Next page

Unit P4

Explaining Motion

Next page

The topics in this unit are:

Next page

Forces

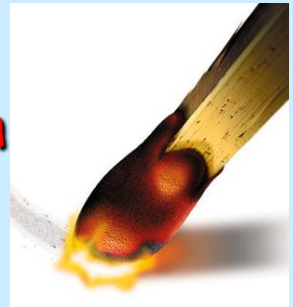
Forces happen when two objects **interact** with each other

Examples of forces are

Gravity

Air resistance

Friction



Thrust

Upthrust

Main menu

Next page

Opposite Forces

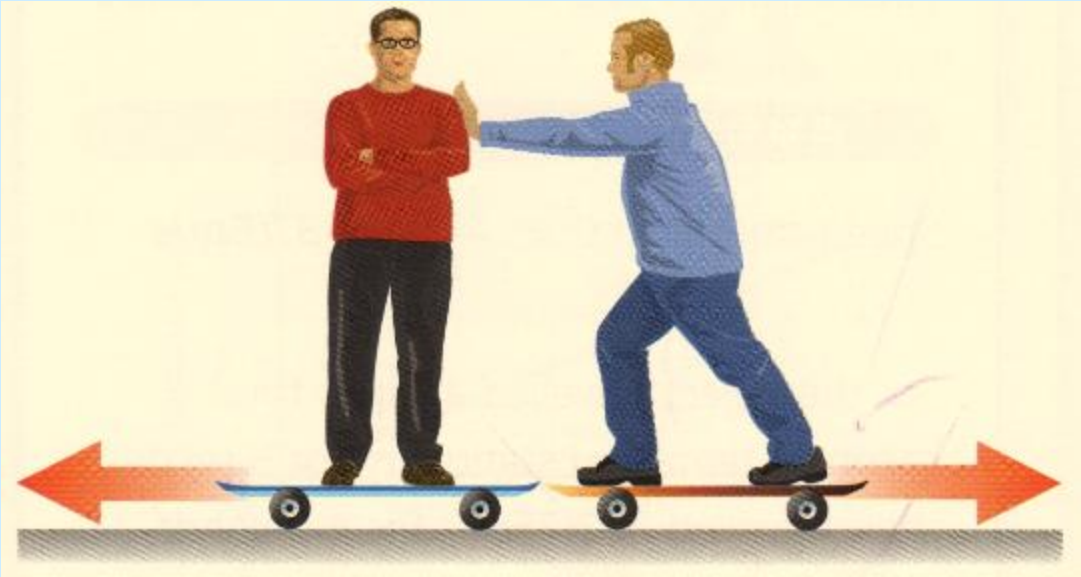
Forces occur because of an **interaction** between two objects

This means forces always come in **pairs** (interaction pairs)

They are **equal in size** and **opposite in direction**

Example

If two people are standing on skateboards and one pushes the other, both skateboards move away from each other



Main menu

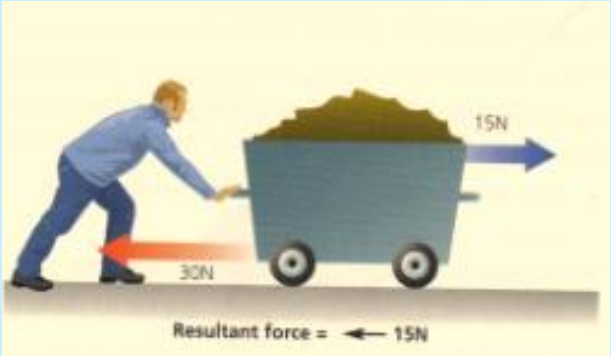
Next page

Forces and Motion

Arrows are used in diagrams of forces to show the size and direction.

If more than one force acts on an object, the forces will **add up** it they are in the **same direction** or **subtract** if they are acting in the **opposite direction**.

The overall effect is called the **resultant force**.



