AQA GCSE Physics

Paper 2 (H) Revision

Topic 8: Space

Name: _____

Form: 11 ___

AQA GCSE Physics
Paper 2 Revision
Topic 8: Forces

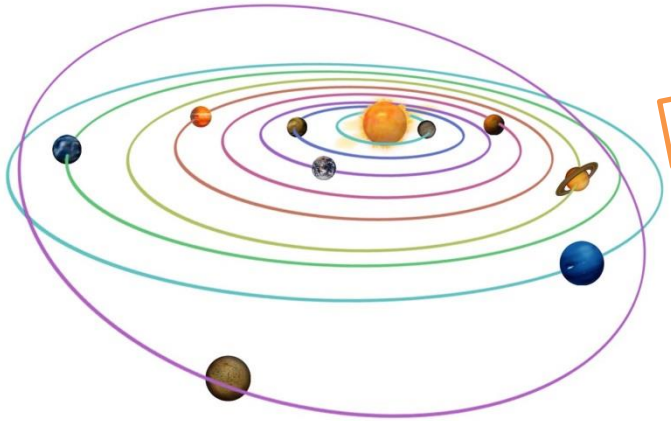
Specification point	Notes ✓	☺		☹	Questions?
Identify objects in the solar system					
Describe what a galaxy is and know that our galaxy is called the Milky Way					
Describe how stars form					
Describe and explain the lifecycle of a low mass star like our Sun					
Describe and explain the lifecycle of a high mass star					
Explain how fusion is responsible for producing all of the elements and how/where they are formed					
Describe which force is reposbible for keeping objects in orbit					
Explain how the radius of an orbit changes if the speed of the satellite changes					
Describe red shift					
Describe the Big Bang theory					
Explain how red shift is evidence for the Big Bang					
Explain the relationship between a galaxies red shift, their velocities and distances from us. State the supernovae allowed us to determine this relationship.					

Objects in space

Our solar system

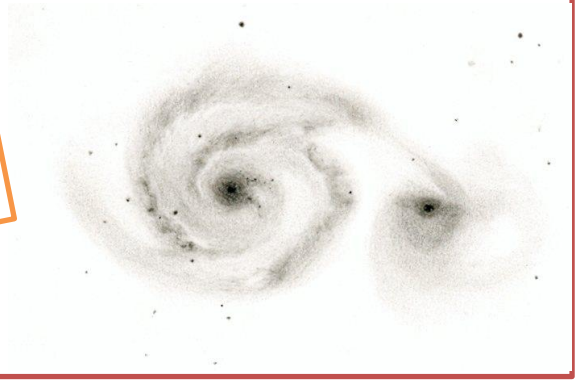
Within our solar system there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun. Natural satellites, the moons that orbit planets, are also part of the solar system.

Our solar system is a small part of the Milky Way galaxy.



How would you define a satellite?

What is a galaxy?



Do you think governments should still invest in space programmes? Why? Why not?

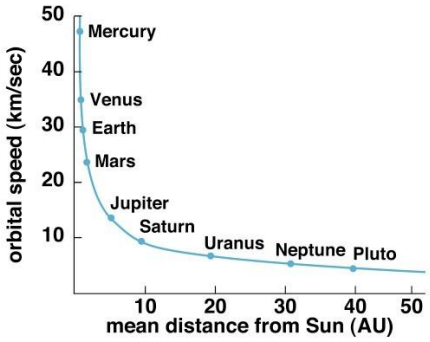
Orbits

Gravity provides the force that allows planets and satellites (both natural and artificial) to maintain their circular orbits.

Can you give examples of artificial satellites or what they're used for?

Satellites and planets are constantly acceleration due to them constantly changing direction and hence their velocity changes even if their speed does not.

