Name________________________________

Physics Paper 1 Knowledge Booklet

P1 Energy

- **State and give examples for the different types of energy**
  Chemical – Any fuels
  Kinetic – Movement
  Gravitational potential – height
  Elastic potential – stretching
  Sound
  Light
  Thermal – Heat
  Magnetic

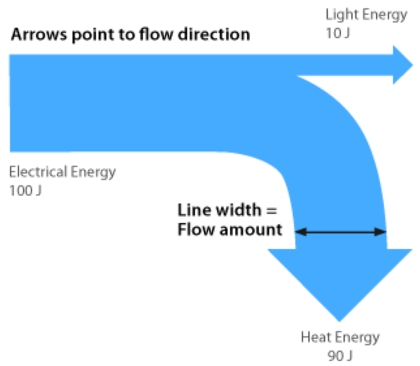
- **Describe energy stores and transfers in a car**
  The car uses chemical energy (from petrol) and transfers some to kinetic; this is useful energy, and some to thermal that is wasted.

- **Describe energy stores and transfers in a bungee jump**
  The person has high gravitational energy, stood on the bridge. When they jump the GPE decreases and is transferred to kinetic energy. The kinetic energy is transferred to elastic potential as the rope stretches

- **Describe conservation of energy**
  Conservation of energy means energy cannot be created or destroyed only transferred. So if 100J of electrical energy 100J is transferred out, some as kinetic and some as thermal energy.

- **Describe efficiency**
  Efficiency is how much energy that is input is **useful.**
  Efficiency = Useful Energy / Total Energy

- **Calculate efficiency from sankey diagrams**
  Efficiency = Useful Energy / Total Energy
  Efficiency = Light 10J / Total 100J
  Efficiency = 0.1



- **Describe what happens to wasted energy**
  All wasted energy is eventually transferred to the soundings as thermal energy.

- **Define work done and energy transferred**
  Work Done and energy are the same thing. The amount of energy transferred to an object by an energy transfer, this is usually measured in Joules (J).

Energy Transferred (J) = Force (N) X Distance (m)

Work Done (J) = Force(N) X Distance (m)

- **Describe how friction is used**

  Friction is used in a car or bike to reduce the amount of kinetic energy and transfers it to heat.

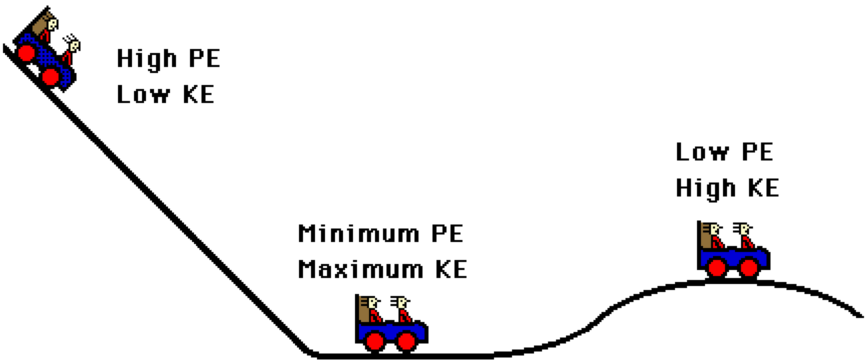
- **Describe how to calculate gravitational potential energy (GPE)**

GPE (J) = Mass (kg) X Gravitational Field Strength (N/kg) X Height (m)

- **Describe how to calculate kinetic energy**

Kinetic Energy (J) = 0.5 X Mass X Velocity^2

- **Describe and compare GPE and kinetic energy on a rollercoaster**

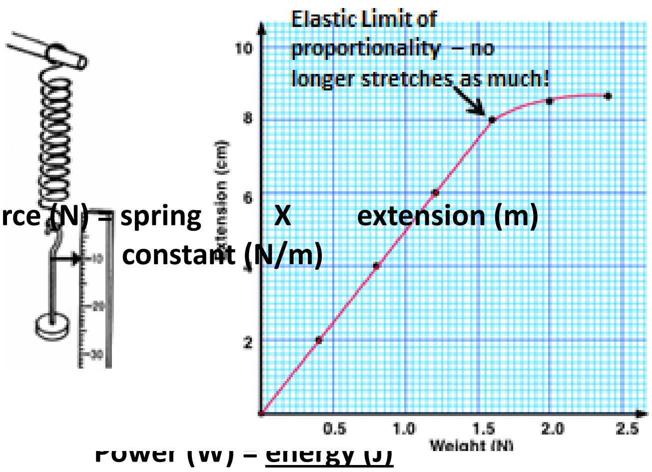


As a coaster car loses height, it gains speed; PE is transformed into KE. As a coaster car gains height it loses speed; KE is transformed into PE. The sum of the KE and PE is a constant.

