Energy Stores

There are 8 energy stores:

Store	Stored in...
Kinetic	moving objects
Gravitational potential	objects raised above ground
Elastic potential	Stretched or compressed objects
Thermal	All objects due to particle movement
Chemical	Substances (foods, fuels) that can release energy in a chemical reaction
Nuclear	The nucleus of atoms
Magnetic	Magnets attracting or repelling
Electrostatic	Separation of charges

Conservation of energy law:
Energy is NEVER created or destroyed

Energy is transferred by different pathways – by heating or when work is done

When energy is transferred, some is often transferred to the environment – this is wasted or dissipated energy

Efficiency

Tells us how much of the energy is transferred usefully.

$$\text{Efficiency} = \frac{\text{Useful output energy transferred by the device}}{\text{Total input energy supplied to the device}}$$

$$\text{Efficiency} = \frac{\text{Useful power out}}{\text{Total power in}}$$

Wasted energy always ends up in the **thermal store** of the surroundings

P1 Energy

Calculating energy stores

The energy stored in a raised object can be calculated using:

GPE = mass x height x gravitational field strength
GPE= mgh

The energy stored in a moving object can be calculated using:

KE = ½ mass x velocity^2
KE = ½ m v^2

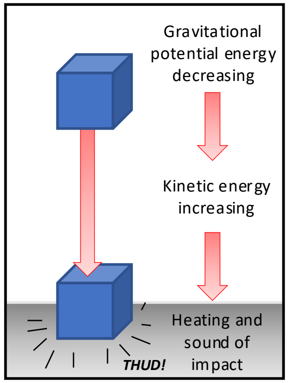
Energy stored in a stretched or compressed object can be calculated using :

E = ½ spring constant x extension^2
E = ½ k e^2

Transfers of energy:

E.g. An object above ground has GPE.
If that object falls:

1. Decreases its GPE store
2. Increases its KE store as it falls
3. Waste energy transferred to the environment by heating and sound



Specific heat capacity

The amount of energy needed to change the temperature of 1Kg of a substance by 1ºC

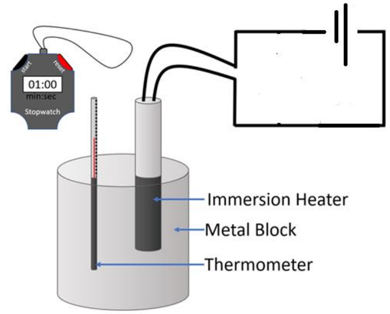
It is calculated by:

E = specific heat capacity x mass x temp change
E = SHC x m x θ

Units for SHC are J/Kg/°C

Different materials have different specific heat capacity values.

This can be investigated using the equipment below:



- Energy is supplied to the block by the immersion heater over a fixed time period (e.g 5 mins)
- The thermometer measures the temperature of the block at the start and the end of the experiment
- The stopwatch measures the time
- If the power of the heater is known (e.g 50W) the energy transferred to the block can be found using the equation:

Energy (J) = Power (W) x time (s)

The specific heat capacity of different materials can be investigated by:

- changing the metal **(independent variable)**
- measuring the temperature increase **(dependent variable)**
- Keeping the energy supplied, mass and insulation the same **(control variables)**

Insulating the block reduces energy transferred to the thermal store of the environment, improving accuracy

Energy Stores

Complete the table:

Store	Stored in…
kinetic	
	objects raised above ground
Elastic potential	
	All objects due to particle movement
Chemical	
	The nucleus of atoms
Magnetic	
	Separation of charges

1. What is the conservation of energy law?
2. In what two general ways is energy transferred?
3. What is wasted energy?

Efficiency

1. What is the equation to calculate efficiency?
2. Where does wasted energy end up?

1. What is the equation linking gravitational field strength, GPE, height and mass?

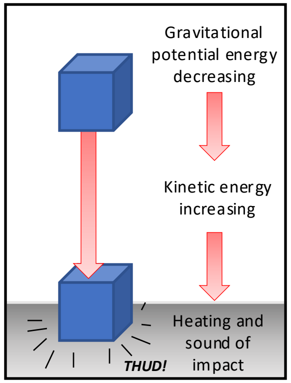
2. What is the equation linking kinetic energy, mass and velocity?

3. What quantity is found in both equations?

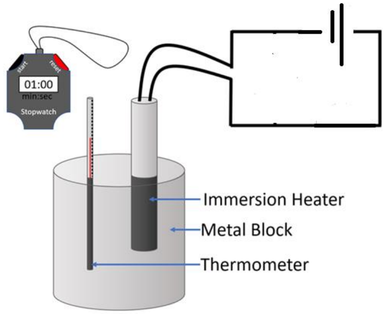
4. What happens to the GPE store when a raised object falls?

5. What happens to the KE store of a raised object when it begins to fall?

6. By which two pathways is energy transferred to the environment when an object falls?



1. What is the specific heat capacity of a substance?
2. In the hypothesis 'different metals have different specific heat capacity values' what is the independent variable?



3. What does the immersion heater do?
4. What two readings are taken using the thermometer?
5. What is a sensible time period to use for transferring energy to the block?
6. What should be put round the block?