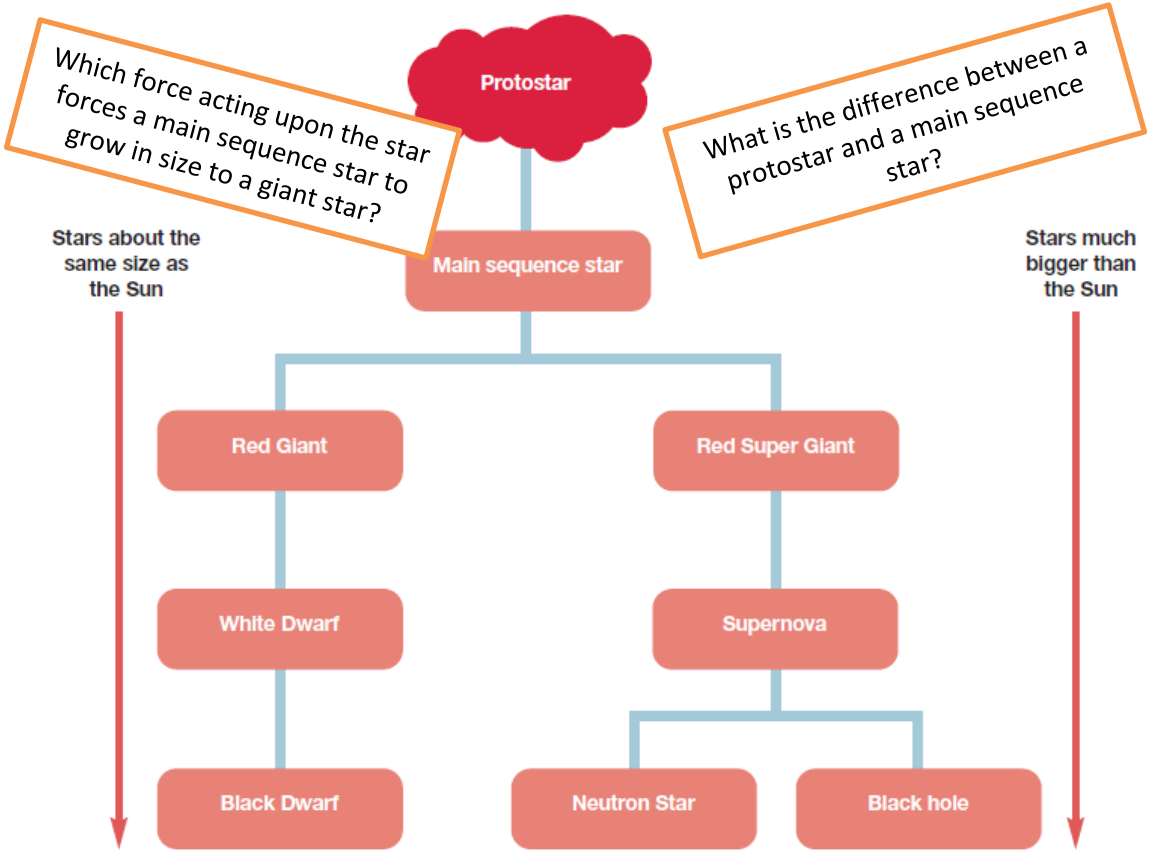
If the speed of a satellite changes then the radius must also change (as v increases, r decreases for a stable orbit to occur.



Lifecycle of a star

Which force acting upon the star forces a main sequence star to grow in size to a giant star?

What is the difference between a protostar and a main sequence star?



A main sequence star is a stable star where the radiation pressure, caused by fusion, balances the gravitational force of the star.

Hydrogen nuclei form to become helium nuclei in a main sequence star. This process continues up until, and including, iron. After this too much energy is required for heavier elements to be formed.

The heavier elements form when a star collapses and then explodes as a supernova, where there is enough energy available for heavier elements to form.

Earth has plutonium on it which is a very heavy element, how did it get here?

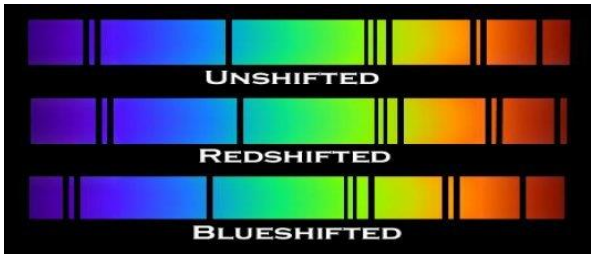
Stars form when dust and gas is pulled together by gravitational attraction. Once enough matter is pulled together a protostar forms which continues collecting dust and gas, becoming hotter and hotter. Eventually a star is born and fusion can begin in a main sequence star.