- **Describe elastic potential energy**

Elastic Potential Energy (J) = 0.5 X spring constant (N/m) X extension^2

- **Describe Hooke's law practical**



Force (N) = spring constant (N/m) X extension (m)

You added force to the spring and measure the extension of the spring. The limit of proportionality is the point where the spring doesn't stretch as much.

- **Define and calculate power**

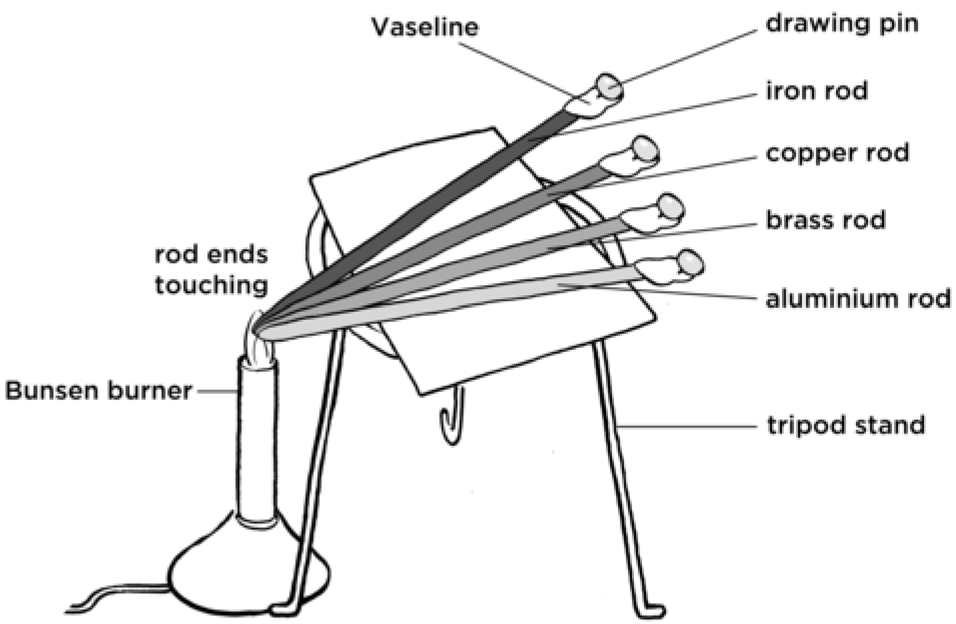
Power is the amount of energy transferred per second.

$$\text{Power (W)} = \frac{\text{energy (J)}}{\text{time (s)}}$$

P2 Energy Transfer by heating

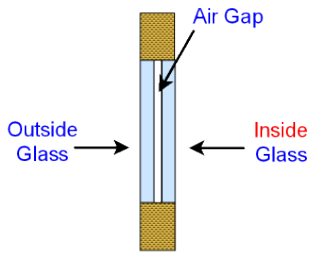
- **Define conduction**
  Conduction is when thermal energy is transferred through a material through particles colliding into each other.

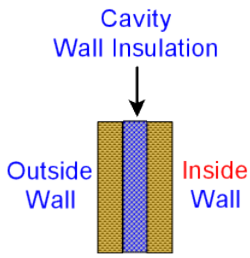
- **Describe a practical to test conduction**



Different metals will conduct at different rates and melt the Vaseline and the drawing pin will drop off. The good conductors will drop the drawing pin first.

- **Describe how we use insulation**





Insulation usually traps air to stop conduction of energy. This is used in double glazing and cavity wall insulation.

- **Describe the practical for specific heat capacity**

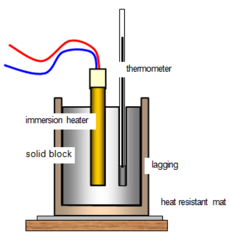


Figure 1

Connect the ammeter in series and the voltmeter in parallel; these are used to calculate the energy supplied by the heat. You measure the temperature at the beginning and the end to get the temperature change.

- **Define specific heat capacity**
  Specific heat capacity is the energy used to heat 1kg of substance by 1°C.

  Energy (J) = Mass (kg) X Specific Heat Capacity (J/kg/°C) X Temperature change (°C)

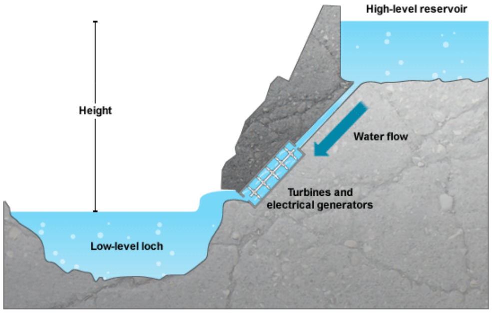
The higher the specific heat capacity the more energy the substance can store and the less it will heat up.
So if all of these substances are supplied with the same amount of energy, water would have the lowest temperature. Lead would be the hottest substance.

