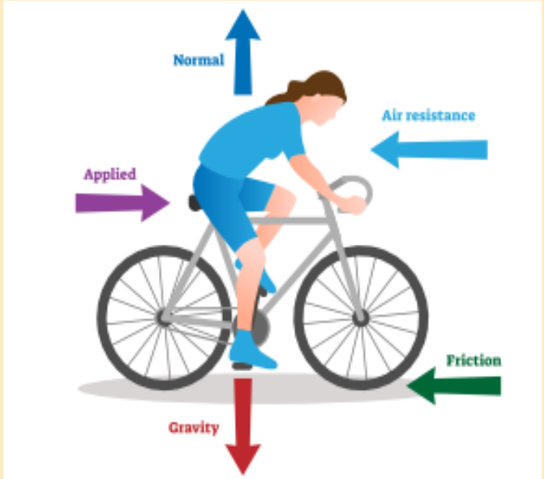
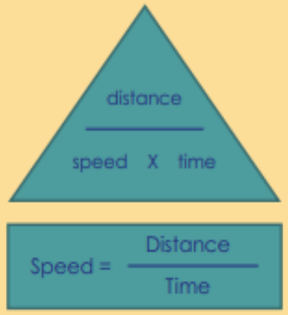
Forces can be contact or non-contact. Contact forces must touch something to influence them, non-contact forces don't need to touch something.

Contact examples: friction, air resistance
Non-contact examples: gravity, magnetism.

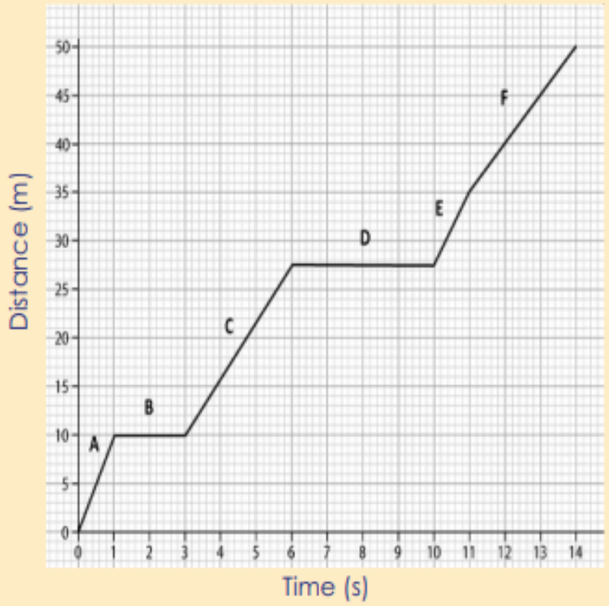
We draw forces using force arrows. The bigger the arrow, the bigger the force.





Speed is a measure of how fast or slow something is going.
The faster something is going, the quicker it will cover a distance.

Speed is therefore distance divided by time.
Speed is measured in m/s.
Distance is measured in metres.
Time is measured in seconds.



We can show speed in a distance time graph.

We show time on the x-axis and distance on the y-axis.

If the line is at a diagonal then the object is moving – the steeper the gradient, the faster they are moving.

If the line is flat, they are stood still.

FRICTION AND DRAG

- Friction is a force that acts when two objects rub together.
- When the two objects appear to be smooth, there is less friction.
- When the two objects are rough, there is a greater amount of friction.
- Drag is friction with the air or with water. It slows the object travelling through it down.

Forces can be measured using a Newton - meter

STRETCHING

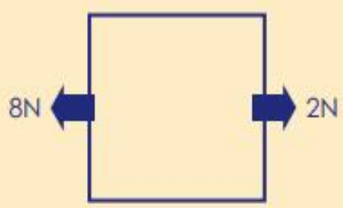
If a material returns to its original size and shape when you remove the forces stretching or deforming it (reversible deformation), we say that the material is demonstrating elastic behaviour.

A plastic (or inelastic) material is one that stays deformed after you have taken the force away. If deformation remains (irreversible deformation) after the forces are removed then it is a sign of plastic behaviour.

A force can be a push or a pull.
We can measure a force using a force meter or Newton meter.
The unit of force is called the Newton (N).

1. Balanced forces mean no change in velocity/speed:
   - If an object is stationary it will remain stationary.
   - If an object is moving it will travel at a steady/constant speed.

2. If the forces on an object are unbalanced, two things about the object can change:
   - The velocity/ speed of the object may change, it may either accelerate or decelerate.
   - The direction of the object may change.



The box will accelerate to the left with a force of 6N.

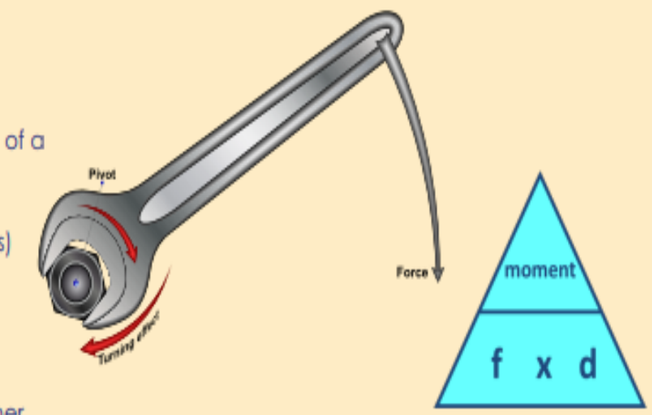
MOMENTS

The turning effect of a force is called a moment.
The factors that affect the size of a moment are:

1. Size of the force (in Newtons)

2. Distance from the pivot (in either m or cm).

Moments are measured in either Nm or Ncm depending on the distance used.



moment = force (N) x distance from pivot (cm or m)

Keyword	Definition
Velocity	Speed in a particular direction
Acceleration	Speeding up, rate of change of velocity
Terminal Velocity	Steady speed reached when weight and drag balance. Resultant force = 0N
Balanced	Two forces are equal and opposite so resultant force = 0N.
Resultant Force	The sum of all the forces acting on an object
Friction	A force that opposes the motion of a moving object.
Work Done (Mechanical)	Energy transferred when a force moves an object through a distance.
Drag	A force that resits motion through the air.
Lift	A force that uses motion to make objects rise up.
Upthrust	An upwards force pushing on an object in fluids.
Reaction or Normal Force	A force that stops you falling through the floor.