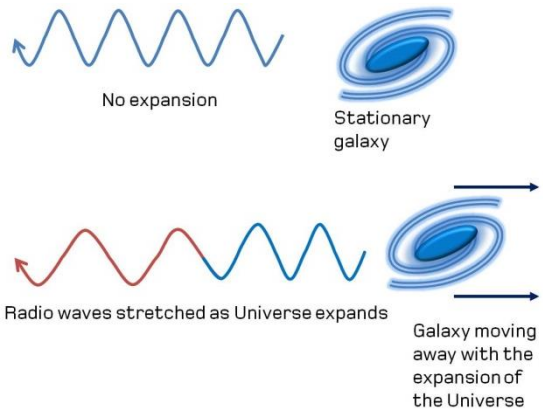
The Big Bang

Red-shift
There is an observed increase in the wavelength of light from most distant galaxies. The further away the galaxies, the faster they are moving and the bigger the observed increase in wavelength. This effect is called red-shift.

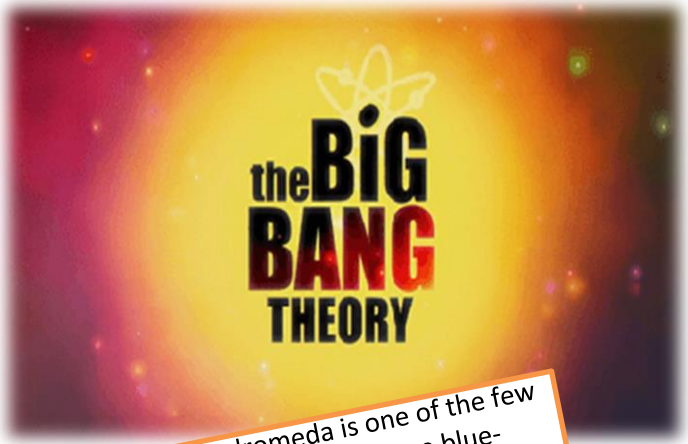
Observation of supernovae in different galaxies show that the further away the galaxies are, the fast they are travelling and the greater the red-shift.

The future
There is still a lot scientists do not understand d about our Universe, such as dark energy and dark matter. It is the evidence gained through observations that that allow scientists to arrive at theories, such as that of the Big Bang theory.





Big Bang evidence
The vast majority of galaxies are red-shifted. This means all of the galaxies are moving away which suggests evidence from the Big Bang – a very small, hot and dense region in space which underwent rapid expansion (and is causing the Universe to still expand).



Andromeda is one of the few galaxies that are blue-shifted. What does this mean about its motion?

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Paper 2 Revision
Topic 5: Forces

Moments, levers and gears

Moments

A force or a system of forces may cause an object to rotate such as a steering wheel or a see-saw. The turning effect can be called the moment of a force and can be calculated using:

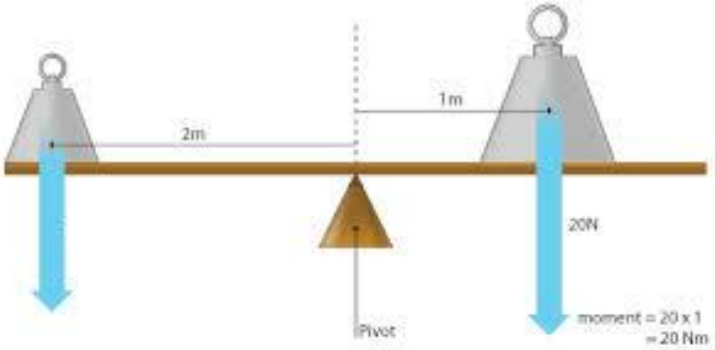
M= Fd

How is this equation different to the work done equation?

Where M is moment (Nm), F is force (N) and d is perpendicular distance from the force to the pivot (m).