Main menu

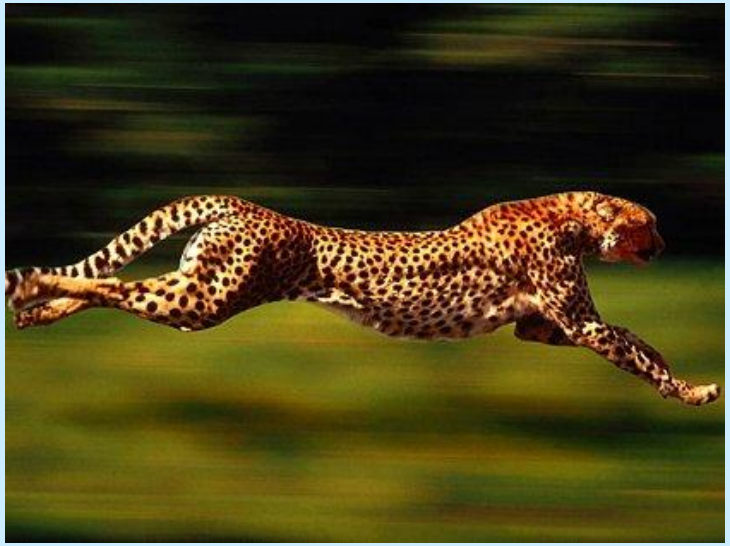
Next page

Speed and Velocity

Speed tells you how **far** an object will travel in a certain **time**

e.g. A lorry travels along a road at 15 m/s

Velocity tells you the objects **speed** and **direction**



Main menu

Next page

Calculating Speed

To calculate the speed of an object we need to know **two** things

- the **distance** it has travelled
- the **time** it took to get there

We use the formula

$$\text{Speed (m/s)} = \frac{\text{distance travelled (m)}}{\text{time (s)}}$$

Example

An object travels 10 metres in 5 seconds. What speed was it travelling at?

$$\text{Speed (m/s)} = \frac{10\text{m}}{5\text{s}} = 2\text{m/s}$$

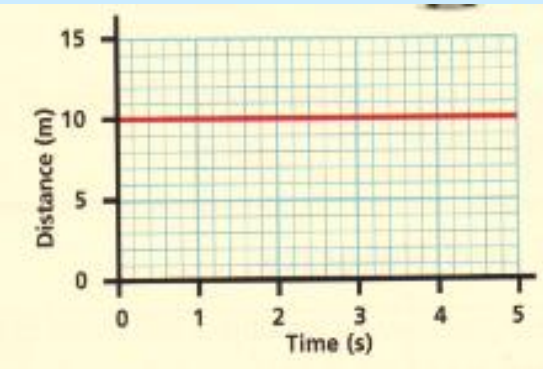
Main menu

Next page

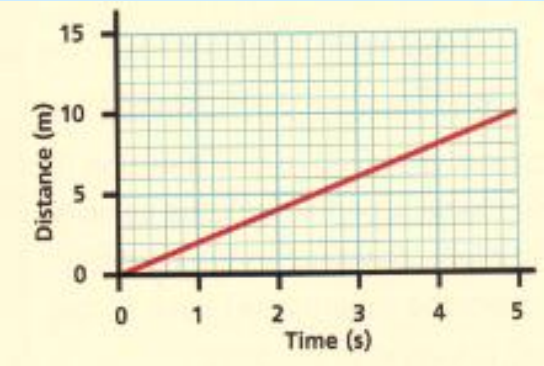
Distance Time Graphs

The **slope** of a distance time graph is a **measure** of the speed of an object.

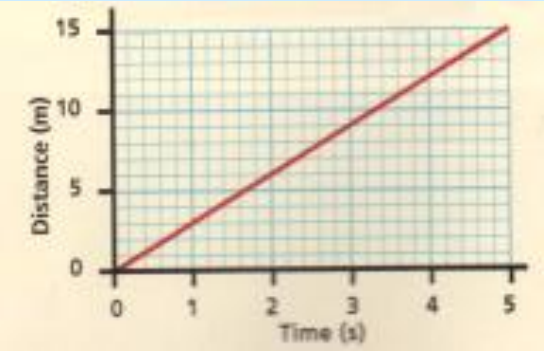
The **steeper** the slope, the **greater** the speed.



