

The Science of Forces

WHAT IS A FORCE?

A force is a push or a pull on an object that causes it to speed up, slow down, or stay in one place.

Forces are measured in Newtons (N).

TYPES OF FORCES

Weight force	Downward force due to gravity. This force depends on the mass of the object. Mass is measured in grams or kilograms.
Lift force	Force that acts in a right angle to the direction the object is moving in. Usually this means it is an upward force, so opposing the weight force. Lift is caused by a fluid (a gas or a liquid, such as air or water) moving past a solid object. The particles in the fluid "stick" to the object and this changes the direction of the fluid movement. If an object is shaped in a certain way, for example an airplane wing, the lift force will push the object upwards.
Frictional force	Force between two objects that are in contact. Friction slows or stops movement of an object. Air resistance, caused by particles of air hitting an object (e.g. a car) is a form of friction. This can also be called drag. Water resistance, caused by water particles hitting an object, (e.g. a boat), is also a type of friction.
Thrust force	Force that moves an object forwards. In a car, thrust is produced by the engine.
Buoyancy force	Upwards force caused by a fluid, usually water. Buoyancy force opposes weight force.
Support force	Upwards force that supports the weight of an object on a surface. A book sitting on a table has a support force pushing up from the table that is equal to the downwards weight force of the book.

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BALANCED + UNBALANCED FORCES

If an object is stationary (standing still) then the forces acting on it are said to be balanced. This means that the forces are of equal strength but in opposite directions so they balance each other out. The **weight force** is equal to the support force.

If an object is moving at a constant **speed** in one direction, say 10km/h, then the forces acting on it are **balanced**. The **frictional force** that is trying to slow the object down is equal to the **thrust force** driving the object forward.

If the forces are **unbalanced**, an object that is not moving will start to move. The thrust force is greater than the frictional force.

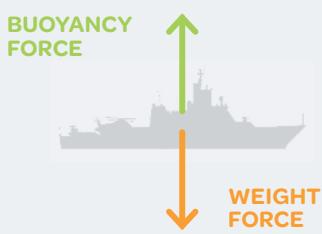
If the forces are **unbalanced** on an object that is already moving, then the object's speed or direction will change, it will speed up (accelerate) or slow down (decelerate).

FORCE DIAGRAMS

Force diagrams are an easy way to show the forces acting on an object. The length of the arrows represent the strength of the force. If the forces are balanced, then the arrows should be the same size.

The forces are drawn in pairs, so that you always show the force and the opposing force. You can include all relevant forces. If a ship is staying still, then you do not need to include thrust or frictional force. The arrows point away from the object and come from the centre of the object.

A stationary ship



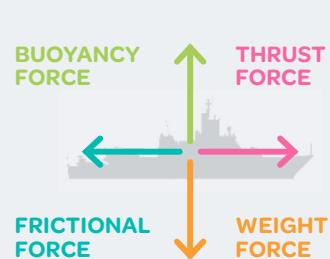
The arrows are the same size which shows the forces are balanced. There are no horizontal arrows as the ship is stationary.

A sinking ship



The weight force is greater than the buoyancy force showing that the ship is moving in the downwards direction.

A ship going at a constant speed



All arrows are the same size. The thrust by the engine is equal to the air and water resistance caused by friction, so the ship is not slowing down or speeding up, but going at a constant speed.