Substance	c / J kg^{-1} °C^{-1}
Water	4200
Aluminium	900
Glass	600
Iron	480
Copper	370
Lead	130

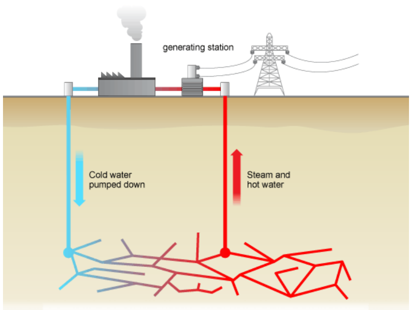
P3 Energy Resources

- **Describe what Biofuels are**
  Fuels produced from plant material. Whilst they do produce carbon dioxide when burnt, they are considered carbon neutral as they give out the same amount as taken in whilst photosynthesising.

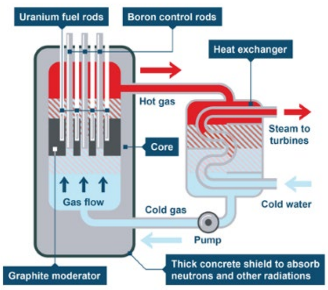
- **Describe how hydroelectric power station works**



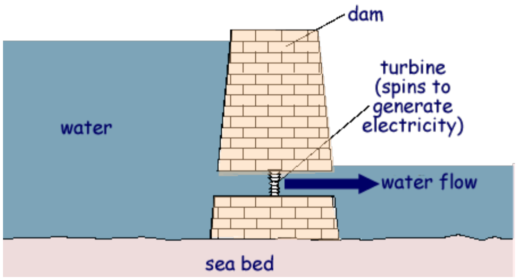
- **Describe how geothermal energy is produced**



- **Describe how nuclear power is produced**



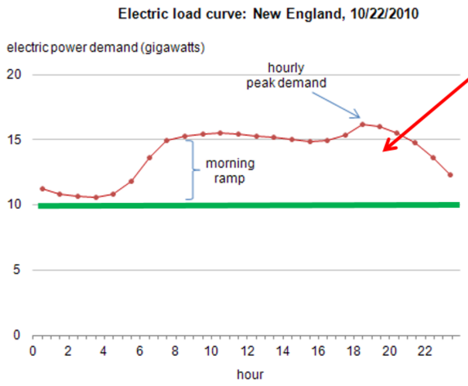
- **Describe how tidal energy is produced**



- **Compare advantages and disadvantages of different power stations**

	Power station	Advantage	Disadvantage
Non Renewable	Coal – burning coal to heat water to produce steam to turn a turbine.	Reliable – constant energy	Produces CO_2 = Global warming
	Oil – burning oil to heat water to produce steam to turn a turbine.	Reliable – constant energy	Produces CO_2 = Global warming
	Gas – burning gas to heat water to produce steam to turn a turbine.	Reliable – constant energy	Produces CO_2 = Global warming
	Nuclear – nuclear reaction to produce heat to produce steam to turn a turbine.	Reliable – constant energy	Produces dangerous waste
Renewable	Wind – directly turns the turbine.	No greenhouse gases	Un-reliable
	Tidal – Traps water at high tide, at low tide it flows through the turbines.	No greenhouse gases	Destroys habitats
	Hydroelectric – water flows from high reservoirs through turbines	No greenhouse gases	Short supply of electricity
	Solar – absorbs the sun’s energy	No greenhouse gases	Expensive
	Geothermal – Uses hot rocks in volcanic areas to heat water to produce steam to turn a turbine	No greenhouse gases Reliable	Only in volcanic areas

- **Describe how we plan to meet energy demand**



Peaks in demand can be supplied by less reliable sources like hydroelectric, tidal and solar.

Base load – The minimum energy needed to supply electricity. This is provided by power stations that are reliable like coal, oil, gas and nuclear.

We use a combination of power stations, some have a short start up time and some have a long start up time. This is how quickly the power station can start making electricity.

