

Speeding up

Calculating speed

Speed tells us how fast something is going.

We can work out the mean (average) speed of something by using this formula:

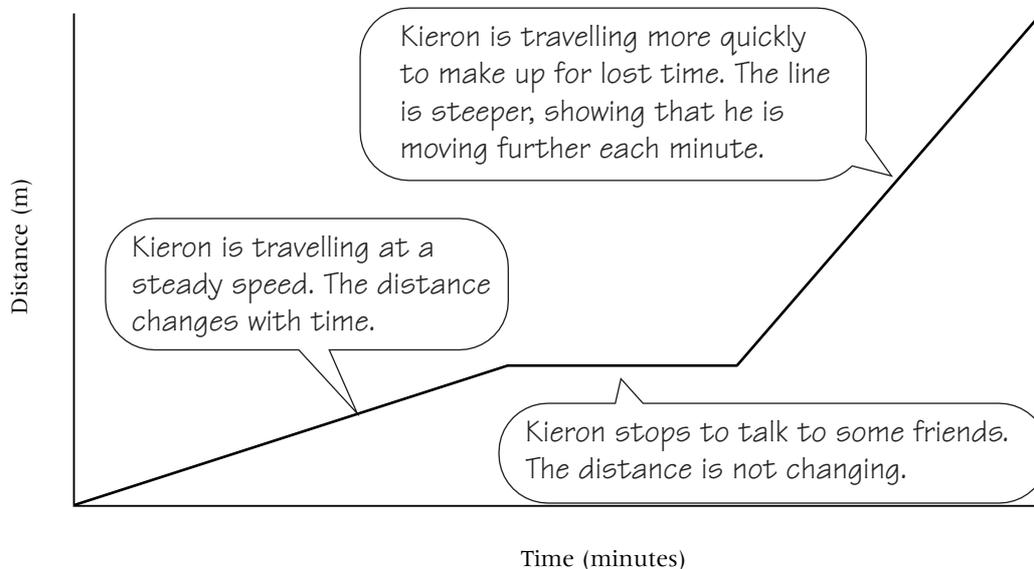
mean speed = distance travelled \div time taken.

Speed can be measured in:

- metres per second (m/s)
- kilometres per hour (km/h)
- miles per hour (mph).

$$\frac{D}{S \times T}$$

We can show how things move on a **distance–time graph**. This graph shows Kieron walking to school.



Forces

Balanced forces are forces which are the same size but work in opposite directions.

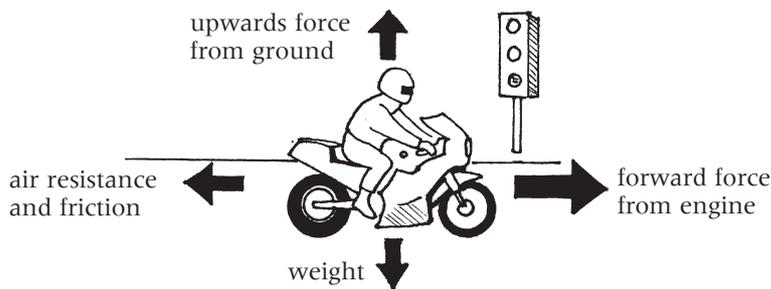
Unbalanced forces make things change speed, change shape or change direction.

If forces are balanced:

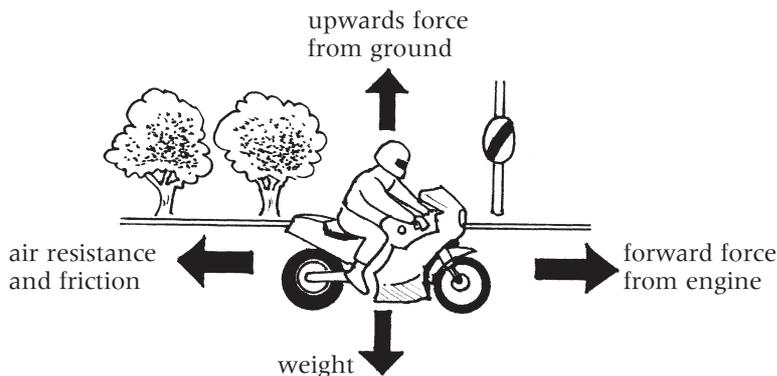
- a stationary object stays stationary
- a moving object continues to move at the same speed.

If forces are unbalanced:

- a stationary object will start to move
- a moving object will change its speed or direction.



The motorbike is accelerating because the forward force is greater than the backward force.



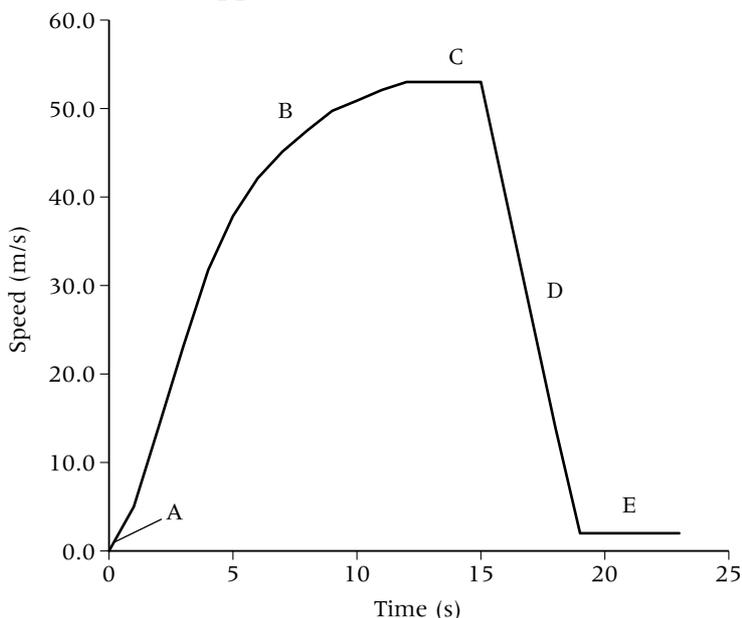
The motorbike is going at a steady speed. The forces are balanced.

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A car or motorbike uses fuel to move at a steady speed because it needs a force from the engine to balance the forces of **air resistance** and **friction**.

The amount of air resistance on something can be reduced by giving it a smooth, **streamlined** shape. The air resistance increases as the speed increases, so cars use up more fuel per mile when they are travelling fast. Air resistance is caused by air particles hitting the moving object. The particles transfer energy to the object, which is why objects moving through air can get hot.

The forces on a skydiver change during a jump. Her weight is the same all the time, but her air resistance changes during the jump. We can use a **speed-time graph** to show what happens.



Speed-time graph for a skydiver.

- At A she has just jumped out of the plane so she has only just started to move downwards. Her air resistance is very small.
- At B her air resistance is bigger, but not as big as her weight so she is still gaining speed.
- At C the forces on her are balanced so she falls at a steady speed.
- At D she has opened her parachute. The air resistance force is suddenly a lot bigger than her weight, so she slows down.
- At E the forces are balanced again, and she will continue to fall at a steady speed until she reaches the ground.