Speed = $\frac{0}{5}$ = 0m/s



Speed = $\frac{10}{5}$ = 2m/s



Speed = $\frac{15}{5}$ = 3m/s

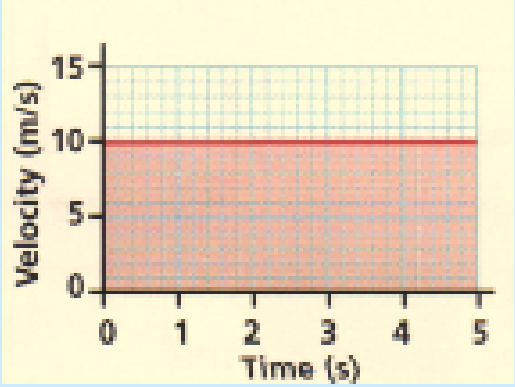
Main menu

Next page

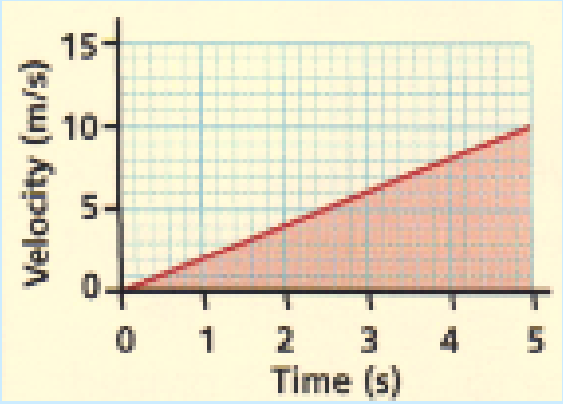
Velocity Time Graphs

The slope of a velocity time graph shows how quickly an object is increasing in speed

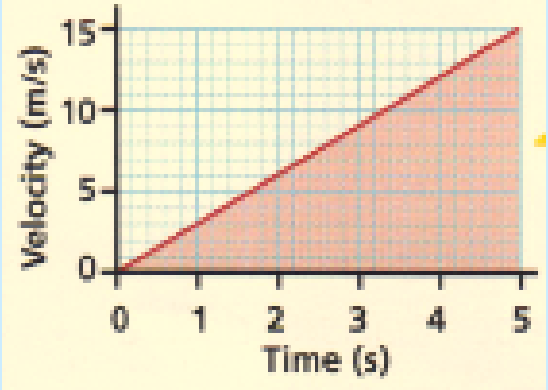
i.e. the faster the slope the faster its speed is increasing



Velocity = constant speed



Velocity $= \frac{10 - 0}{5} = 2 m/s^2$



Velocity $= \frac{15 - 0}{5} = 3 m/s^2$

Main menu

Next page

Momentum

Momentum is a measure of the **motion** of an object.

We work it out by

momentum (kg m/s) = mass (kg) x velocity (m/s)

Example

A car has mass 1200kg. It is travelling at a velocity of 30m/s. calculate the momentum

momentum = 1200 x 30 = 36000 kg m/s

Change in momentum can be calculated by

change of momentum (kg m/s) = force (N) x time it acts (s)

Main menu

Next page

Collisions

If a car is involved in a collision it comes to a **sudden stop** – a change in momentum

The **smaller the time** for the car to stop, the **larger the force** acting on it and the **more damage** can be caused

Any **sudden** change in momentum will not only affect the car but also the **passengers**.

Seat belts, crumple zones and air bags are designed to reduce the force of impact.

Main menu

Next page

Kinetic Energy

A moving object has **kinetic energy**.

The amount of kinetic energy depends on

- the **mass** of the object and the **velocity** of the object

It can be calculated by

kinetic energy (J) = $\frac{1}{2}$ x mass (kg) x velocity ^{2} (m/s^2)

Example

A bicycle of mass 50kg is moving at a velocity of 8m/s^2. How much kinetic energy does it have?

Kinetic energy = $\frac{1}{2}$ x 50 x 8^2

= $\frac{1}{2}$ x 50 x 64

= 1600 J

Main menu

Next page

Gravitational Potential Energy

An object lifted above the ground has gravitational potetnialk energy

We cam calculate gravitational potential energy with the formula:

gravitational potential energy (J) = weight (N) x vertical height difference (m)

Main menu

Next page

Work

When a force moves an object, work is done on the object leading to a transfer of energy.

The amount of work done is calculated by:

work done (J) = force (N) x distance moved (m)

Example

A car needs to be pushed with a force of 100N to overcome friction. If the car is pushed for 5m, calculate the work done

Work done = 100N x 5m

= 500 J

Main menu