science physics

Year 7 - Forces 1: Speed & Gravity

1) Speed

$$Speed = \frac{Distance}{Time}$$

Distance (m)

Time (s)

metres per second (m/s)

Average speed is the total distance travelled/total time taken.
You may need to convert units so remember:

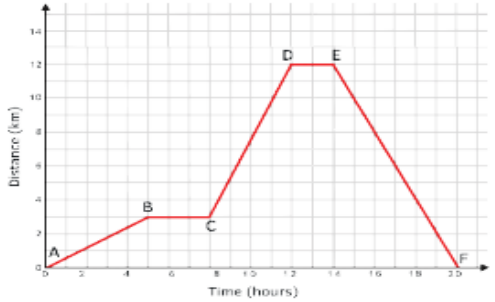
- 1 km = 1000m
- 1 minute = 60 seconds
- 1 hour = 60 minutes = 3600 seconds

2) Distance-Time Graphs

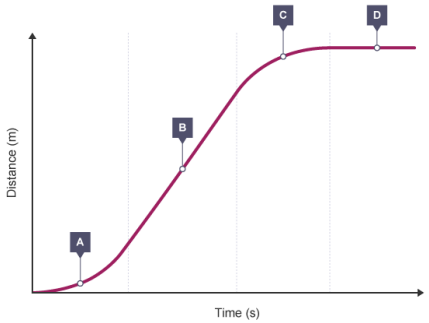
Distance-time graphs can show what is happening to the position of an object.

- **Straight diagonal line** shows the object is moving at a **constant speed**
- The steeper the slope the faster the object is moving
- **Horizontal line** shows the object is **stationary** (not moving).

A – B constant speed
B – C stationary
C – D constant speed
D – E stationary
E – F constant speed



- A curve means the object is accelerating or decelerating:



A – accelerating
B – constant speed
C – decelerating
D – stationary

3) Investigating cars on a ramp

Independent variable (the one we choose to investigate) is the height of the ramp

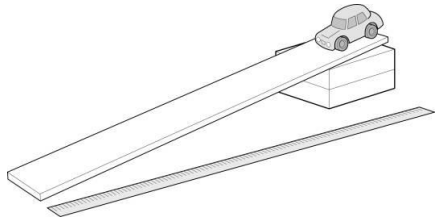
Dependent variable (the one we measure) is the time it takes the car to reach the end of the ramp.

To work out the speed we need to divide the length of the ramp (distance) by the time it takes the car to reach the end of the ramp. Speed = distance ÷ time

Control variables (ones we keep the same to ensure a fair test):

- Length of ramp
- Type of car
- Type of surface of ramp
- Point at which we start and stop timing

We should repeat our readings so we can calculate an average



4) What is relative motion?

Relative motion is the movement of an object compared to another object which is also in motion.

When 2 objects are moving in the same direction:

Relative speed = fastest speed – slowest speed

When 2 objects are moving in opposite directions:

Relative speed = speed of object 1 + speed of object 2

5) 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 **newtonmeter**.

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**.

6) 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.

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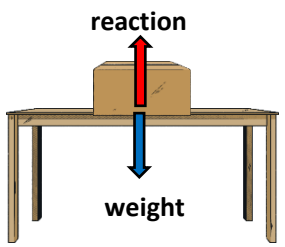
7) Force Diagrams

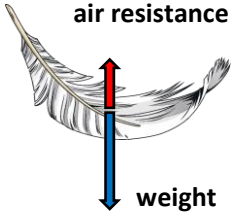
In a force diagram, an arrow represents each force. The arrow shows:

- 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

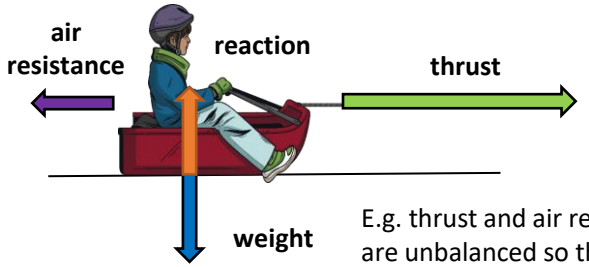


When the forces acting on an object are the same size but in opposite directions we say that they are **balanced**. **Unbalanced** forces act in opposite directions but are not the same size.

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.

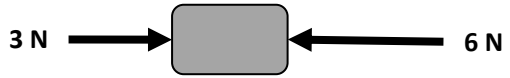
Unbalanced forces cause a change in the motion of an object. It may speed up, slow down or change direction.



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

8) 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 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**.

9) Mass

- Mass is the **amount of matter** an object is made up of.
- Mass is measured in **kilograms** (**kg**).
- Mass is not affected by gravitational field strength so the value of mass will stay the same when the location of the object changes.

10) Gravity

Gravitational forces pull all objects together.
The greater the masses of the objects, the greater the force.
The force due to gravity is also stronger when objects are closer together.

Gravity is everywhere. Just as a stone, feather or skydiver fall to the Earth because of gravity, so the Earth is pulled towards the Sun because of gravity.

Gravity keeps the Earth and all the planets in orbit about the Sun.

11) Weight

- Weight is the **force** acting on an object **due to gravity**.
- Weight is measured in **Newtons** (**N**).
- Weight **depends on the gravitational field strength** acting on the object so if the location of an object changes, then its weight may change
- **Gravity on Earth = 10 N/kg**

Weight = mass × gravitational field strength
(N) (kg) (N/kg)

For example: an object on Earth has a mass of 5 kg. The gravity on Earth is 10 N/kg. What is the object's weight?

- Weight = mass x gravitational field strength
- Weight = 5 kg × 10 N/kg
- Weight = 50 N

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