Year 11 – Paper 2 - Physics Knowledge Organiser -Forces

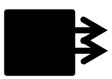
Representing Forces and Other Vector Quantities

Since forces are a vector quantity, it is useful to show their magnitude (size) AND direction using an arrow. The arrow points in the direction that the force acts, and its **length** shows the magnitude. For instance: in the first diagram, the force acting on the object is larger than in the second, and is opposite in direction.

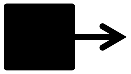
The Resultant Force

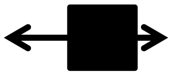
Unit = Newton (N)

In real life, there are usually a few forces acting on any particular object. All the forces can be shown with vectors.

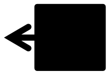


two forces are acting together; by adding them we get the resultant force….





this time, the forces are opposite in direction, and are different in magnitude. We subtract one from the other to get the resultant force…



Speed vs. Velocity

Unit = meters per second (m/s)

Speed and velocity are both quantities that measure the rate of change of distance, but velocity includes the direction. This makes velocity a vector quantity, so we can show velocity with an arrow.

Acceleration

Unit = meters per second squared (m/s^2)

Acceleration is the measure of how quickly velocity changes. It is a vector quantity, because direction is included.

Momentum

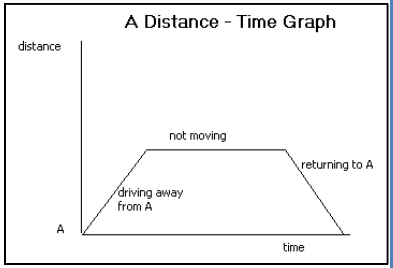
Unit = kilogram meters per second (kgm/s)

Momentum is a property that any moving object has. It is defined as the product of mass and velocity of the object, so if the velocity is 0 m/s (stationary), the momentum is also 0.

Conservation of Momentum

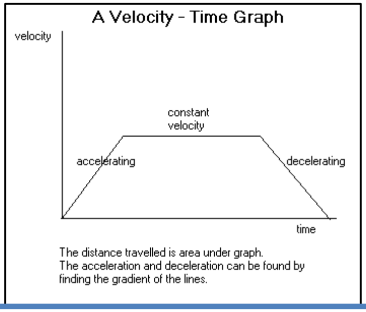
Momentum is a property that is conserved in closed systems. This means the total momentum before an event is exactly equal to the total momentum after the event. This is called **conservation of momentum**.

Distance-time Graphs



A distance-time (DT) graph shows how far an object has gone from its starting point at a certain time.
A slope means the object is moving, because distance is changing as time changes. If the line of the graph is horizontal, the object cannot be moving because distance is not changing with time.
The gradient (steepness of the slope) tells you the speed of the object.

Velocity-time Graphs



A velocity-time (VT) graph shows the velocity of an object at any particular time on its journey. Using the gradient of a slope, you can find the acceleration.
The distance travelled during the journey is also shown on a VT graph – but you have to work it out by calculating the area under the line on the graph.

Newton's First Law

An object will remain at rest or at constant speed unless a resultant force acts on it.

Newton's Second Law

This law follows on very sensibly from the first law. It reminds us that an object will only change in velocity (accelerate) if there is a resultant force acting on it. It also shows that the amount of acceleration depends on the resultant force and the mass of the object (F=ma)

Newton's Third Law

This law is often written as: 'for every action, there is an equal and opposite reaction'. In this version, action means the force exerted by object A on object B, and reaction means the force exerted by object B on object A.

This law explains why pushing **down** with your legs makes you jump **up** (the ground pushes back with the same size force as your push). It also explains why rockets can fly through space: the gases pushing out the back cause the rocket to move forward.