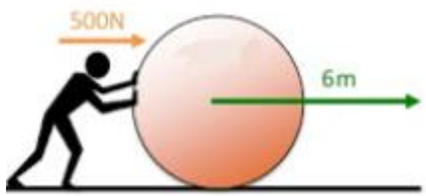
Power and work done

Work done = energy transferred

Energy transferred mechanically is calculated:

Work done = force x distance

W (J) = F (N) x s (m)



Work done = 500N x 6m

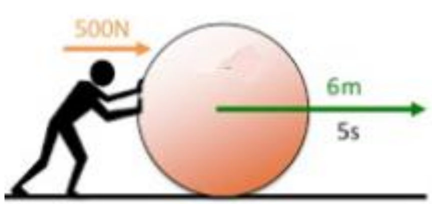
= 3000 J

Power = energy transferred per second

1 Watt = 1 Joule per second

Power = energy transferred ÷ time

P (W) = e (J) ÷ t (s)



Power = Energy ÷ time

= 3000 J ÷ 5 s

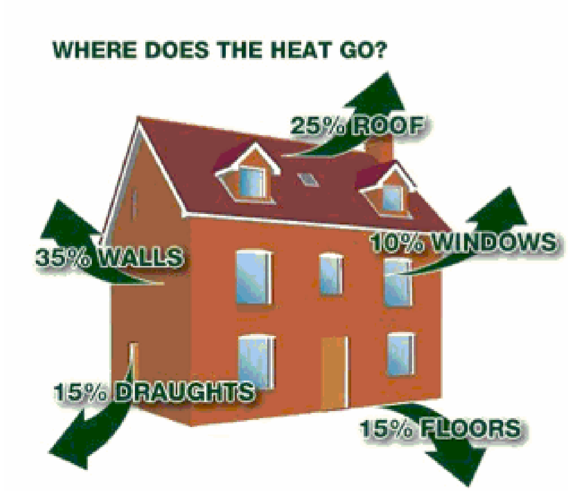
= 600W

A more powerful appliance transfers more energy per second, eg:

Reducing unwanted energy transfers

Reducing wasted energy means lower costs

Materials that conduct heat well have a high **thermal conductivity**.



Reducing energy transfers in homes

- Double glazing
- Thick walls
- Walls made of materials with low thermal conductivity
- Insulation – wall and loft

Reducing energy transfers in appliances:

- Lubrication – reduces friction

- Streamlining – reduces air resistance

Energy resources

We use energy resources for electricity generation, transport and heating

Non-renewable – ones that are being used faster than they can be replaced and will run out.

Example	+	-
Coal, oil, natural gas	Reliable method of generating electricity	Release CO_2 which contributes to global warming
nuclear	No CO_2 released	Produces radioactive nuclear waste

Renewable resources:

Ones that will not run out , they are being replenished as they are used

Example	+	-
Solar	No CO_2 released	Don't work at night or well on cloudy days
wind	No CO_2 released	Doesn't work if it isn't windy
Hydro	No CO_2 released	Damage to habitats
Geothermal	No CO_2 released	Only found in specific places
waves	No CO_2 released	Damage to habitats
Biofuel	Carbon neutral	Uses crop land to grow new forests

1. What are the units for work done?

2. What are the units for force?

3. What is the equation to calculate work done during mechanical work?

4. What is the equation to calculate power?

5. What is the unit for power?

6. What is the unit for time in the power equation?

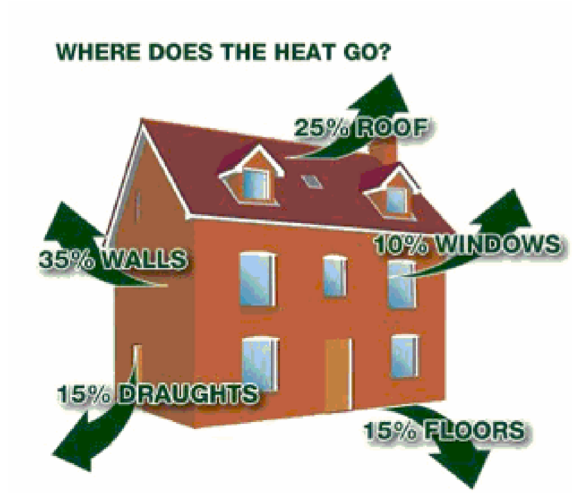
7. What is 1 Watt equivalent to?

8. How would you recognise a more powerful lightbulb?

9. What is meant by a more powerful appliance?

1. Why is reducing unwanted energy transfers from the home important?

2. What is meant by 'high thermal conductivity'?

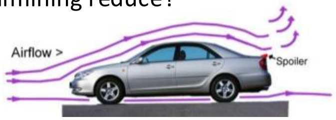


3. Where is most of the heat lost through in a house?

4. Give two ways to reduce the heat lost though the walls of a house.

5. What does lubrication reduce?

6. What does streamlining reduce?



1. Give the three main uses for energy resources

2. What is a non-renewable energy resource?

3. Give 2 examples of non-renewable energy resources

4. Give two disadvantages of using coal and oil

5. Give one advantage to using nuclear resources to generate electricity.

6. What is a renewable energy resource?

7. Give 4 examples of renewable resources

8. Give 2 advantages of using renewable resources to generate electricity

9. Give two disadvantages of using renewable resources to generate electricity

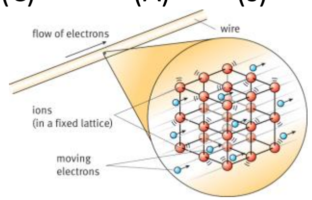
P2 – Electricity

Current, resistance and potential difference

Electrical current is the flow of electrical charge.
Current is measured in amps (A), charge is measured in Coulombs (C).
The size of the current depends on the rate of the flow of charge – ie how many coulombs of charge per second.

