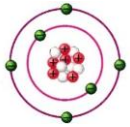
P1

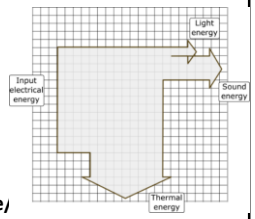


Atom Radius = 0.1nm or 1 x 10^{-10m}
Nucleus Radius =1/10,000 or an atom radius or 1 x 10^{-14m}

Energy can be transferred, stored or dissipated but can not be created or destroyed
Upwards projected object : kinetic store → G.P.E store
Object hitting obstacle: kinetic store → thermal and sound store
Boiling kettle: electric energy store → thermal energy store

kinetic energy = 0.5 × mass × speed²
elastic potential energy = 0.5 × spring constant × extension²
g.p.e. = mass × gravitational field strength × height

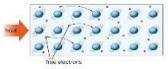
Energy in (J) = Energy out (J)
Efficiency = useful energy or power out / Total energy or power in



Waste energy is usually heat dissipated to the surroundings. Lubrication and thermal insulation can reduce unwanted transfers

power = energy transferred or work done/
Power = energy transfer of 1 Joule per second

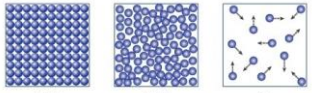
Conduction – only in solids
Heat the particles → More vibrations
→ vibrations passed on to neighbouring particles



Higher **Thermal conductivity** of a material means higher rate of energy transfer by conduction e.g. buildings cool quickly if walls are thin with and high thermal conductivity

Density = mass/volume

When substances change state
Mass does not change.

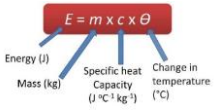


Melt (solid → liquid), freeze (liquid → solid), boil and evaporate (liquid → gas) condense (gas → liquid), sublimate (solid →gas)

Internal energy is the total kinetic energy and potential energy in all atoms within an object or collection of objects (system)

Specific Heat Capacity -How much energy is needed to raise 1Kg by 1°C

How much energy is needed to heat 2Kg of water (4200J/Kg°C) from 10°C to 100°C?
2 x 4200 x 90 = 756000J



As you heat a substance the temperature increase depends on the amount of energy input, mass and type of material

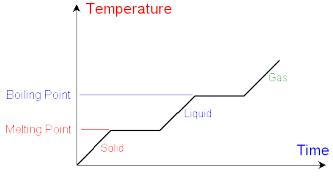
Latent heat: energy needed to change state
Specific latent heat of fusion – energy needed for solid → liquid
Specific latent heat of vaporisation – energy needed for liquid → gas

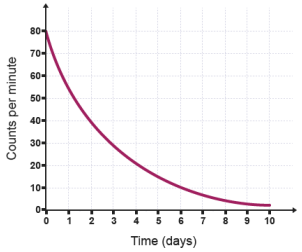
There is no temperature change while a change of state is happening as energy is being used to break intermolecular bonds

Source	Advantages	Disadvantages
Fossil fuels: oil, coal, gas	Provide high amounts of energy. Reliable	Non- renewable Release CO_2 (Global warming) and SO_2 (Acid rain) - Carbon capture can be used to reduce amount of CO_2 released
Nuclear	Provide very high amounts of energy No CO_2 or SO_2 released	Non- renewable Nuclear waste dangers High set up costs Difficult to decommission
Biofuel: Wood, ethanol	Renewable Carbon neutral No SO_2 released	Damage to habitats Time and space needed to grow plants
Wind and Solar	Renewable, No CO_2 or SO_2 released Low running cost	Unreliable, Visual and Noise pollution, High set up costs Low amounts of energy
Hydro-Electric, Wave power, tidal	Renewable, reliable, No CO_2 or SO_2 released Low running cost Pumped storage can be used (Hydro)	Visual and Noise pollution High set up costs Low amounts of energy Damage to habitats
Geothermal	Renewable, reliable, No CO_2 or SO_2 released Low running cost	Only possible in volcanic areas High set up costs

