KS3 Science
Year 7 - Forces

Additional keywords: force, Newton, Newton meter, squash, stretch, friction, drag, air resistance, water resistance, gravity, stationary, speed, average speed, relative motion, acceleration, deceleration, constant speed, gradient

What is a force?

A force can be a push or a pull. You cannot see a force but you can see what it does. When a force is exerted on an object it can;

- Change the object's speed,
- Change the movement of an object (speed it up or slow it down)
- Change the shape of the object.

Video link

A **Newton meter** is used to measure force. They contain a spring connected to a metal hook. The spring stretches when a force is hung on the hook. The bigger the force applied, the longer the spring and the bigger the reading, which is measured in **Newtons**.

Forces can be **contact** forces, such As drag, friction and air resistance.
Or **non-contact** forces, such as Magnetism, gravity and static.

Resultant forces

When two forces acting on an object are not equal in size, we say that they are **unbalanced** forces. The overall force acting on the object is called the **resultant force**. If the forces are balanced, the resultant force is zero. In this case;

- a stationary object starts to move in the direction of the resultant force
- a moving object changes speed and/or direction in the direction of the resultant force

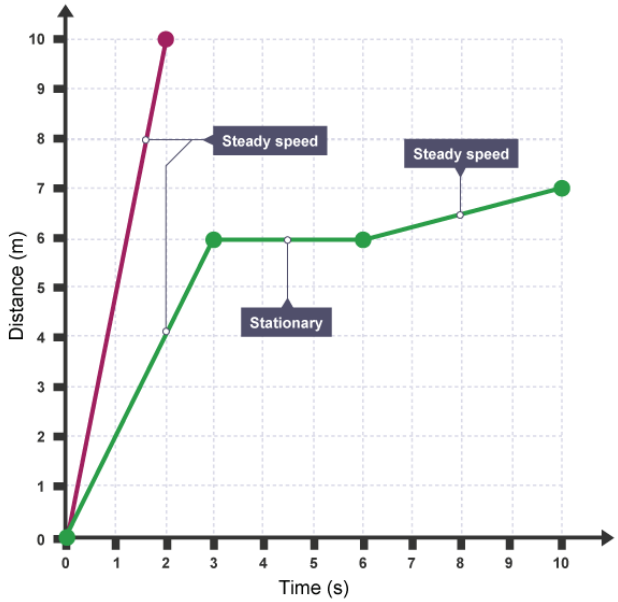
The resultant force is the difference between the two forces:

The greater the resultant force, the greater the change in the motion of the object. Whether a moving object speeds up, or slows down, depends on the direction of the resultant force:

- the object speeds up if the resultant force acts in the direction of movement
- the object slows down if the resultant force acts opposite to the direction of movement

Distance-time graphs

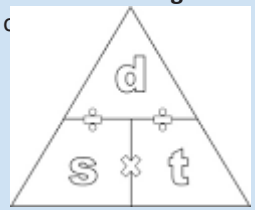
A **distance-time graph** shows how the distance moved from a starting point changes over time



Calculating speed

Speed is a measure of how **fast** something or somebody is moving.

A **formula triangle** is a quick way to calculate the speed, distance



For example:
D = S × T
S = D ÷ T
T = D ÷ S

The unit used for speed depends on the units for distance and time. For example:

- Distance = **m (metres)**; Time = **s (seconds)**; Speed = **m/s (metres per second)**

Changing speeds

You can find the **average speed** of an object if you know:

- the **distance** travelled
- the **time** taken to travel that distance

You can calculate average speed using this equation:

average speed = distance ÷ time

The change in the motion of an object depends upon:

- the size of the resultant force
- the direction of the resultant force

An object speeds up, or **accelerates**, if the resultant force acts **in the direction of movement**

An object slows down, or **decelerates**, if the resultant force acts **opposite to the direction of movement.**

In a distance-time graph:

- distance travelled is plotted on the vertical (y) axis
- time taken is plotted on the horizontal (x) axis

The **gradient** (slope) of the line is equal to the speed. This means that the line is:

- **horizontal** for a **stationary** object (because the distance stays the same)
- a **straight diagonal** for an object moving at a **constant speed**

The steeper the line, the greater the gradient and the greater the speed.