Q = I t

Charge = Current x time
(C) (A) (s)



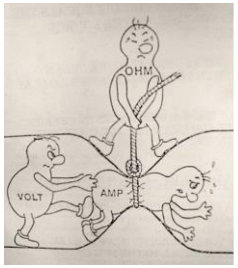
Ohms Law

The current through a component depends on the potential difference and the resistance of the component.
If a component has high resistance, the current will be smaller for a given potential difference

potential difference = current x resistance

V = I R

pd is measured in volts (V), resistance in Ohms (Ω)

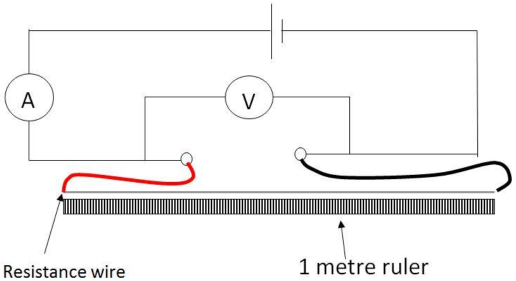


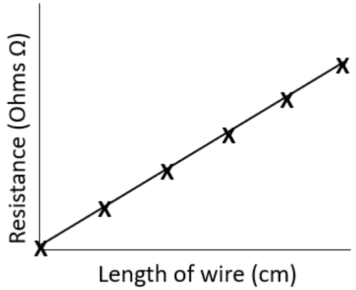
Hypothesis 'the length of the wire affects resistance'

Independent variable – length of wire
Dependent variable – resistance
Control variables – type of wire, temperature of the wire, diameter of the wire

1. Set up the circuit as shown, with an ammeter in the circuit and a voltmeter connected across the wire
2. Use crocodile clips to change the length of the wire in the circuit
3. Make the wire 10cm long and read the current and pd. Switch off the current between readings or the wire will got hot, increasing the resistance.
4. Repeat for 20, 30, 40, 50 cm. (5 minimum)
5. Calculate resistance using Ohms Law R = V/I

Plot length of wire (IV) against resistance (DV)

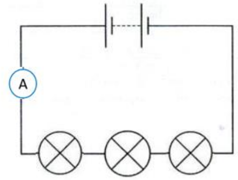




The relationship is directly proportional

Series and parallel circuits

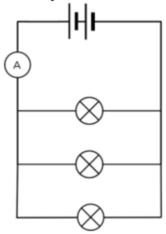
Series circuits:
A series circuit is one single loop



In a series circuit:

- the current is the same at all points in the circuit.
- potential difference is shared between components (equally if components are identical resistance)
- total resistance = sum of all resistors

Parallel circuits
A parallel circuit consists of more than one loop from the battery/cell.



In a parallel circuit:

- The current is shared amongst the branches
- The potential difference is the same across all components
- Resistance in the whole circuit is LESS than that of the smallest resistor

P2 – Electricity

Current, resistance and potential difference

1. What is current?
2. What is the unit for charge?
3. What is the unit for current?
4. What is the equation linking charge, current and time?
5. What is the equation linking current, potential difference and voltage?
6. If a component's resistance increases, what happens to current through that component?
7. What is the unit for resistance?

Hypothesis 'the length of the wire affects resistance'

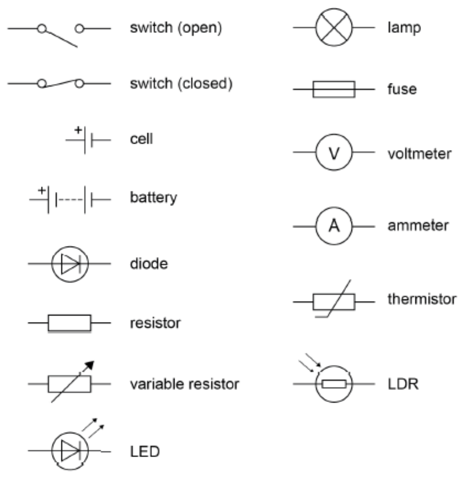
1. What is the independent variable in this investigation?
2. What is the dependent variable?
3. What is the minimum number of readings needed for a line graph?
4. What two readings are taken?
5. How is resistance calculated?
6. What sort of relationship is seen?
7. Why is it important to turn off the power in between readings?

Series and parallel circuits

1. What is a series circuit?
2. In a series circuit, the current is……
3. How do you find total resistance in a series circuit?
4. The potential difference is shared equally among components as long as………
5. What is a parallel circuit?
6. What is true about potential difference across all of the components in a parallel circuit?
7. How is total current calculated in parallel?
8. What is true for total resistance in a parallel circuit?

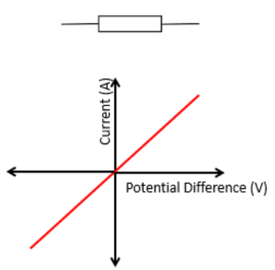
P2 – Electricity

Components

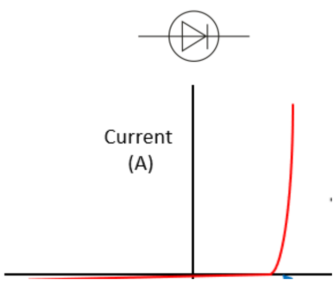


- A **diode** only allows current to flow one way in a circuit
- A **resistor** is a component that provides a fixed resistance in the circuit – e.g a 5 Ω resistor
- A **variable resistor** is a component whose resistance can be changed (e.g a dimmer switch)
- A **thermistor** is a resistor whose resistance changes with temperature – the higher the temperature the lower the resistance
- An **LDR** (light dependent resistor) has resistance that changes
- An LED (light emitting diode) is a light that only allows the flow of current one way