P4 Electrical Circuits

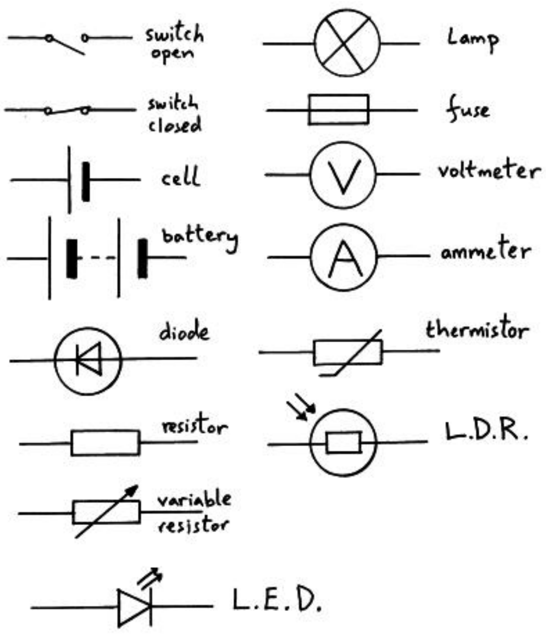
- **Describe how static forms**

  Static forms when one object gets a negative charge – through gaining electrons. One object gets a positive charge – through losing electrons.

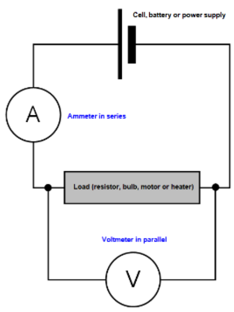
- **Describe why things attract and repel**

  Attract – when objects have opposite charges
  Repel – when objects have like charges

- **State circuit symbols**



- **Describe how to connect ammeters and voltmeters**



Voltmeters are connected in parallel – around the component you are measuring.
Ammeters are connected in series.

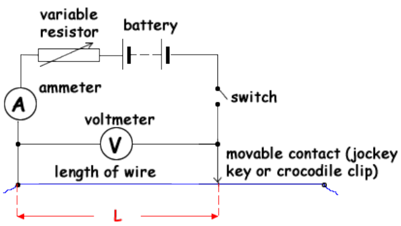
- **Describe what current, charge, potential difference and resistance are**

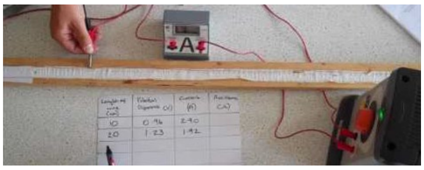
  Current – The flow of electrons around the circuit
  Charge – The size of electrical current
  Potential Difference – The energy transferred to the component by the electrons
  Resistance – How easy it is for electrons to flow

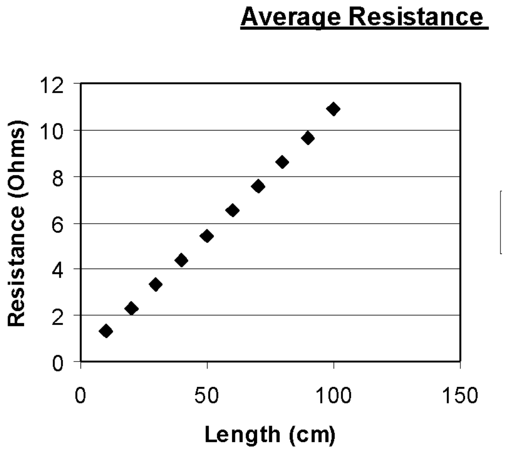
- **Describe how resistance changes**

  When the resistance is high, current cannot flow and the circuit is off.
  When the resistance is low, the current can flow and the circuit is on.

- **Describe how to investigate resistance of a wire**

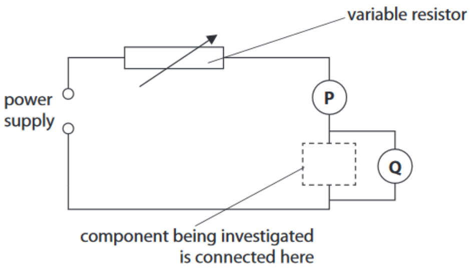






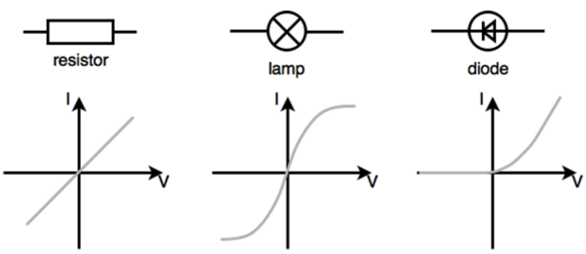
You measure the current and potential difference at different lengths. Use the equation to calculate the resistance. The resistance should be higher the longer the wire.

- **Describe how to investigate resistance of different components**



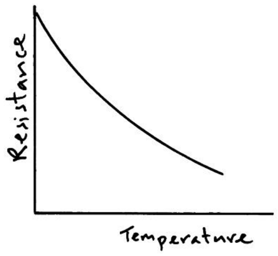
You measure the current and potential difference for different components. Use the equation to calculate the resistance.

