Forces **Knowledge Organiser**

Types of Forces

Contact Forces

Contact forces act between objects that are physically touching each other.

friction – The force between two surfaces that are sliding, or trying to slide, past each other.

air resistance – The force that acts in the opposite direction to an object's movement as it moves through the air.

normal contact – The force that supports an object on a solid surface.

tension – The force transmitted through a rope, string or wire when pulled by forces acting on each end.

upthrust – The upward force exerted by a fluid on an object floating in it.

Non-Contact Forces

Non-contact forces act between objects without them physically touching each other.

gravitational force – The force acting on an object due to gravity.

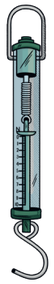
magnetic force – The force exerted by a magnetic field on a magnetic material.

electrostatic force – The force that acts between two charged objects.

Measuring Forces

Forces are measured in newtons (N).

Forces can be measured using a newton meter.



Interaction Pairs

Forces always act in pairs.

The person's weight pushes down on the chair.

The normal contact force from the chair pushes the person up.

Force Fields

Non-contact forces act in fields. The field is the area around the object where the force is exerted.

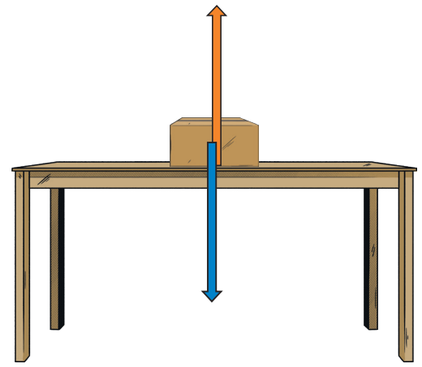
As an object gets farther away from the object exerting a force, the field gets weaker. For example, if a magnetic object is farther from a magnet, it will experience a smaller force of attraction towards the magnet.

Force Diagrams

You can't see forces but you can see their effects.

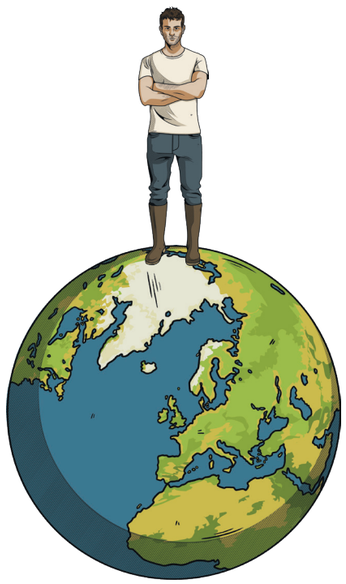
We add force arrows to a diagram to show which forces are acting. The arrows show the direction and the size of the force (the longer the arrow, the bigger the force).

The force arrows should touch the object in the diagram.



Mass and Weight

The Moon has a smaller gravitational field strength than the Earth. This means that an object or person would weigh less on the Moon. Their mass would remain the same.



mass: 65kg

weight 650N

mass: 65kg

weight 104N

Mass

Mass is the amount of matter an object is made up of. Mass is measured in kilograms (kg).

The value of mass will stay the same when the location of the object changes.

Weight

Weight is the total amount of force acting on an object due to gravity. Weight is measured in newtons (N).

The value of weight will change depending on the gravitational field strength acting on the object.

To calculate weight we use the equation:

weight = mass × gravitational field strength

The gravitational field strength on Earth is 10N/kg.

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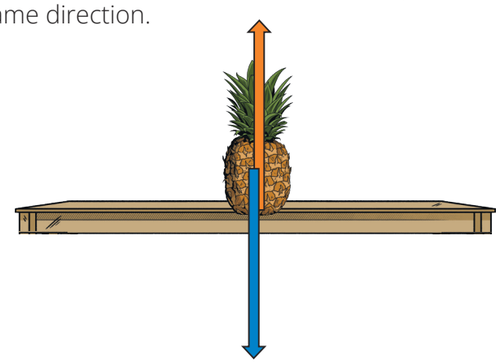
Balanced Forces

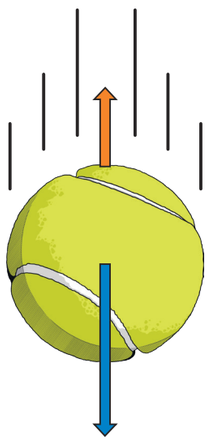
When the forces acting on an object are the same size but in opposite directions, we say that the forces are **balanced**. When this happens, the object is in a state of **equilibrium**. There will be no change to the motion of the object: a stationary object will remain stationary and a moving object will continue to move at a constant speed in the same direction.