Pressure
If a gas is kept at a **constant volume** but the **temperature increases**, the pressure will increase due to the increase in Kinetic energy and more **frequent collisions**

Temperature increase is **directly proportional** to pressure increase if volume kept the same





Sub- atomic particle	Charge	Mass
Proton	+1	1
Electron	-1	0
Neutron	0	1

Absorb EM radiation = electrons move to a higher shell
Emit EM radiation = electrons move to a lower shell

Mass number = protons + neutrons
Atomic number = protons (same as electrons)
Isotopes = different versions of an element with the same protons but different neutrons
Positive ions lose electrons, **negative ions** gain electrons

Atom theory
"tiny spheres" → electrons discovered → plum pudding model → alpha particle scattering experiments → nuclear model (Bohr)→ proton discovered → Neutron discovered (Chadwick)

Alpha Scattering experiments
Positive particles shot through gold atoms. Most of the particles went straight through so atom not solid and mostly empty space (plum pudding wrong). Some positive particles deflected by the small positive nuclei in the centre (nuclear model correct)

Type	Structure	Ionising	Range in air	Stopped by
Alpha	2p,2n	High	5cm	paper
Beta	e-	Mid	1m	Thin Al
gamma	EM radiation	Low	1km	Lead

Radiation activity is measured in **becquerels** and detected by **Geiger-Muller tube**

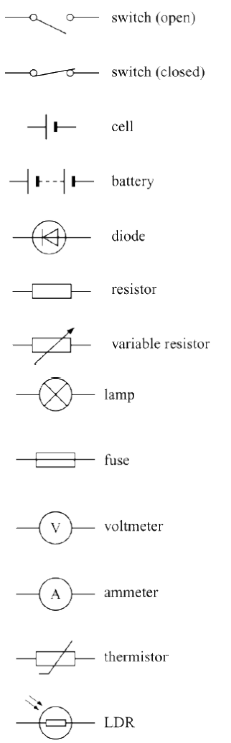
Half life – average time it takes for number of radioactive nuclei in a sample to halve

Contamination is unwanted presence of radioactive atoms. Suitable precautions include tongs, lead shields and limited exposure

Irradiation is exposing an object to nuclear radiation but it does not become radioactive – e.g. to sterilise fruit

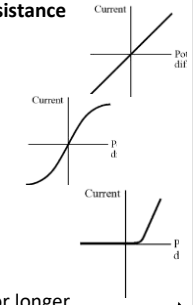
Alpha decay - mass number -4, atomic number -2 (more –ve)
Beta decay – atomic number +1 (more positive)

$^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$ $\quad {}^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}\text{e}$



Energy	J
Work done	J
Latent heat energy	J
Mass	Kg
Spring constant	N/m
Gravity	N/Kg
SHC	J/Kg°C
Density	Kg/m^3
Volume	m^3
Radiation	Bc
Current	A
Charge	c
Time	s
Potential Diff	v
Resistance	Ω
Frequency	Hz
Power	W

charge flow = current × time **PD = current x resistance**
The greater the **resistance** the smaller the current



Current through a **ohmic conductor resistor** is **directly proportional** to PD if temperature constant

In a **filament lamp**, the increase in temperature increases kinetic energy of metal ions in the wire and so resistance increases

In a **diode** the resistance is very high in one direction

LDR: Resistance decreases as light intensity increases – e.g. in camera – light level low the shutter stays open for longer

Thermistor: Resistance decreases as temperature increases e.g. thermostat

Series circuit: add up each component resistance = total resistance
R_{total} = R1 + R2 - current is same for every component, PD is shared

Parallel circuit: PD is the same for every component ,add up each component current = total current

Adding resistors in series **increases** the total resistance whilst adding resistors in parallel **decreases** the total resistance