- **Describe resistance graphs**



Constant temp   Changing temp   Diode

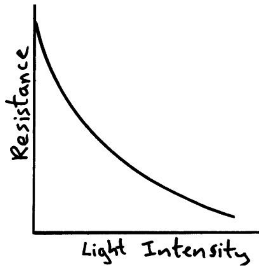
- **Describe what thermistors are**



Thermistor – resistance changes depending on the temperature. When the resistance is high, current cannot flow and the appliance is off. When resistance is low, current flows and the appliance is on.

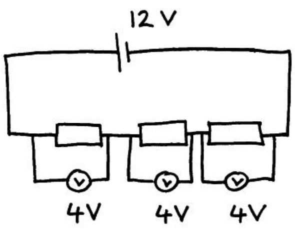
- **Describe what light dependent resistors are**

LDR – resistance changes depending on the light intensity. When the resistance is high, current cannot flow and the appliance is off. When resistance is low, current flows and the appliance is on.

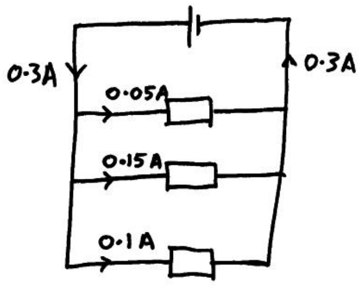


- **Describe the circuit rules for series and parallel circuits**

	Current (A)	Potential Difference (V)
Series circuit	**The current is the same all over the circuit**	**The potential difference splits between the components**
Parallel circuit	**The current splits between the branches**	**The potential difference is the same on each branch**



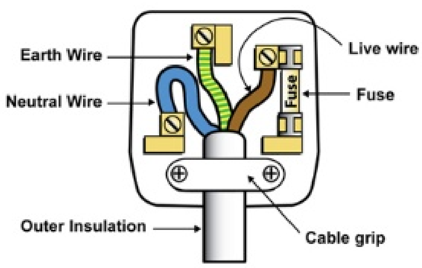
This is a series circuit and we are looking at potential difference. There are three components and the potential difference from the cell is split between the three.



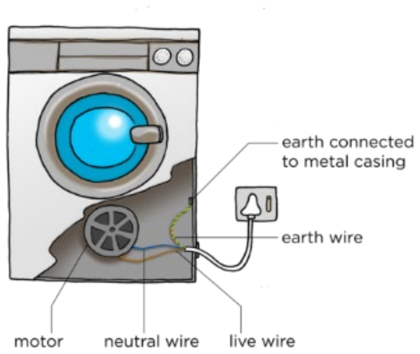
This is a parallel circuit and we are looking at current. The 0.3A from the main branch splits between the three branches in the circuit.

P5 Electricity in the Home

- **Describe how to wire a plug**



- **Describe why we use earth wires**

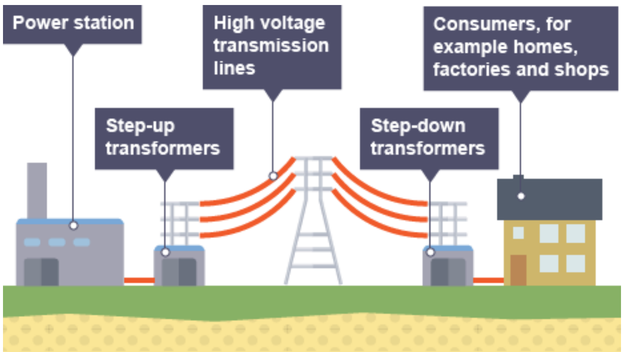


The earth wire is connected to the metal casing of appliances. If the casing becomes charged, the electricity goes to earth so people don't get shocked.

- **Describe the role of fuses**

Fuses control the amount of current. When too much current flows the wire breaks and breaks the surface.

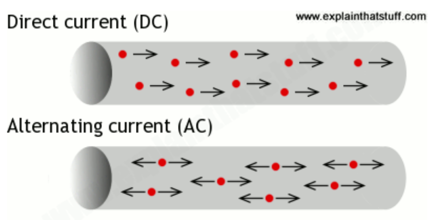
- **Describe what the national grid is**



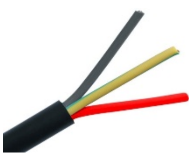
Step up transformers increase the potential difference to increase the efficiency of transmission (less heat loss).
Step down transformers lower the potential difference to make it 230V which is safe.

- **Describe mains electricity**
  Mains electricity is 230V and 50Hz.

- **Describe different types of current**
  Alternating Current – Current flows both ways. This is produced from mains electricity.
  Direct Current – Current flows in one direction. This is produced from batteries.



- **Describe double core wires**



Double core wires have two layers of insulation to protect the user from electric shock if wires become frayed.