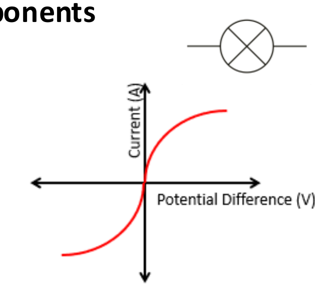
Current, potential difference and resistance for different components



A fixed (ohmic) resistor has fixed resistance current is directly proportional to potential difference
Resistance remains constant (at constant temp)

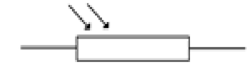


A diode very high resistance in one direction.
Only when the potential difference is positive does current flow

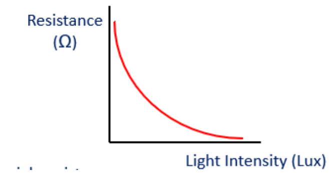


A filament bulb contains a thin wire that glows as current flows.
As the pd increases, the current initially increases.
However, at higher pd, the wire gets hot
The ions in the wire move faster and collide with the moving charges
Resistance increases, so current stops increasing

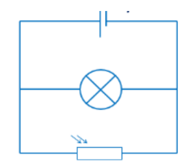
LDR



A light dependent resistor has varying resistance.
As the light intensity increases, the resistance decreases



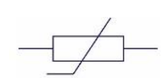
LDRs can be used to switch on lights at night time.



In this circuit, when it is day time, the resistance in the LDR is low, so all current flows through the LDR.

As light levels fall, resistance increases, until eventually there is less resistance in the bulb than the LDR, so current flows through the bulb – switching it on.

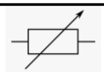
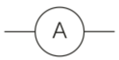
Thermistor



As the temperature increases, the resistance in a thermistor decreases.

P2 – Electricity

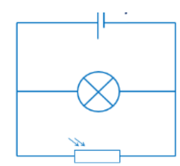
Components

Symbol	Name
	Cell
	
	fuse
	
	Voltmeter

1. Complete the table opposite
2. Which component has a resistance that decreases as light intensity increases?
3. Which component only allows current to flow one way?
4. What is a fixed resistor?

LDR

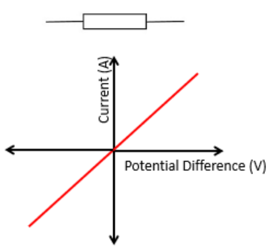
1. Draw the symbol for an LDR
2. Draw the pattern you would expect for resistance as the light intensity increases.
3. The circuit below is for a night light. What is resistance in the LDR like during the day time? (high light levels)

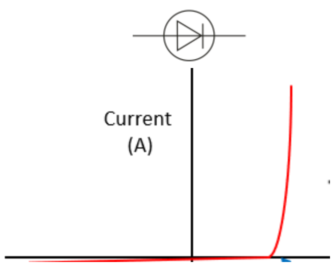


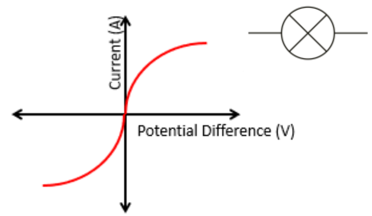
4. Why does the light switch on when it goes dark?
5. Draw the symbol for a thermistor
6. Describe the relationship between temperature and resistance in a thermistor

Current, potential difference and resistance for different components

1. What readings would you need to take from a circuit to calculate resistance?







2. Describe the relationship shown
3. Why is there no current on one side of the graph?
4. What happens to current when the pd rises at first ?
5. What happens to the current as the pd gets higher?
6. Why does the resistance increase at higher pd?

P2 – Electricity

Domestic use of electricity

There are two types of electrical supply – direct (DC) and alternating current (AC)

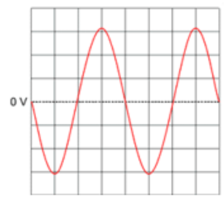
AC

The pd changes direction and magnitude, giving alternating current

The number of times the change of direction happens per second is the frequency.

UK mains is AC - **230V**

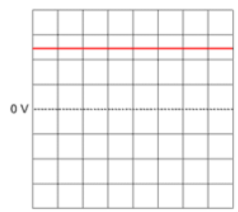
Frequency of **50 Hz**

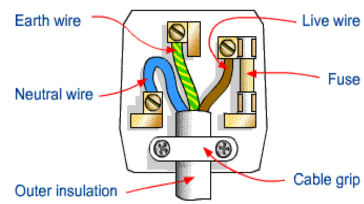


DC

A direct pd produces current that flows in one direction

Batteries supply DC



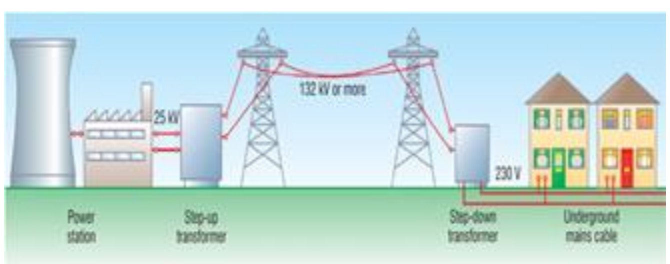


Electrical appliances are connected using 3 core cable

- Brown – live wire, with pd of 230V
- Blue – neutral, 0V, completes the circuit
- Yellow and green – Earth wire, is at 0V unless there is a fault, when it will become live

The National Grid

The National Grid is a system of cables and transformers connecting power stations to homes and businesses



The National Grid uses very high pd and low current.
High current causes heating in the wires and would result in large energy losses.
Step up transformers increase the pd from the power station (to around 400000V) so that low current can be used to transmit power.
This means the wires don't get hot, so less energy is lost.
Near homes and businesses, step down transformers reduce the pd to 230V for safety.

