The steeper the line, the greater the acceleration of the object. The blue line is steeper than the red line because it represents an object with a greater acceleration.

Notice that a line sloping downwards - with a negative gradient - represents an object with a constant deceleration - slowing down.

Why Things Float

The reason some objects float and others sink is due to density

Density is an equation of an object's mass divided by its volume

Density = mass / volume

If an object is more dense than water, it sinks

If it is less dense, it floats!

Objects will either sink of float, depending upon their density - if they are more dense than water, they sink, less dense, and they float

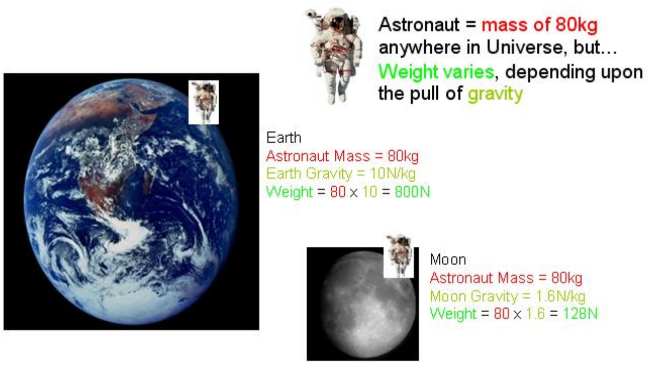
The shape of an object has a lot to do whether it sinks or not - 100kg of steel will sink, but 100kg of steel shaped into a boat will float, because overall the volume of the boat is much bigger (it contains a great deal of space which isn't steel), so its overall density is reduced

*Buoyancy defined: an object in a fluid experiences an upward force equal to the weight of the fluid displaced by the object – if the boat can displace a greater mass of liquid than its own mass, then it will float!

Mass, Weight

Mass is the amount of stuff there is (in kg)

Weight is caused by the pull of gravity (in N/kg) - this will be different if you are own the Earth / Moon / in a black hole!



Bar magnets

Before we look at electromagnets let's recap **bar magnets**.

Bar magnets are **permanent** magnets. This means that their magnetism is there all the time and cannot be turned on or off. They have two poles:

Bar magnet

1. north pole (or north-seeking pole)
2. south pole (or south-seeking pole).

The north pole is normally shown as **N** and the south pole as **S**.

Magnets are made from magnetic materials. These are metals that can be magnetised or will be attracted to a magnet. Most materials are not magnetic, but **iron**, **cobalt** and **nickel** are magnetic. **Steel** is mostly iron, so steel is magnetic too.

Attract and repel

If you bring two bar magnets together, there are two things that can happen:

- if you bring a north pole and a south pole together, they **attract** and the magnets may stick together
- if you bring two north poles together, or two south poles together, they **repel** and the magnets push each other away.

We say that unlike poles attract, and like poles repel.

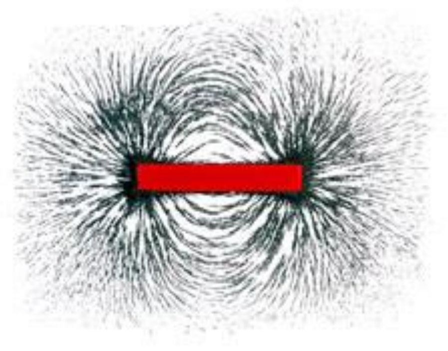
Magnetic fields

Before we look at electromagnets let's recap **magnetic fields**.

Magnets create **magnetic fields**. These cannot be seen.

They fill the space around a magnet where the magnetic forces work, where they can attract or repel magnetic materials.