P6 Molecules and Matter

- **Describe how to calculate density**

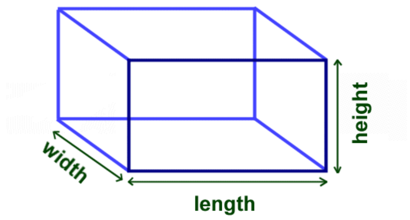
  Measure the mass using a balance and measure the volume of the object.

  $$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

- **Describe what density means**

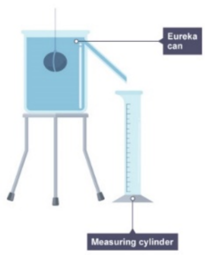
  Density is the number of particles in a given space.

- **Describe how to find the density of regular objects**



For a regular object fine the volume using maths and a ruler. For example, if it is rectangular you calculate length X Height X Width. Then take the mass of the object using a balance. Then use the equation

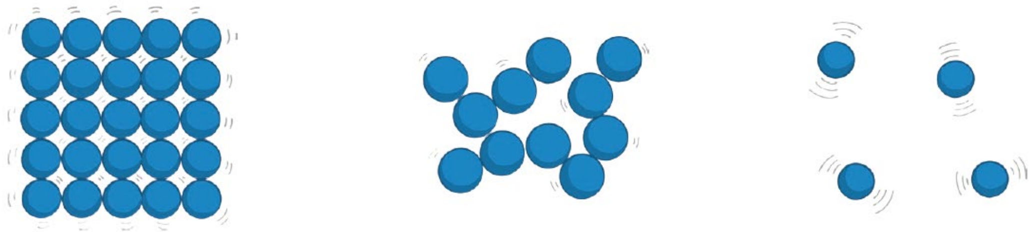
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$



- **Describe how to find the density of irregular objects**

For an irregular object we cannot use an equation to calculate the volume, we need to use a eureka can. Calculate the mass using a balance. Fill the eureka can up to the top with water. Place the object in the eureka can. Measure the water displaced using a measuring cylinder. The volume of water displaced is the same as the volume of the object. Density = $\frac{\text{Mass}}{\text{Volume}}$

- **Describe properties of the three states of matter**

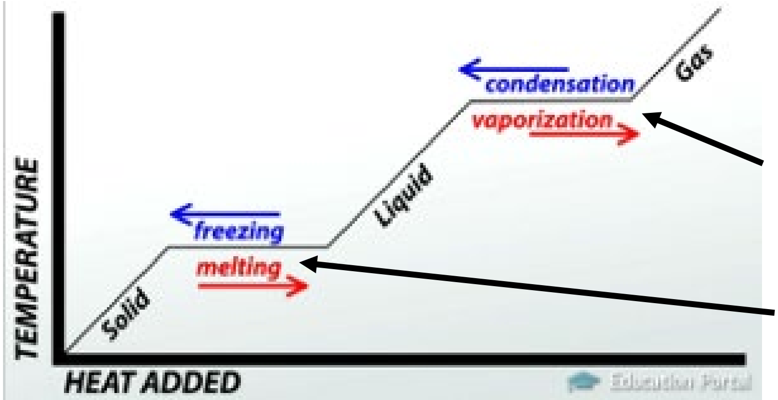


Solid Liquid Gas

Solids have the least internal kinetic energy and vibrate on the spot. Gases have the most internal energy and have a lot of kinetic energy. The particles tend to have a range of speeds.

	volume	shape	ease of flow	ease of compression
solid	definite	definite	doesn't flow	not easily
liquid	definite	takes shape of container	flows easily	not easily
gas	no definite volume	takes shape of container	flows easily	easy

- **Describe heating and cooling graphs**



The flat area, where the temperature doesn't change shows the changes of state.

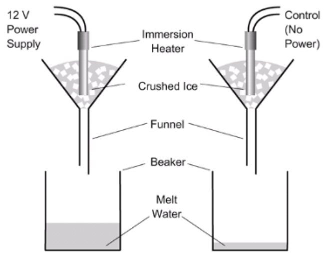
Specific Latent Heat of vaporisation – The amount of energy needed to turn 1kg of a substance from a liquid to a gas.

Specific Latent Heat of fusion – The amount of energy needed to turn 1kg of a substance from a solid to a liquid.

- **Describe evaporation**

  Evaporation causes the temperature of the liquid left behind to remain constant as the energy is taken with the escaping gas particles (like sweating).
  Increase the rate of evaporation:
  Hot
  Windy
  Dry (not humid)

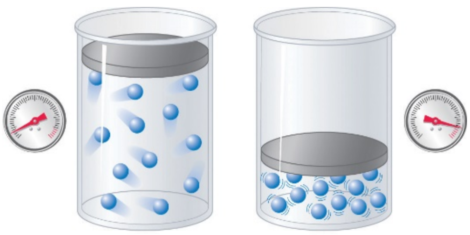
- **Describe how to experimentally find the specific latent heat of fusion**



Measure how much energy is needed to melt 1kg of ice.