Appliances in the home and power

Power is measured in Watts (W) or kW
Power can be calculated by using:

Power = Voltage x current
$P = IV$

Power = current^2 x resistance
$P = I^2 R$

Appliances transfer energy.
Energy is measured in Joules (J) or kJ
The energy transferred can be calculated by using:

Energy = charge flow x potential difference
$E = Q V$

Energy = power x time
$E = p t$

For example
A kettle transfers energy from the thermal store of the filament in the kettle to the thermal store of the water inside.

Some energy is transferred to the thermal store of the surroundings.

P2 – Electricity

Domestic use of electricity

1. What are the two types of current?
2. What type of power supply produces DC current?
3. What are the two differences between AC and DC current?
4. What is the pd of the UK mains supply?
5. What is the frequency of UK mains supply?
6. What colour is the live wire in UK plugs?
7. What is the purpose of the blue wire in UK plugs?
8. When does the yellow and green wire carry a current?

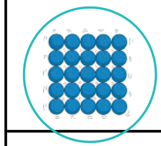
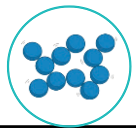
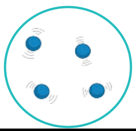
The National Grid

1. What is the National Grid?
2. What sort of pd does the National Grid use to transmit electrical power?
3. What is used to increase the pd from the power station?
4. What is used to reduce the pd near homes and businesses?
5. Why is such a high pd used?

Appliances in the home and power

1. What is the equation linking current, potential difference and power?
2. What is the equation linking current, resistance and power?
3. What two factors affect how much energy an appliance transfers?
4. What is the equation linking energy, power and time?
5. What are the units for power?
6. What is the equation linking charge, energy and potential difference?
7. What are the units for energy?

P3 - Particle model of matter

State	Pattern	Energy and movement	Forces between particles
Solid 	Ordered and all touching	Vibrate around fixed positions	Strong forces between particles
Liquid 	Random and touching	Move around randomly	Weaker than in a solid
Gas 	Random and far apart	Move around randomly	Weak forces of attraction

Models	+	-
Particle diagrams	Easy to see/draw arrangement	• Can't see the forces between particles • Particles look like flat circles rather than 3D spheres • Movement isn't shown
Kinetic models (eg marbles or animations)	Easy to see particle arrangement Can see the movement of particles	Can't see forces between particles

<u>Density</u>

Density is mass per cm^3

It can be calculated using:

Density = mass ÷ volume

$\rho = m \div V$

Required practical – measuring the density of different materials.

For regular solids :

Mass measured by **top pan balance**

Volume measured by measuring **length x breadth x height**

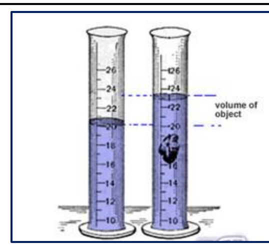
For irregular solids:

Mass measured by **top pan balance**

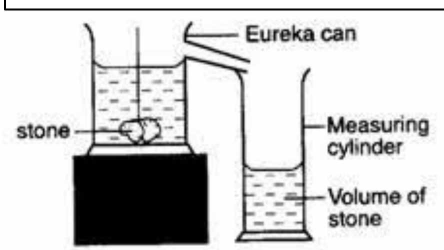
Volume measured by **displacement of water**

This means putting the object into water and measuring the volume of water 'pushed out'

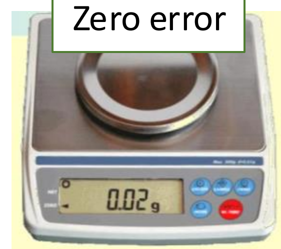
Measure the volume of small objects by putting them into a measuring cylinder with $100cm^3$ water in



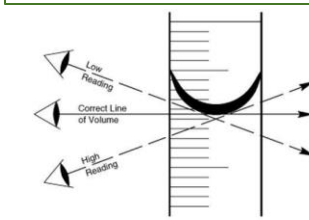
Measure the volume of larger objects by putting them into a full eureka can and catching and measuring the water that is displaced



Zero error



Read the meniscus!



<u>Required practical continued : Density of liquids</u>

1. Find the mass of an empty measuring cylinder using a top pan balance.
2. Pour a known volume (100ml) of liquid into the measuring cylinder.
3. Use the meniscus to measure the volume of the liquid accurately. This is the volume.
4. Now measure the mass of the measuring cylinder + the liquid combined.
5. Subtract the mass of the empty measuring cylinder and this is the mass of the liquid.

Density = mass ÷ volume.

Particle model

1. Describe the arrangement of the particles in a solid, a liquid and a gas
2. Describe the movement of the particles in a solid, a liquid and a gas
3. In which state of matter are the forces between the particles the weakest?
4. In which state of matter are the forces between the particles the strongest?
5. Give one advantage of using particle diagrams to show the different states of matter
6. Give three disadvantages of using particle diagrams to show the different states of matter
7. Give two advantages of using kinetic models to show the different states of matter
8. Give one disadvantages of using kinetic models to show the different states of matter

Density

1. Give the formula that links density, mass and volume?
2. Give a unit for density
3. Which piece of equipment is used to measure mass of an object?
4. What type of error is it if a balance reads 0.03g when nothing is resting on it?
5. What term is used to describe when water is pushed out of the way by a solid object?
6. Name two pieces of equipment that could be used to measure the volume of an irregular object
7. What three measurements do you need to calculate the volume of a regular object?