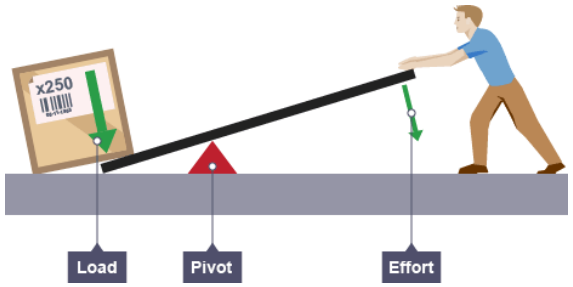
For an object to be in equilibrium (balanced), the total clockwise moment must be equal to the total anticlockwise moments:

What is the missing force?

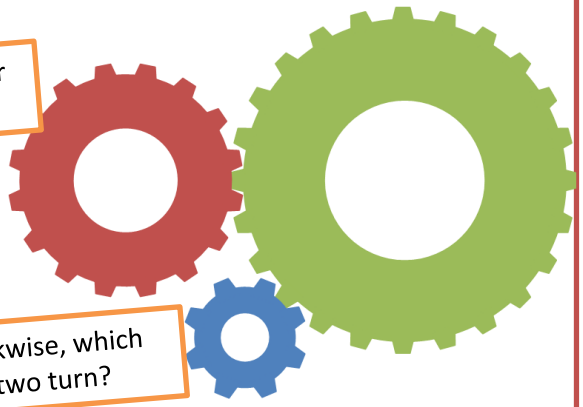


Levers and gears

Both levers and gears are used to transmit (and often multiply) an applied force. A **lever** is a simple machine that makes work easier to do. Examples of simple levers include cutting with scissors, or lifting the lid on a tin of paint with a screwdriver. Levers **reduce the force needed to** perform these tasks.



Which gear is fastest?



If the left gear rotates clockwise, which directions do the other two turn?

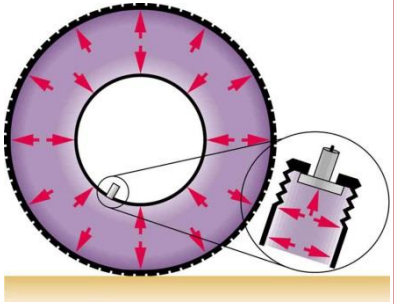
Pressure in fluids

Calculating pressure

Pressure can be calculated using:

$$P = F/A$$

Where P is pressure (Pa), F is force (N) and A is surface area (m^2). The force from the fluid acts at right angles (normal) to the surface. Note: A fluid is a liquid or a gas.



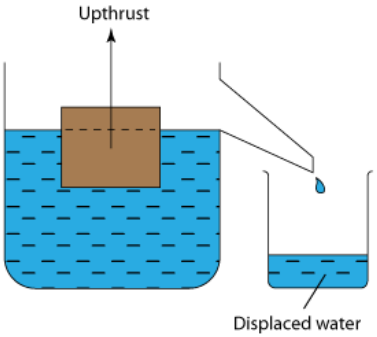
The pressure in a liquid increases with depth as there are more liquid particles above that point resulting in a larger weight of liquid pushing down on that point. This can be calculated using:

$$p = h\rho g$$

Where p is pressure (Pa), h is the height/depth (m), ρ is the density of the liquid and g is the gravitational field strength (N/kg).

More on pressure in liquids

It is the pressure difference that causes the force we call upthrust. There is a higher pressure on the bottom of the block in the image below compared to the higher parts. If this upthrust is smaller than the weight then it will sink. The weight of the submerged part of the block is equal to that of the water displaced.



Atmospheric pressure

The air particles around Earth is referred to as the atmosphere. Air particles colliding with surfaces causes air pressure. The atmosphere becomes less dense with altitude so air pressure decreases.

Objects in motion

Speed and velocity

Speed is a scalar and velocity is the speed in a given direction i.e. a vector.

