

### 1) What are Forces?

A force is a **push** or a **pull** in a particular direction. It can also be a **twist**.



Forces are measured in **Newtons (N)** using a **Newton meter**.

Forces affect how things move, they can make objects:

- Change speed
- Change direction
- Change shape

Since forces cause changes in speed or direction we can say that **forces cause acceleration**.

### 2) Types of Forces

**Contact forces** are when a force is applied by one object that is in contact with another object.

**Non-contact forces** act on an object without coming physically in contact with it, e.g. gravitational, magnetic and electrostatic.

**Weight:** The downwards force acting on an object due to its mass and the gravitational pull towards the Earth's centre.

**Reaction:** this acts at 90° to the surface in contact with the object (also called a contact force).

**Thrust:** This is a driving force. It can be a push or pull or an engine driving an object forward.

**Friction:** When an object moves against another object or surface they rub together. This slows down a moving object.

**Air resistance:** This acts against a moving object through the air. It can slow down a moving object.

**Lift:** The force needed to lift an object through a liquid or gas.

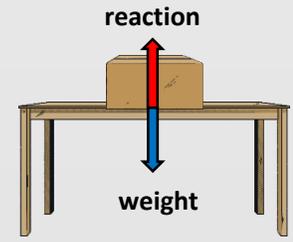
**Upthrust:** This is an upwards force acting in water. It acts on an object against gravity and is why certain objects float.

### 3) Force Diagrams

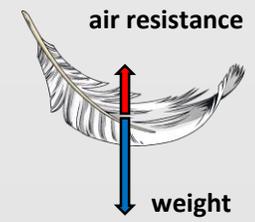
In a force diagram, an arrow represents each force. The arrow shows:

- the size of the force (longer the arrow, bigger the force)
- the direction in which the force acts

E.g. a box on a table



E.g. a feather falling

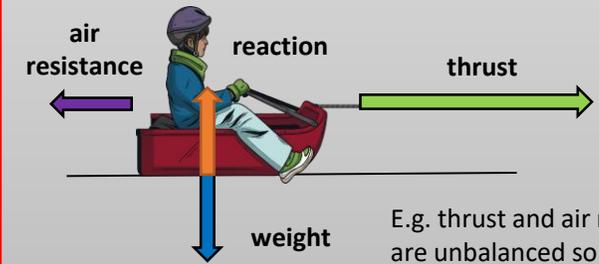


When the forces acting on an object are the same size but in opposite directions we say that they are **balanced**. **Unbalanced** forces act in opposite directions but are not the same size.

E.g. the two forces acting on the box are equal in size so are balanced, where the two forces acting on the feather are not equal in size so are unbalanced.

**Balanced forces do not change the motion** of the object so it will remain stationary or keep moving in the same direction, at the same speed.

**Unbalanced forces cause a change in the motion** of an object. It may speed up, slow down or change direction.



E.g. thrust and air resistance are unbalanced so the person on the sled will speed up.

### 5) Resultant Forces

When more than one force is acting on an object then the resultant force is the single force which has the same effect on an object as the number of original forces acting on the object.



E.g. the resultant force is the difference between the two forces:  $6 - 3 = 3 \text{ N}$  to the left.

If more than one force is acting in the same direction they can be added together. If the forces are **balanced**, the resultant force is **zero**.

### 6) Spring and Hooke's Law

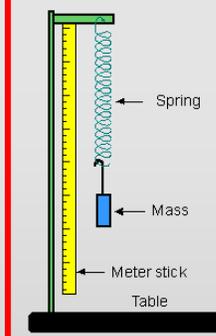


Figure 7.2 - Simple harmonic oscillation.

A spring will stretch when mass is added to it. The amount it stretches is **directly proportional** to the mass added **until** it reaches its **elastic limit**, after which point it will not spring back to its original shape and may break. This is known as **Hooke's Law**.

**Directly proportional:** As one variable increases the other also increases at the same rate - see graph below.

**Elastic limit (also called limit of proportionality):** the point at which a spring will no longer return to its original shape - see graph.

