

Newton's Second Law



If the ending force acting on an object is not zero, all the forces are said to be **unbalanced**.

This forms the basis of **Newton's second law of motion**, which states:

If the forces on an object are unbalanced, two things about the object can change:

- the **speed** of the object may change – it may either increase or decrease
- the **direction** of motion may change.



How is movement calculated from force?

The ending force acting on an object is related to the object's mass and acceleration. These three factors are linked by the following equation:

$$\text{force} = \text{mass} \times \text{acceleration}$$

- Ending force is measured in **newtons** (N).
- Mass is measured in **kilograms** (kg).
- Acceleration is measured in **meters per second per second** (m/s^2).

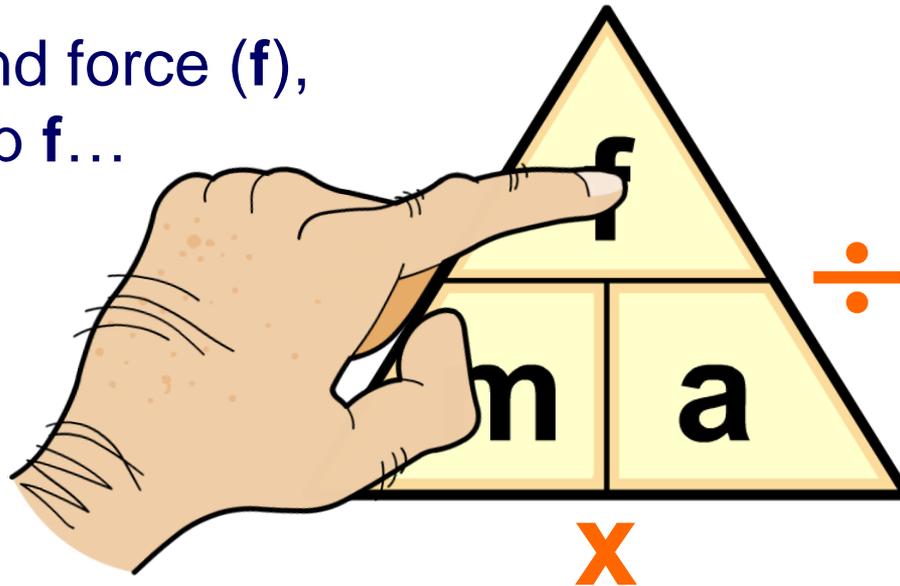


Using a formula triangle

A formula triangle helps you to rearrange a formula. The formula triangle for **force (f)**, **mass (m)** and **acceleration (a)** is shown below.

Cover the quantity that you are trying to work out, which gives the rearranged formula needed for the calculation.

So to find force (**f**),
cover up **f**...



...which gives
the formula...

$$f = m \times a$$

How do we use Newton's second law?

A car has a mass of 1,000 kg. What force must the car's engine supply to cause an acceleration of 2 m/s^2 ?



force = mass x acceleration

= 1,000 x 2

= **2,000 N**



How do we use Newton's second law?

A truck has a mass of 12,000 kg. What acceleration is caused by a force of 10,000 N?

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{acceleration} = \frac{\text{force}}{\text{mass}}$$

$$= \frac{10,000}{12,000}$$

$$= 0.83 \text{ m/s}^2$$





You will need this equation to answer the following questions about force, mass and acceleration:

$$\text{force} = \text{mass} \times \text{acceleration}$$

Click "**start**" to begin.

start

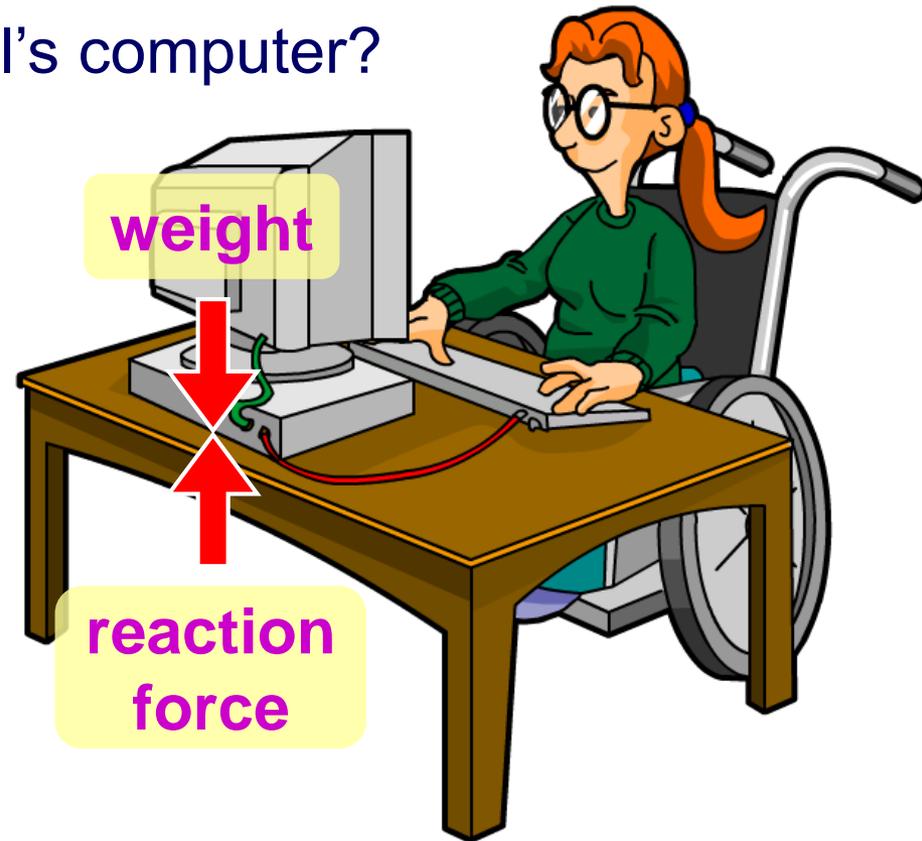


Newton's Third Law of Motion

What forces are acting on Mel's computer?

The computer is pulled downwards by the force of **gravity** and causes it to have **weight**.

The table exerts an **equal and opposite** force pushing upwards on the computer. This is called the **reaction force**.



These forces are **balanced** so the computer does not move.

What forces are acting on Mel as she works at her computer?

What is Newton's third law?

A force cannot exist on its own – there is always a second force acting against it.

This forms the basis of **Newton's third law of motion** states, which states:

For every action, there is an equal and opposite reaction.

These pairs of forces that act between two objects are called **action–reaction** pairs.



What are the action–reaction pairs of forces?

Action–reaction forces always exist in pairs.

Click "**start**" to see some examples.



start



Balanced and unbalanced forces

How many pairs of balanced, unbalanced and action–reaction forces can you spot?



What are unbalanced forces?



What happens when the resultant force acting on an object is no longer zero?

Click "**start**" to investigate unbalanced forces.



start