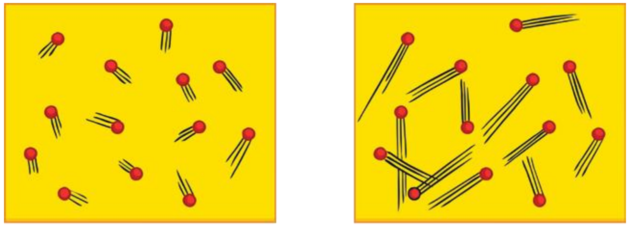
Internal energy

The temperature of any substance is related to the average speed of its particles.

The internal energy of a system is the total kinetic energy and the potential energy of the particles

The particles in a system **vibrate** or **move around** because they have energy in their **kinetic energy stores**

The faster a particle moves, the greater its **kinetic energy store**



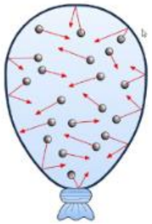
Low Temperature High Temperature

The particles also have energy in their **potential energy stores** due to their position.

As particles **move further apart**, their potential energy stores **increase**

Gas pressure

The particles in a gas are in constant random motion
They collide with the walls of their container
This exerts a force **on the container.**



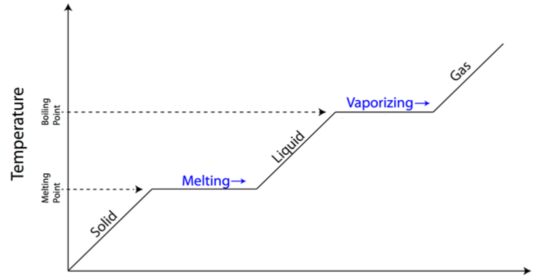
The more energy the particles have, the higher the temperature.
An increase in temperature of a gas causes the particles to move further apart.
If this is not possible, because of the container, then there is an increase in pressure.

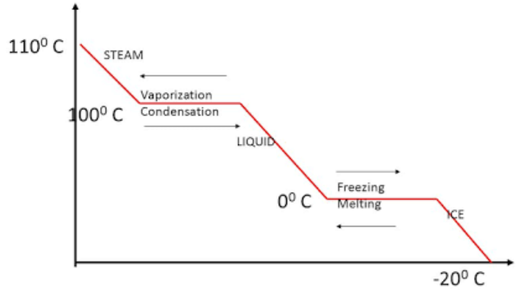
Heating and cooling

When the internal energy of a substance changes, then either :

- **The temperature** of the substance changes
- **The state** of the substance changes

This can be seen by plotting the temperature change during **heating** or **cooling.**
Heating a solid would give us a graph that looks like this:





- The **temperature stays the same**.
- This is when a change of state is happening – for example melting.
- The energy transferred is not increasing the mean particle speed – it is increasing the potential energy of the particles.

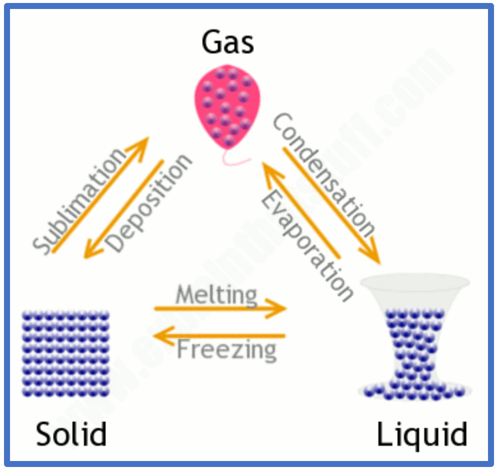
When the line is increasing (heating) or decreasing (cooling)

- The temperature is increasing / decreasing
- The kinetic energy store is increasing / decreasing
- Average particle speed is increasing / decreasing

Specific latent heat

Specific latent heat is the amount of energy needed to **change 1kg of a substance from one state to another** without changing the temperature.
Specific latent heat will be different for different materials.

- Energy needed to change 1kg of Solid → liquid - **specific latent heat of fusion**
- Energy needed to change 1kg of Liquid → gas - **specific latent heat of vaporisation**



The amount of energy needed to change 1Kg of a material is found by the equation:

Energy = mass (kg) x specific latent heat (L)

E = m L

Specific heat capacity

This is the among of energy needed to change the temperature of 1Kg of a substance by 1ºC
It is calculated by:

E = specific heat capacity x mass x temp change

E = SHC x m x θ

Internal energy

1. What two stores of energy make up internal energy?
2. Which energy store is linked with particle movement?
3. Which energy store increases if the particles in a substance move further apart?
4. What happens to the temperature when the kinetic store of the particles increases?

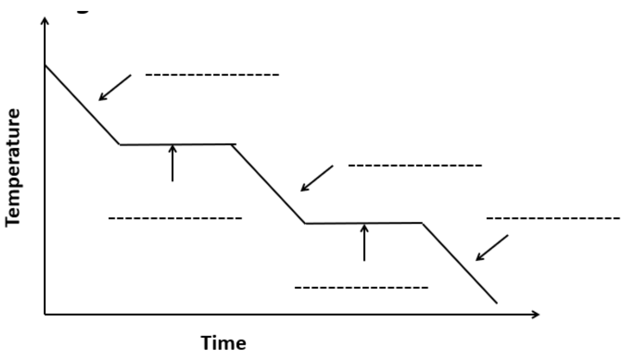
Gas pressure

1. What causes gas pressure?
2. What happens to the temperature of a gas if the kinetic energy store of the particles increases?
3. What happens to the space between particles in a gas as it heats up?
4. If the volume of the gas is kept constant, what happens to the pressure?