Unbalanced Forces

Unbalanced forces act in opposite directions but are not the same size. One force is greater than the other.

If forces are unbalanced there will be a change in the motion of the object. It may speed up, slow down or change direction.



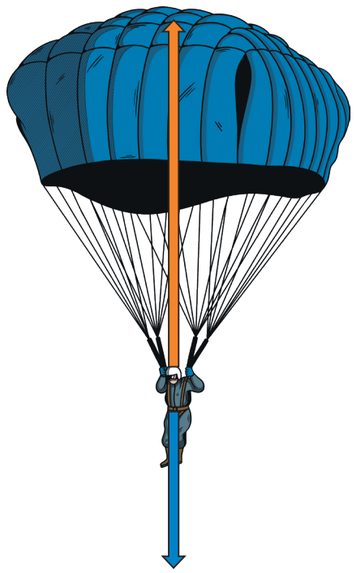
Changing Speed

If the driving force is bigger than the resistive forces acting on an object, the object will speed up (**accelerate**).

When the driver presses the accelerator in a car, the driving force increases so the car speeds up.

If the resistive forces on an object are larger than the driving force, the object will slow down.

When the person releases their parachute, the force of air resistance is larger than their weight so they will slow down.

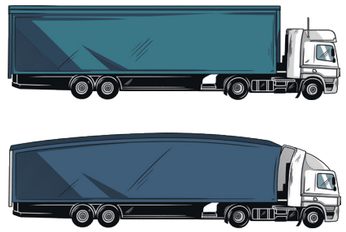


Reducing Resistive Forces

Friction can be reduced by using **lubrication**. Lubrication is grease or oil that helps two surfaces move past each other more easily.

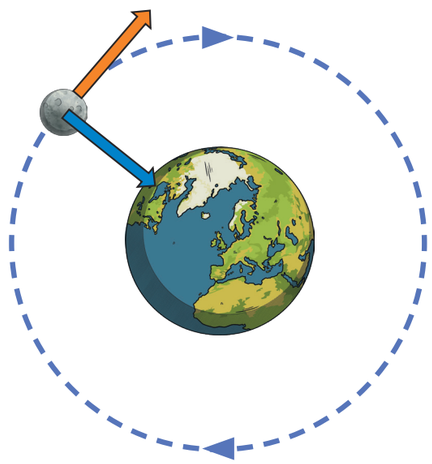
Having a smaller **surface area** in contact with a surface will also reduce the amount of friction.

Drag forces, like water resistance and air resistance, can be reduced by making objects more **streamlined**.



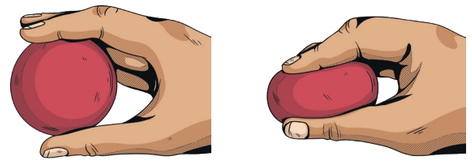
Changing Direction

The gravitational field around the Earth keeps the Moon in orbit. The Moon is moving at a constant speed but the Earth's gravity pulls it towards the Earth, so the Moon moves in a circular path around the Earth.

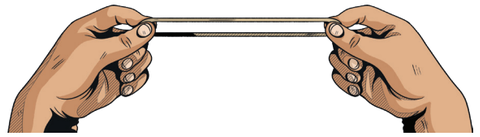


Changing Shape

Elastic objects can be compressed or stretched by forces. When an object is changed in these ways, we say it is **deformed**.



The amount that an object is stretched is called the **extension**.



Hooke's Law

The extension of some elastic objects can be described by Hooke's law.

force (N) = spring constant (N/m) × extension (m)

Spring constant is a measure of the stiffness of a material. It indicates the force needed to change the length of a material by 1m. The greater the spring constant, the greater the force needed to stretch the material.

If you plot the extension of a spring against the force applied to the spring the results give a straight line through the origin.

The graph shows that if you double the force, the extension also doubles.

Hooke's law states that extension is **directly proportional** to the force applied.