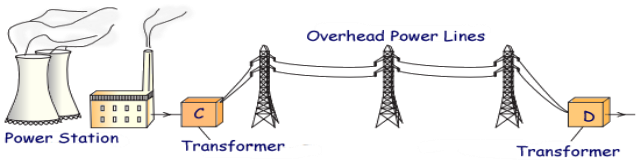
Household electric: DC (cells and batteries) current in one direction
AC alternates (Mains). In the UK it has a frequency of 50 cycles per second (**50 Hz**) and is about **230 V**

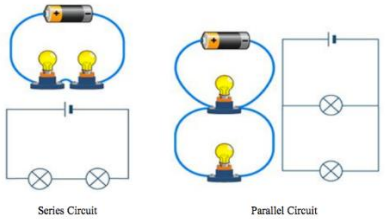
3 core cable: Blue – Neutral, Brown – live, stripes – Earth
The live wire carries the **alternating potential difference** from the supply (230V). The neutral wire **completes the circuit**. The earth wire is a **safety wire** to stop the appliance becoming live (0V)
If live and earth connect it is dangerous due to surge of current

Power = current x PD
Power = current^2 × resistance

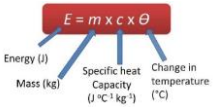
The amount of energy an appliance transfers can be calculated by;
Power = energy transfer/ time
energy transferred = charge flow × potential difference
The greater the power rating the larger the change in energy stores
e.g. High powered hair dryer will be louder and hotter

National grid is a system of cables and transformers linking power stations to consumers
Step up – increase PD but lower current to reduce heat energy transferred
Step down – decrease PD to make is safe for domestic use





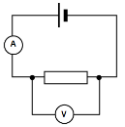
Bias
Organisation or companies could benefit from presenting data in a certain manner. It is better to use an "independent" company or scientist to avoid bias (they have nothing to gain)
Peer reviews make scientific results more trustworthy



RP1: Specific Heat Capacity of metal block: You need to be able to use the equation

RP2: Resistance: Read the Q carefully to see which variable is being changed e.g. IV: Length of wire DV: Measure current and P.D and calculate Resistance (Resistance = P.D/Current) , CV: temperature of wire. As length increases, resistance increases (Plot length on x axis and Resistance on y axis)

RP3: IV Characteristics of a bulb, resistor and diode: Ensure you can explain each of the IV graphs. We use a variable resistor to allow for a range of V (Voltage) and I (Current)



RP4: Density of regular and irregular solids and liquids : Mass = density x volume
In an irregular solid you can put the object in liquid and the displacement = volume

Random errors could include not starting and stopping the stopwatch at exactly correct time – remove anomaly and repeat
Systematic errors is when the same error is made every time – whole experiment needs to be repeated
Zero Error – Scales have a reading even if nothing is on them. You should restart scales or data logger or take away the error for each result

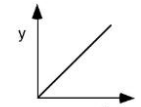
Data is only **reliable** if it is repeated many times during experiment (**repeatable**) and compared with other scientists (**reproducible**)

Accurate data is close to true value, **Precise** data is close to the mean

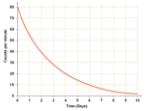
Anomalous data does not fit the pattern or line of best fit- these should be removed when calculating a mean or repeated
Mean (average), **mode** (most common), **median** (mid value)

Categoric data is in categories – use a bar chart (colour, species)
Continuous data can be any value – use a line graph (time, temperature, length)

Graphs
Can have a positive, negative or no correlation
Directly proportional - both variables increase in the same ratio
(e.g. if one doubles the other also doubles)



Just saying this graph is decreasing is not good enough…
You need to say the decrease is high to start with and then becomes less
You can work out a rate by doing y/x (gradient)



Economic – Who will make a profit? **Environmental** – Will it affect the environment or wildlife habitats?
Ethical – Is it morally right? E.g. stem cells, making nuclear weapons, testing drugs on animals