Heating and cooling

1. What two things can happen to a substance when the internal energy changes?
2. Label the graph below using the words given:

   liquid, gas, solid, condensing, freezing

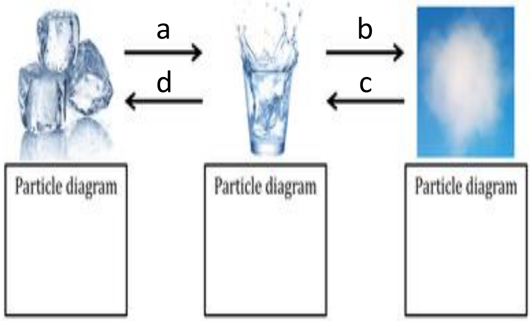


3. What is happening to temperature when the line is flat on a heating or cooling curve?

4. What is happening to the substance when the line is flat?

Specific latent heat

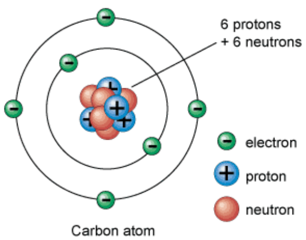
1. What is specific latent heat?
2. What is the term given to the amount of energy needed to change 1kg of a liquid into a solid?
3. What is the specific latent heat of vaporisation?
4. Label the changes of state below
   a.
   b.
   c.
   d.



5. Draw the particle diagrams in the boxes

P4 – Atomic Structure

Atoms



- Atoms are tiny – around 10^{-10}m
- There is a positive nucleus made of protons and neutrons
- Electrons orbit in shells or energy levels
- The nucleus is 10,000 x smaller than the atom (4 orders of magnitude) so around 10^{-14} m

Electrons can move further away or closer to the nucleus

If EM waves (eg UV /light) are **absorbed** electrons can move up energy levels

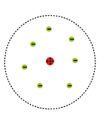
If EM waves are **emitted** by the atom, then electrons move closer to the nucleus

How the atomic model developed:

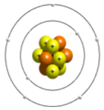
The atomic model has developed over time, when new evidence was discovered.

Atoms were first thought to be tiny spheres that could not be divided

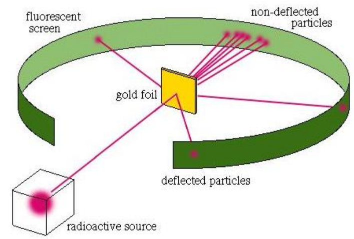
JJ Thomson then discovered the electron
Led to the plum pudding model
Atoms a cloud of positive charge with electrons randomly scattered



Rutherford discovered the positive charge is very small and in the nucleus
This discovery was from the Gold leaf experiment



Chadwick discovered neutrons
Bohr discovered the electrons orbit in shells



<u>Rutherford's experiment:</u>
Alpha particles fired at gold leaf
Most went straight through
Some deflected to the side
Some came straight back
This told him that most of the atom was empty space and that the positive charge was in a tiny nucleus

---

- Atoms of the same element have the same number of protons.
- This is the atomic (proton number)
- In an atom, the number of electrons is equal to the number of protons.
- The total number of protons and neutrons is called the mass number

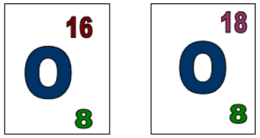
(Mass number) 23
(Atomic number) 11 Na

Sodium has :
11 protons
11 electrons
12 neutrons (23-11)

Isotopes

Isotopes are atoms with same number of **protons**, but different numbers of **neutrons** (different mass number)

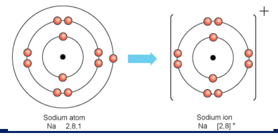
E.g.



These two isotopes both have 8 protons
One has 8 neutrons (16-8)
One has 10 neutrons (18 – 8)

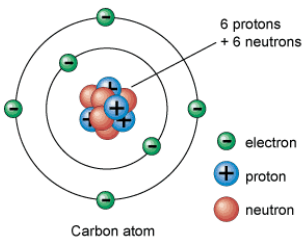
Ions

If atoms lose one or more outer electrons, they turn into positive ions

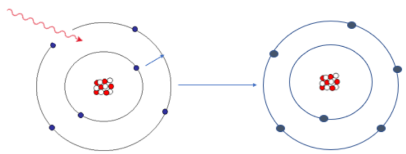


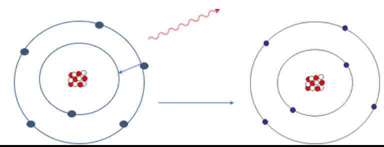
P4 – Atomic Structure

Atoms



1. What is the size of an atom?
2. What is in the nucleus?
3. What is the size of the nucleus?
4. How many orders of magnitude smaller than the atom is nucleus?





4. What can cause electrons to move further from the nucleus?

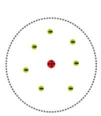
5. What can cause electrons to move closer to the nucleus?

1. What causes scientific ideas to change and develop?

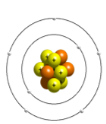
2. What was the thinking about atoms initially?