Use a control, ice without a heated to take off the amount that would naturally melt.

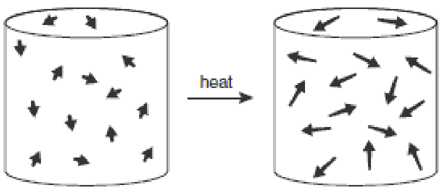
- **Describe gas pressure**



(a) Low pressure (b) High pressure

Gas pressure is caused by particles colliding with the outside of a container. If you decrease the volume the pressure increases.

- **Describe how temperature increases gas pressure**



The higher the temperature the more kinetic energy the higher the pressure.

P7 Radioactivity

- **Describe ways to detect radiation**

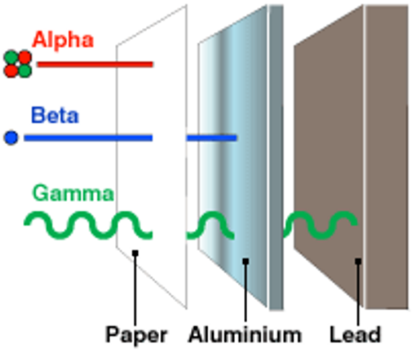
A Geiger counter is used to measure the rate of radiation.

- **Describe the properties of the three types of radiation**

Helium nuclei/ 2 protons and 2 neutrons

High powered electron

Ionising energy – most ionising

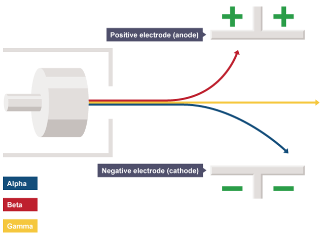


Alpha cannot penetrate very far but is the most ionising (most likely to cause cancer).

Beta is the middle level of penetration and ionisation.

Gamma is the least ionising but can penetrate the furthest.

- **Describe and explain how radiation behaves in magnetic and electrical fields**



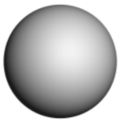
Alpha and beta are both deflected as they are charged.

Alpha and beta travel in opposite directions as they have an opposite charge.

Gamma is not deflected as it is not charged.

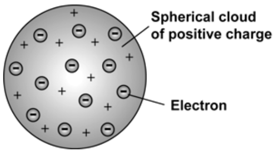
- **Describe the history of the atom**

We haven't always known very much about the atom and different theories have been developed about the atom over time.

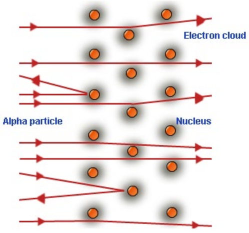


John Dalton – 1880
Atoms are solid spheres that make up everything. Atoms of the same element are the same.

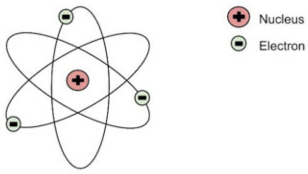
JJ Thompson – 1900 **The Plum Pudding Model**



He discovered electrons. He said that there was a sphere of positive charge with lots of floating electrons, like plums floating in a pudding.



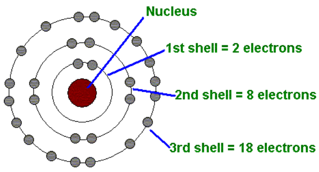
Ernest Rutherford – 1911 **The Nuclear Model**



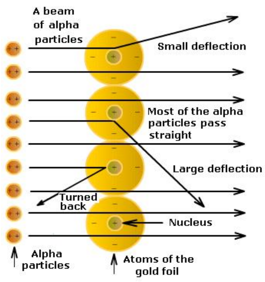
Rutherford Model of the Atom

An experiment was completed where positively charged alpha particles were fired at thin gold foil that was only one atom thick. Some of the alpha particles passed straight through, showing most of the atom was empty space. Some were deflected from the nucleus of the atom, showing that the nucleus of that atom must be positive. A very small number were deflected backwards showing that the nucleus must be very small.

Niels Bohr – 1915
He tweaked Rutherford's model by developing the idea that the electrons orbit the nucleus in shells in a certain configuration.



- **Describe Rutherford's alpha scattering experiment**



Rutherford fired alpha particles at thin gold foil.