A car going around a roundabout at 10 mph has a constant speed but a changing velocity (and therefore is accelerating)

You must learn some typical values for the speeds of certain activities:
Walking~ 1.5 m/s, running~ 3 m/s, cycling~ 6 m/s and the speed of sound = 330 m/s. These are average speeds as it is very rare something travels at a constant speed.

To calculate speed you can use the following equation:

s = vt

In KS3 you would have learnt this as distance = speed x time (d=st)

Where s is displacement/distance (m), v is speed/velocity (m/s) and t is time (s). To calculate the average speed it is the total distance divided by the total time.

Acceleration

Acceleration is defined as the rate of change of velocity. It can be calculated using the following equation:

$a = \Delta v/t$

Where a is acceleration (m/s^2), Δv is the change in velocity (m/s) and t is time (s). The same equation applies if the object is decelerating.

Linking acceleration, distance and velocity

The following equation links the terms introduced previously:

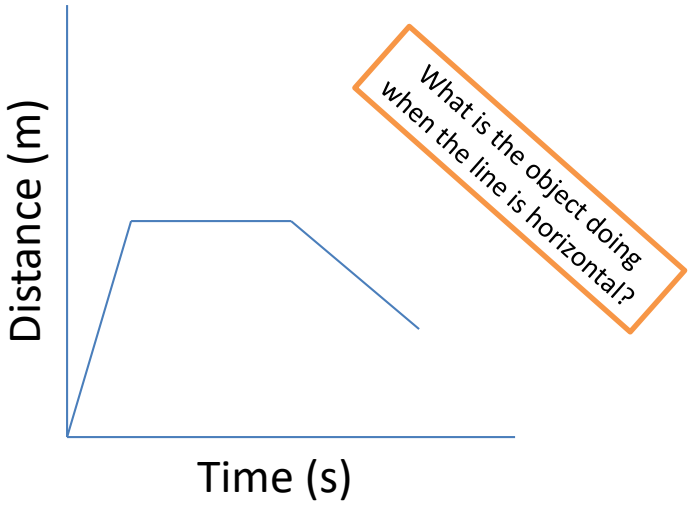
Check you can rearrange this as it can be tricky

$v^2 - u^2 = 2as$

Where v is the final speed/velocity (m/s), u is the initial speed/velocity (m/s), a is acceleration (m/s^2) and s is distance/displacement (m)

Motion graphs

Distance-Time Graphs

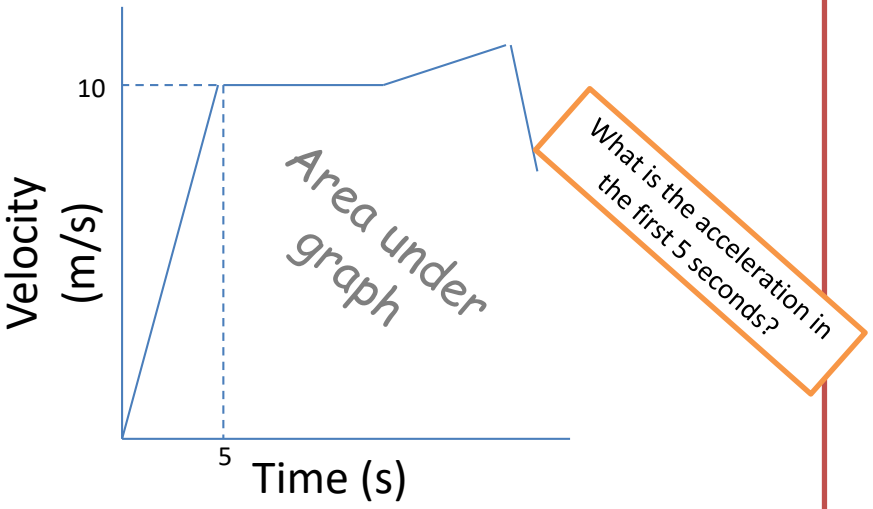


The gradient gives you the speed/velocity of the object

Straight lines means the object is travelling at a constant speed.

Curved lines means the object is accelerating or decelerating and you may be asked to calculate the instantaneous speed by drawing a tangent and finding its gradient.