Speed

The speed of an object tells you how fast or slow it is moving. You can find the average speed of an object if you know the distance it has travelled and the time taken to travel that distance.

The equation is:

Speed(m/s) = Distance(m) ÷ Time(s)

$$V = \frac{S}{t}$$

E.g. A car travels 100m in 20s. Calculate the speed of the car.

Speed = Distance ÷ Time

Speed = 100m ÷ 20s

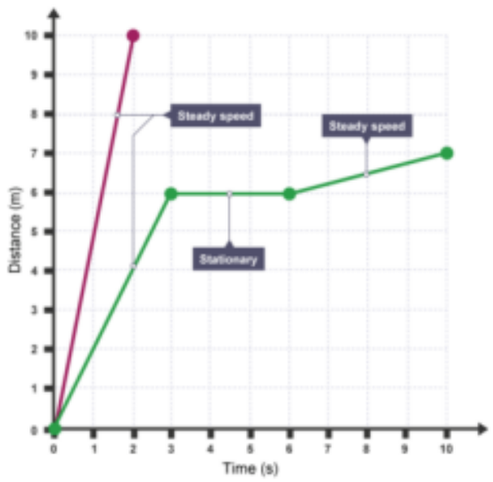
Speed = 5m/s

Further Reading:

https://www.bbc.co.uk/bitesize/guides/zttfyrd/revision/9

Distance Time Graphs

A distance time graph is a useful way to represent the motion of an object. It shows ho the distance move from a starting point changes over time.



If the line is horizontal, the object is stationary (because the distance stays the same).
If the line is a straight diagonal, the object is moving at a constant speed.

The steeper the line, the greater the gradient and the greater the speed.

E.g. Calculate the speed of the green line for the first 3s.

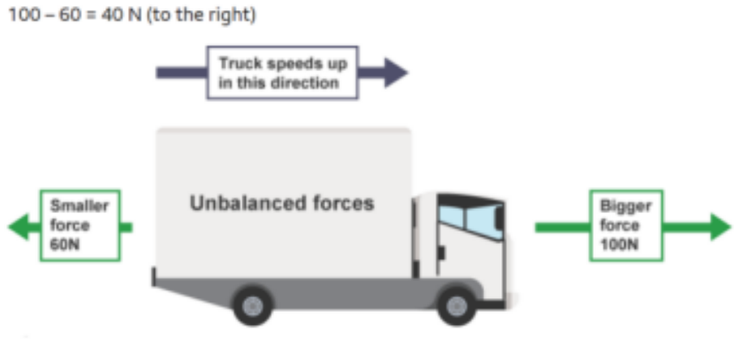
Speed = Distance ÷ Time

Speed = 6m ÷ 3s

Speed = 2m/s

Unbalanced Forces

If more than one force act along a straight line, the resultant force can be found by adding (acting in the same direction) or subtracting (acting in opposite direction) them.



Contact & Non-Contact Forces

All forces between objects are either:
Contact Forces – The objects are physically touching
Non-Contact Forces – The objects are physically separated.

Contact: Friction, Air Resistance, Tension, Normal Contact

Non-Contact: Gravitational, Electrostatic, Magnetic

Acceleration:

Acceleration is the rate of change of velocity. It is the amount that velocity changes per unit time.

$$\text{Acceleration} = \frac{\text{Change in Velocity}}{\text{Time Taken}}$$

Metres per second (m/s)

Metres per second squared (m/s^2)

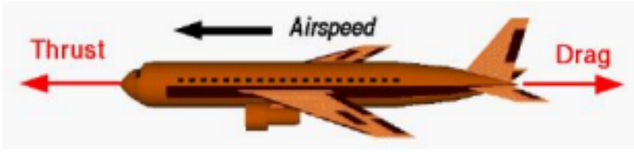
Seconds (s)

$$a = \frac{v - u}{t}$$

Change in velocity = final speed – initial speed

Newton's First Law

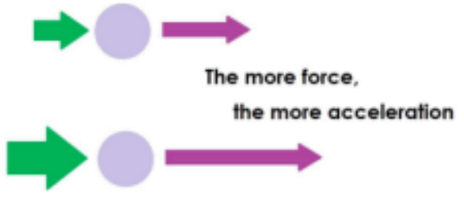
An object has a constant velocity unless acted on by a resultant force



Thrust = Drag. Zero resultant force and the plane moves at a constant velocity.

Newton's Second Law

The acceleration of an object is proportional to the resultant force acting on the object, and inversely proportional to the mass of the object.



F = ma
F is Force in N
m is mass in Kg
a is acceleration in m/s^2.

Newton's Third Law

Wherever two objects interact, the forces they exert on each other are equal and opposite.

Rocket Engine Thrust

For every action, there is an equal and opposite re-action.