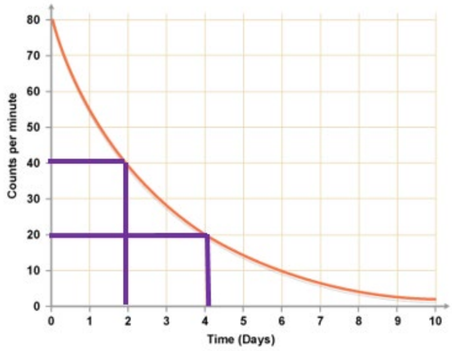
1. He found most alpha particles went straight through showing the atom is mostly empty space.
2. Some were fully deflected by something showing there was a very small nucleus in the centre of the atom.
3. Some were partially deflected because the positive alpha particle is deflected by the positive nucleus.

- **Describe and compare irradiation and contamination**

Irradiation is when the body is externally exposed to radiation. In this case gamma is the most dangerous as it can penetrate through the body.
Contamination is when a radioactive source is ingested. In this case alpha is the most dangerous as it is highly ionising and doesn't need to travel as far.

- **Define half-life**
  Half-life is the time taken for the count rate to halve.

- **Calculate half-life from graphs**



The count rate starts at 80 counts per minute. It takes 2 days for the count rate to half to 40 counts per minute.

- **Calculate half-life from tables**

Count Rate	Time in day
1800	0
1200	5
900	10
600	15
510	20
450	25
300	30

The count rate starts at 1800 counts per minute and it takes 10 days for the count rate to half to 900 counts per minute.

Trilogy Equations (inc Higher Tier)

These equations must be learn off by heart so you are able to recall and apply them in the GCSE Exams, they will not be provided for you.

Weight (N) = Mass(kg) X Gravitational Field Strength(N/kg)	$W = m\ g$
Work Done(J) = Force(N) X Distance(m)	$W = F\ s$
Force applied to spring(N) = Spring Constant(N/m) X Extension(m)	$F = k\ e$
* Distance(m) = Speed(m/s) X Time(s)	$S = v\ t$
Acceleration(m/s^2) = Change in Velocity(m/s) / Time taken (s)	$A = \frac{\Delta v}{t}$
Resultant Force(N) = Mass(kg) X Acceleration(m/s^2)	$F = m\ a$
Momentum(kg m/s) = Mass(kg) X Velocity(m/s^2)	$P = m\ v$
Kinetic energy(J) = 0.5 X Mass(kg) X $(\text{Velocity})^2$(m/s)	$E_k = \frac{1}{2}\ m\ v^2$
Gravitational (J) = Mass(kg) X Gravitational FS(N/kg) X height(m) Potential Energy	$E_p = m\ g\ h$
Power(W) = Energy Transferred(J) / Time(s)	$P = \frac{E}{t}$
Power(W) = Work Done(J) / Time(s) — Remember work done and energy transferred are the same thing!	$P = \frac{W}{t}$
Efficiency = Useful Energy(J) / Total Energy(J)	
Efficiency = Useful Power(W) / Total Power(W)	
Wave Speed(m/s) = Frequency(Hz) X Wavelength(m)	$V = f\lambda$
Charge Flow(C) = Current(A) X Time(s)	$Q = I\ t$
Potential Difference(V) = Current(A) X Resistance(Ω) — This is Ohms Law	$V = I\ R$
Power(W) = Potential difference(V) X Current (A)	$P = V\ I$
Power(W) = $(\text{Current})^2$(A) X Resistance (Ω)	$P = I^2\ R$
Energy Transferred(J) = Charge Flow X Potential Difference(V)	$E = Q\ V$
* Density(kg/m^3) = Mass(kg) / Volume(m^3)	$P = \frac{m}{V}$

Remember that there are a number of ways to calculate some terms, for example power, energy transferred and acceleration. So when you get a question you need to look at the information you are given and choose the equation that has the same terms.

To be able to do this they need to be memorised really well!

These equations will be given to you during the exam – without units- and you need to be able to apply them.

(Final Velocity)^2 – (Initial Vel)^2 = 2 X Acceleration(m/s^2) X Distance (m) (m/s)	$V^2 - u^2 = 2as$
Elastic Potential(J) = 0.5 X Spring Constant(N/m) X (Extension)^2(m^2)	$E_e = \frac{1}{2} k e^2$
Change in Thermal Energy(J) = Mass(kg) X Specific Heat Capacity(J/kg/°C) X Temperature Change(°C)	$\Delta E = m c \Delta\theta$
Period(s) = $\frac{1}{\text{Frequency(Hz)}}$	
Force on a conductor Carrying a current(N) = Magnetic flux Density(Wb) X Current(A) X Length(m)	$F = B I l$
Thermal Energy for a change of State (J) = Mass(kg) X Specific Latent Heat(J/kg)	$E = m L$
Primary Potential Difference(V) X Primary Current(A) = Secondary Potential Difference(V) X Secondary Current(A)	$V_p I_p = V_s I_s$

***Units can change**