Velocity-Time Graphs



The gradient gives you the acceleration of the object. The steeper the line the greater the acceleration.

If the lines gradient is negative then deceleration is occurring.

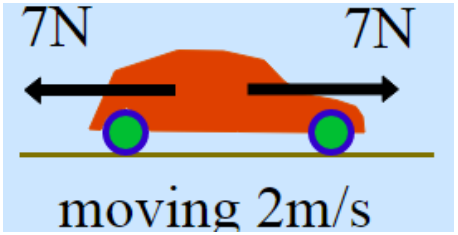
The area below the graph gives the distance travelled by the object – you will have to divide the graph into triangles and squares.

Newton's laws

Newton's 1st law

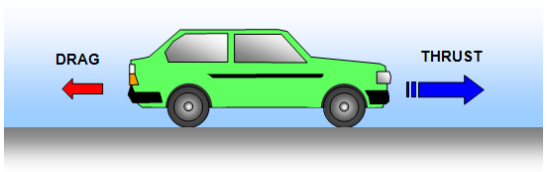
If the resultant force acting on an object is zero and:

- the object is stationary, the object remains stationary
- the object is moving, the object continues to move at the same speed and in the same direction. So the object continues to move at the same velocity.



What will each car do?

Speed: 10 m/s backwards



Note: The tendency of objects to continue in their state of rest or of uniform motion is called inertia.

Newton's 2nd law

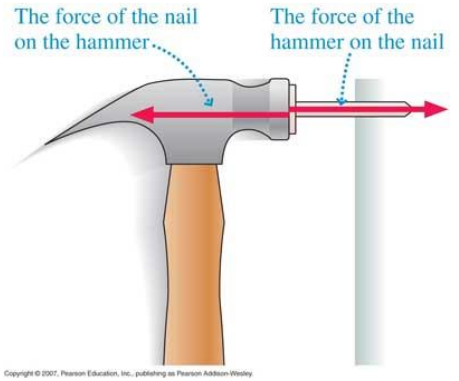
The acceleration of an object is proportional to the resultant force acting on the object, and inversely proportional to the mass of the object.

$$F = ma$$

Where F is force (N), m is inertial mass (kg) and a is acceleration (m/s^2)

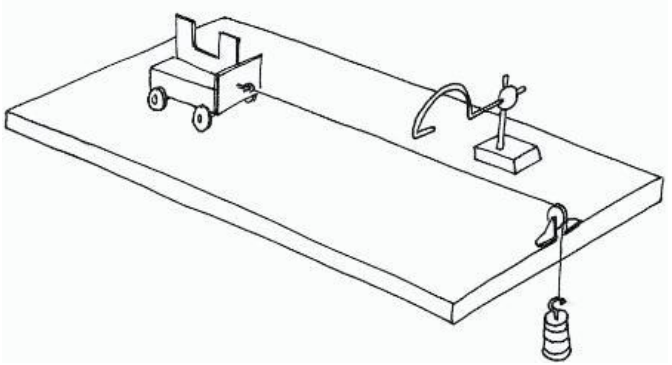
Newton's 3rd law

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



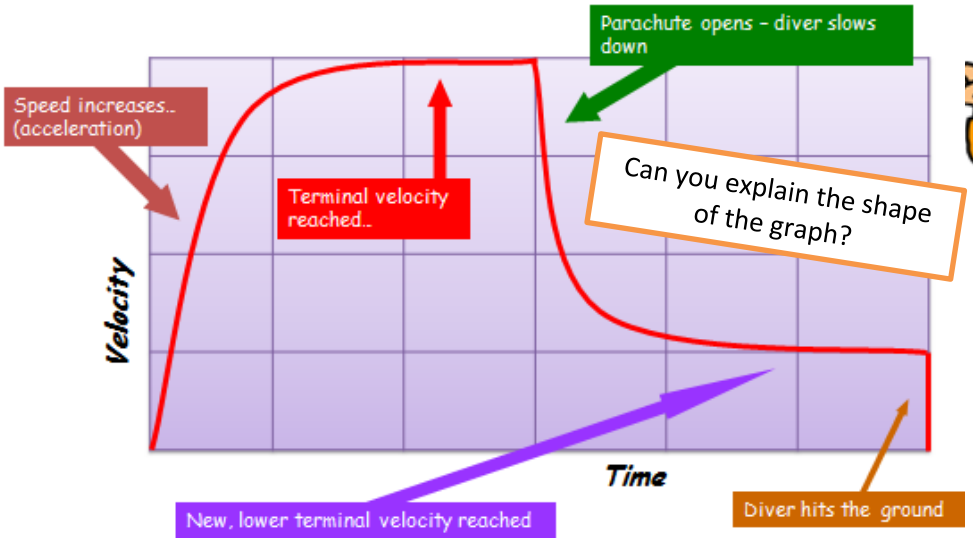
Required practical (Newton's 2nd law)