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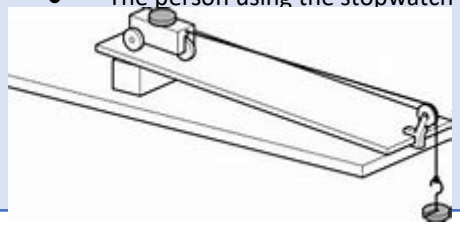
Additional keywords: weight, non-contact force, mass, gravitational field strength, field,

Investigating speed

You can investigate the acceleration of an object using a trolley on a ramp.
In class you may have investigated the effect of increasing force on the acceleration of a trolley (car).
In this case;
The thing you are changing (the **independent variable**) is the force acting on the trolley (using mass (grams).
The thing you are measuring (the **dependent variable**) is the time taken for the trolley to travel a set distance.
The things you must keep the same (**control variables**) are;

- The trolley
- The distance travelled
- The person using the stopwatch



The results show you that increasing the force (or mass added) increases the acceleration of the object.

Analysing data - means, anomalies and outliers

Scientists use data as evidence of their results when testing theories or hypotheses.
In order to overcome errors when collecting data, it is good practise to repeat experiments at least 3 times. This is to avoid reporting a false result caused by human or equipment **errors**. For example, a faulty thermometer, or a broken mass balance. Other errors could be caused by someone reading the incorrect reading on a measuring device.

To make our data more reliable we take repeat readings, usually at least 3. This allows us to calculate a mean value. When calculating a mean value you must ignore any anomalies, or outliers. These are results which do not fit your expected result. For example, below Trial 3 does not fit our pattern and so we exclude it from calculating our mean;

Mass and Weight

The **mass** of an object is the amount of **matter** or 'stuff' it contains. The more matter an object contains, the greater its mass.

Mass is measured in kilograms, kg.

Don't confuse mass and weight. Remember that weight is a force that acts upon a mass, and is measured in newtons, N.

An object's mass stays the same wherever it is. So a 5 kg mass on Earth has a 5 kg mass on the Moon.

The **weight** of an object is the gravitational force between the object and the Earth. The weight of an object depends upon its mass and the gravitational field strength.

Video link

Gravity

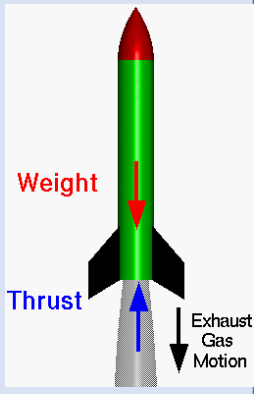
Gravity is a force that attracts objects towards each other. Gravity only becomes noticeable when there is a really massive object like a moon, planet or star. We are **pulled down** towards the ground because of gravity.
The gravitational force pulls in the direction towards the centre of any object. So we are pulled towards the centre of the Earth.
Gravitational field strength is given the symbol *g*. Do not confuse this with g for grams. You can use this equation to calculate the weight of an object:

weight in N = mass in kg × gravitational field strength in N/kg

On Earth, g is about 10 N/kg. This means that a 2 kg object on the Earth's surface has a weight of 20 N (2 kg × 10 N/kg = 20

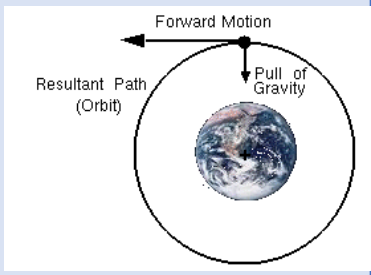
Astronauts journey

In rocket flight, forces become balanced and unbalanced all the time.
A rocket on the launch pad is **balanced**: The surface of the pad pushes the rocket up while gravity tries to pull it down.



As the engines are ignited, the **thrust** from the rocket unbalances the forces, and the rocket travels upward.
When the rocket runs out of fuel, it slows down, stops at the highest point of its flight, then falls back to Earth

Objects in space also react to forces. A spacecraft moving through the solar system is in **constant motion**. The spacecraft will travel in a straight line if the forces on it are **balanced**.



This happens only when the spacecraft is very far from any large **gravity** source such as Earth or the other planets and their moons.
If the spacecraft comes near a large body in space, the gravity of that body will **unbalance** the forces and **curve** the path of the spacecraft.

This happens, in particular, when a satellite is sent by a rocket on a path that is parallel to Earth's surface. If