Finding magnetic fields

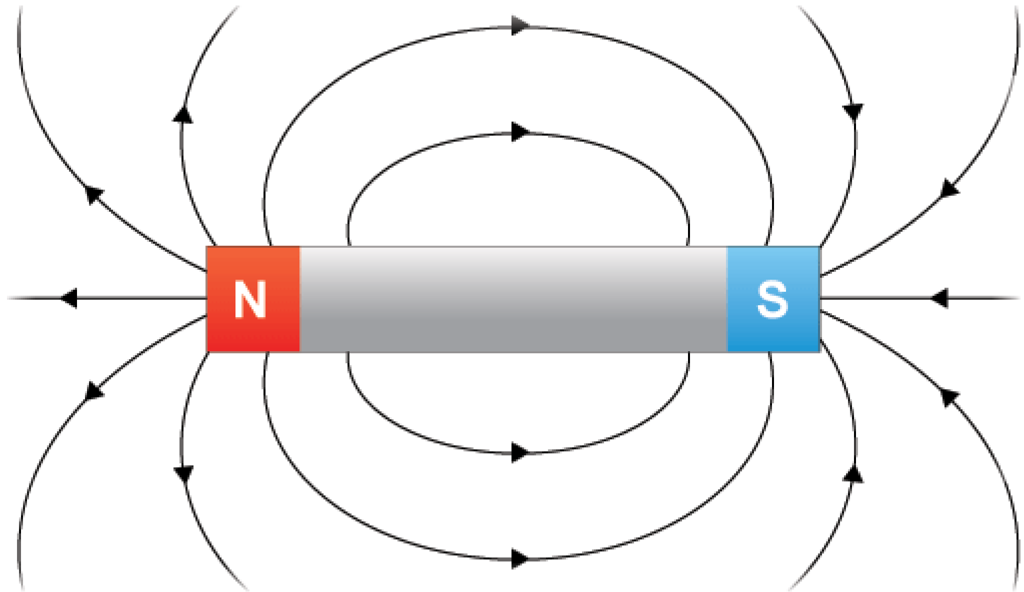


Field lines around a bar magnet

Although we cannot see magnetic fields, we can detect them using **iron filings**. The tiny pieces of iron line up in a magnetic field.

Drawing magnetic field diagrams

It would be difficult to draw the results from the sort of experiment seen in the photograph, so we draw simple magnetic field lines instead.



In the diagram, note that:

- the field lines have arrows on them
- the field lines come out of N and go into S
- the field lines are more concentrated at the poles.

The magnetic field is strongest at the poles, where the field lines are most concentrated.

Electromagnets

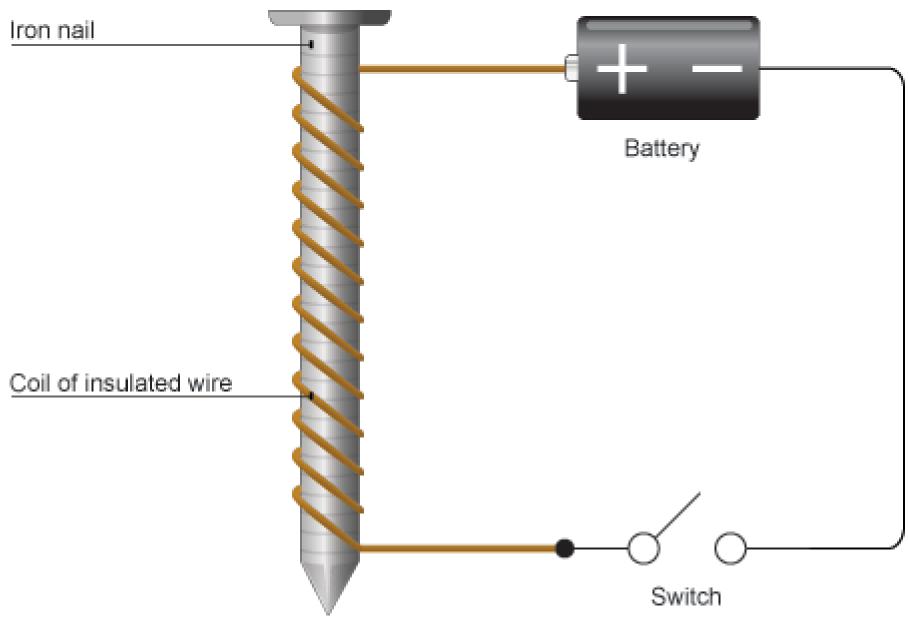
When an electric current flows in a wire it creates a magnetic field around the wire.

By winding the wire into a **coil** we can strengthen the magnetic field. Electromagnets are made from coils like this.

Making an electromagnet stronger

We can make an electromagnet stronger by doing these things:

- wrapping the coil around an **iron core**
- adding **more turns** to the coil
- **increasing the current** flowing through the coil.



The magnetic field of an electromagnet

The magnetic field around an electromagnet is just the same as the one around a bar magnet. It can, however, be reversed by turning the battery around.

Unlike bar magnets, which are permanent magnets, the magnetism of electromagnets can be turned on and off just by closing or opening the switch.