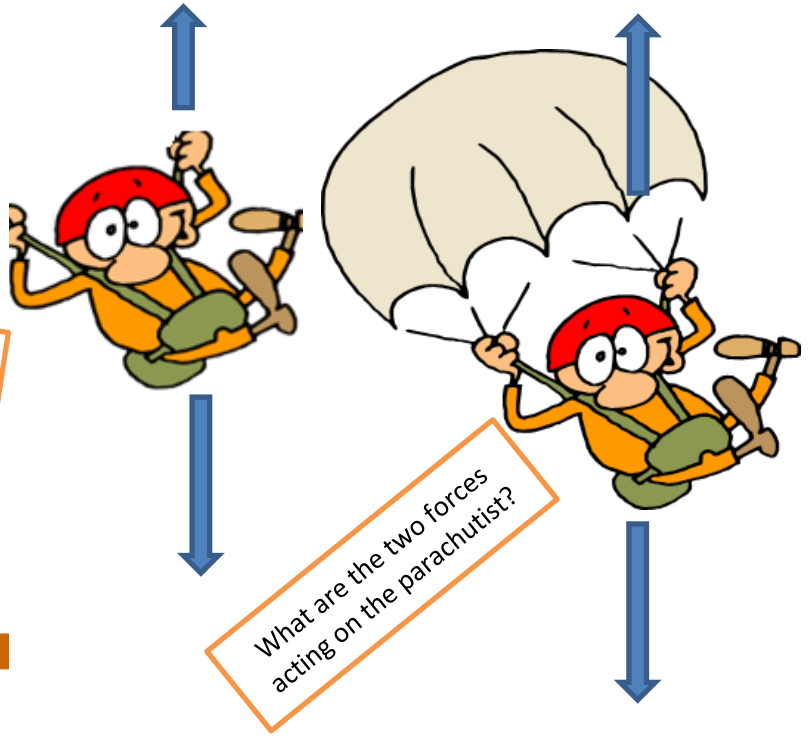
You change the mass and measure the acceleration to verify Newton's 2nd law.



Terminal velocity

Velocity-Time graph for a parachutist





When an object starts to fall, the resultant force is in the downwards direction due to the weight causing the object to accelerate. As the object accelerates the resistive force increases. Eventually the two become equal but opposite (there is no resultant force) so the object starts to travel at a constant velocity, this is known as the objects terminal velocity.

Why does a van that has the same sized engine and that is the same mass have a lower terminal velocity than a car?

What would the weight of the parachutist be if he weighed 70kg? Take $g=9.8m/s^2$

At terminal velocity, what would the value of the resistance forces be? How is this force different to the parachutists weight

Forces and braking

Motion of the car

The car has kinetic energy when it is moving. There is friction between the tyres and roads generates heat energy.

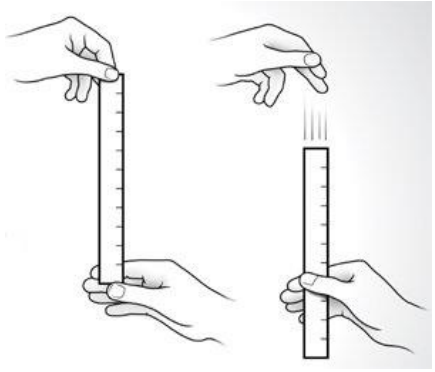
Braking

The faster the car is travelling, the greater the braking force needed to stop in a certain distance. When the car brakes, work is done against the kinetic energy and hence it decreases.