3. Which particle was discovered by JJ Thomson?

4. Where is the positive charge in this model?

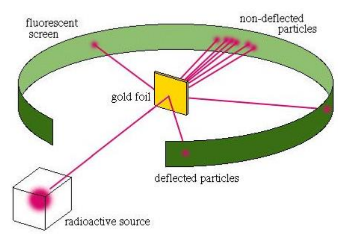


5. Where is the positive charge in this model?



6. Who discovered neutrons?

7. What was the discovery that Bohr made?

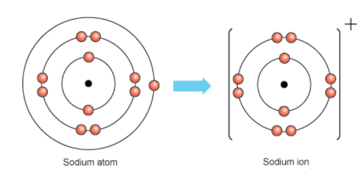


Rutherford's experiment:

1. What did Rutherford fire at gold leaf?
2. What happened to most of them?
3. What two conclusions did he come to?

---

1. What do all atoms of the same element have in common?
2. What does the bottom number on the elements in the periodic table represent?
3. What does the mass number show?
4. What is the number of electrons in an atom equal to?
5. What is an isotope?
6. What is an ion?
7. What type of ions are formed when atoms lose electrons?



P4 – Atomic Structure

Nuclear radiation

If an isotope is **unstable**, then **particles** and **energy** are emitted from the nucleus.
There are 3 main types :

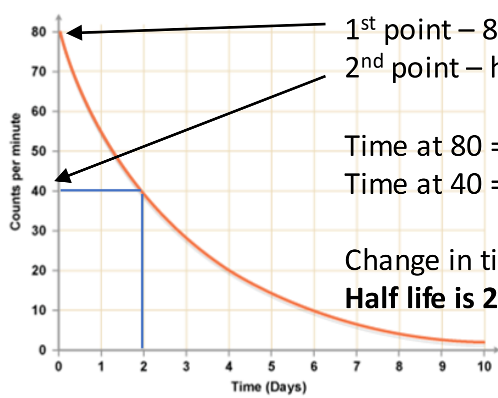
Radiation	What is it?	How far does it travel?	Ionising power	Penetrating power
Alpha α	2 protons and 2 neutrons	A few cm	Strong	Stopped by paper
Beta β	A fast moving electron	Metres	Medium	Stopped by aluminium
Gamma γ	An electromagnetic wave	kilometres	Weak	Takes thick concrete or lead to stop it

Neutrons can also be emitted from the nucleus.

Half life

Radioactive decay is random.
The half life of an isotope is the time it takes for half of the atoms in the sample to decay OR for the count rate to fall by half

Half life is calculated from a graph by reading two points off the y axis – one value being half the other.
Read the corresponding change in time.



1st point – 80
2nd point – half of that, so 40

Time at 80 = 0
Time at 40 = 2 days

Change in time = 2 days
Half life is 2 days

Isotopes are selected for use depending on their properties and half life – e.g. a medical tracer needs to have a short half life so it isn't in the body for very long

Alpha decay:

An unstable nucleus gives out 2 protons and 2 neutrons
An alpha particle is written as : $^{4}_{2}\alpha$

So when a particle gives out alpha radiation, it loses 2 from the proton number and 4 from the mass number
E.g

$$^{226}_{88}Ra \rightarrow \, ^{222}_{86}Rn + \, ^{4}_{2}\alpha$$

Beta decay:

In an unstable nucleus, a neutron changes into a proton and an electron.
The electron is fired out as the beta particle
Beta particles are written as $^{0}_{-1}\beta$ or $^{0}_{-1}e$

The proton number increases
The mass number stays the same
E.g. $^{14}_{6}\text{carbon} \longrightarrow \, ^{14}_{7}\text{nitrogen} + \, ^{0}_{-1}e$

The emission of a gamma ray **does not change the nucleus**

Irradiation is the exposure to alpha, beta or gamma radiation

Contamination is the presence of radioactive atoms on materials.

P4 – Atomic Structure

Nuclear radiation

1. Why do atoms give out particles or energy from the nucleus?

2. Which radiation is the most strongly ionising?

3. What is an alpha particle made of?

4. Which radiation is the most difficult to stop?

5. Which radiation is a fast moving electron?

6. Which radiation can only travel a few cm?

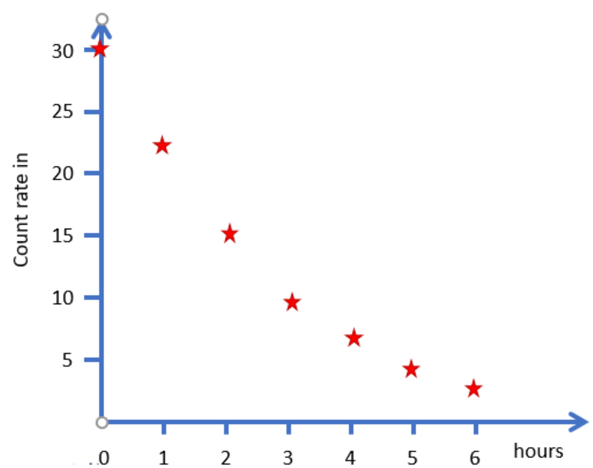
Half life

1. What is half life?

2. What is the unit missing from the Y axis on the graph opposite?

3. Draw a line of best fit onto the graph

4. What sort of half life would you want in an isotope being used as a medical tracer?



Alpha decay:

1. How is an alpha particle written?

2. What happens to the proton number of an atom when alpha decay happens?

3. What happens to the mass number when alpha decay happens?

4. What happens in the nucleus during beta decay?

5. How is a beta particle written?

6. What happens to the proton number during beta decay?

7. What happens to the mass number during beta decay?

8. What is irradiation?

9. What is contamination?