Energy can only be transferred, What type(s) of energy is the kinetic energy transferred to?

Reaction time

The thinking distance is related to the reaction time of the driver. Reaction times vary from 0.2 to 0.9 s (you must learn these values). Can you explain how you could find someone's reaction time?



Thinking Distance

This is the distance travelled by the car before the driver reacts and presses the brakes.
Drugs, alcohol, speed of car etc. can affect the thinking distance.

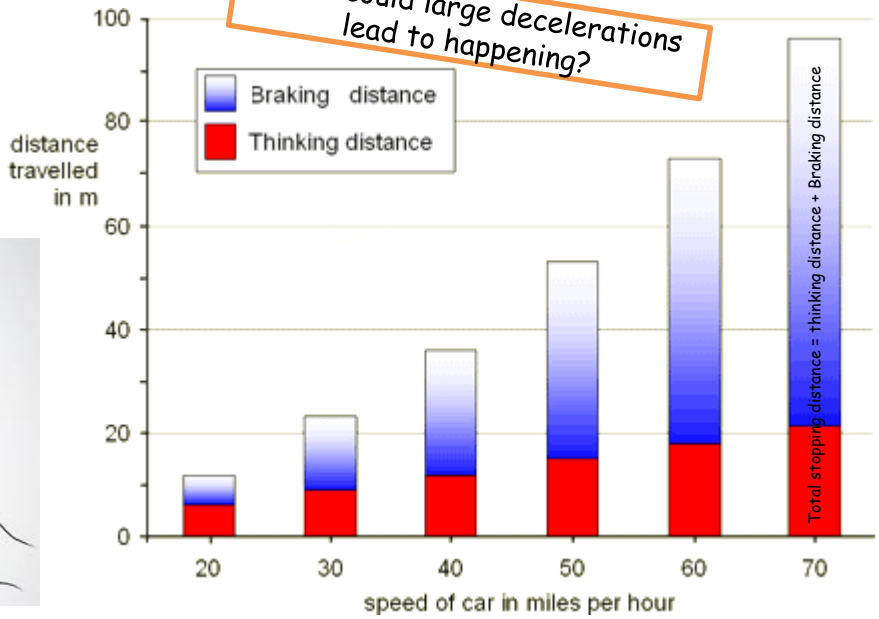
What factors could affect the braking distance?

Braking distance

This is the distance travelled once the cars brakes are applied.

Stopping distance is the thinking distance + braking distance

What could large decelerations lead to happening?



AQA GCSE Physics
Paper 2 Revision
Topic 5: Forces

Momentum and impacts

Explain why a skateboard moves backwards when the skateboarded jumps forwards. Which one will move fastest, why?

Momentum

Momentum is a property all moving objects have.

Momentum = Mass x Velocity
(kg m/s) (kg) (m/s)

p = m x v

The Conservation of Momentum

In a closed system, the momentum before an event must be equal to that of the momentum after the event.

$m_{before} \times v_{before} = m_{after} \times v_{after}$

A 1500 kg car is moving at 10 m/s and collides with a stationary car of 2000 kg. After the crash the 2000 kg car moves off at 6 m/s. What speed and direction (relative to the 2000 kg car) does the 1500 kg move off at?

Impacts

Air bags and crumple zones increase the amount of time an impact takes place in. The longer the impact time, the more the impact force is reduced. This can also be used to explain why playgrounds use rubber tiles.

Why is this the case?

We know acceleration = velocity/time. If we increase the time the acceleration therefore decreases.

We also know that force = mass x acceleration. As the acceleration has decreased this therefore means that the force decreases.

In terms of momentum there is another equation:

$F = m\Delta v/t$

Where m is the mass (kg), Δv is the change of velocity (m/s) and t is time (s). Again, a the impact time increases, the rate of change of momentum decreases and so does the force.

Key Equations

On the Data Sheet

NONE

Not on the Data Sheet

NONE