PHYSICS REVISION CARDS

Science (9-1)

Combined Science / Physics Topics 8 - 15

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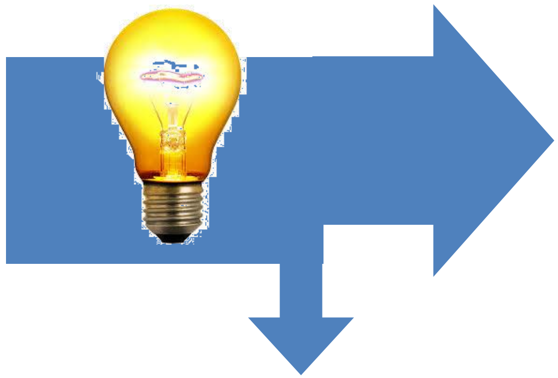
Modified 22/05/2018 (PB)

PHYSICS INDEX

The box on the bottom left identifies the Learning Outcomes, The on-line version of these Revision Cards contain links to relevant You Tube videos, web pages and photographs, accessed by links at the bottom of each page.

Topic 8: Energy transfers

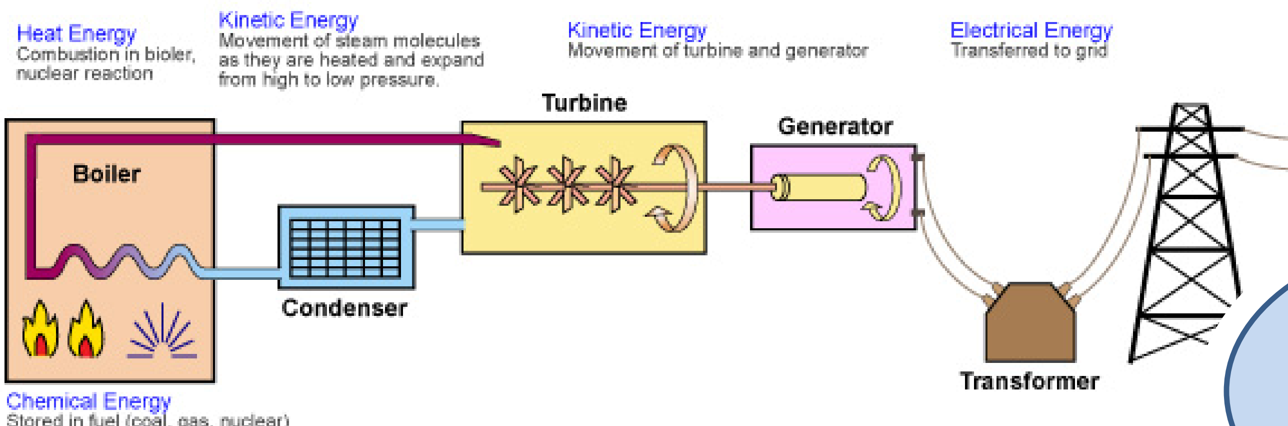
Electrical energy (100 joules)



Heat energy (90 joules)

Light energy (10 joules)

Remember. Energy is not created or destroyed – it's **conserved**. So for every 100 joules of electrical energy in, 100 joules will be transferred to other forms of energy – there will be **no net energy change**.



Energy transfer (Sankey) diagrams can be quite complex.

Investigation: Conservation of energy

Topic 8: Energy changes

Work done by the electric motor increases the potential energy of the hay bale.

Chemical energy in the gas is converted to heat energy in the water and elastic potential energy in the steam

Chemical energy in the batteries, or electrical energy from the plug, is converted to sound.

Kinetic energy is used to wind the torch, stored in a capacitor and then converted to light.

In all examples:
the useful energy transfer will not be 100% efficient and energy will be lost to the surroundings (often as heat and sound)

Topic 8: Work done

Formula you need to know:

work done = force x distance moved in the direction of the force

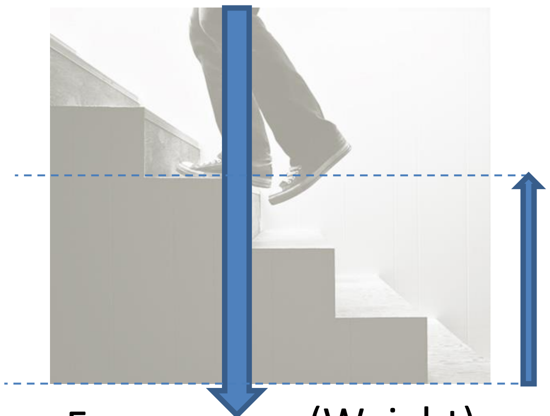
$$E = F \times d$$

(joules, J) = (newton, N) x (metre, m)

Note: Work done is equal to energy transferred. Getting a student to calculate the energy transfer and then following this up with a 1 mark question asking how much work has been done (the same answer) is a very common occurrence.

$$\textbf{Efficiency} = \frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to device)}}$$

Topic 8: Work done examples



Force (Weight)

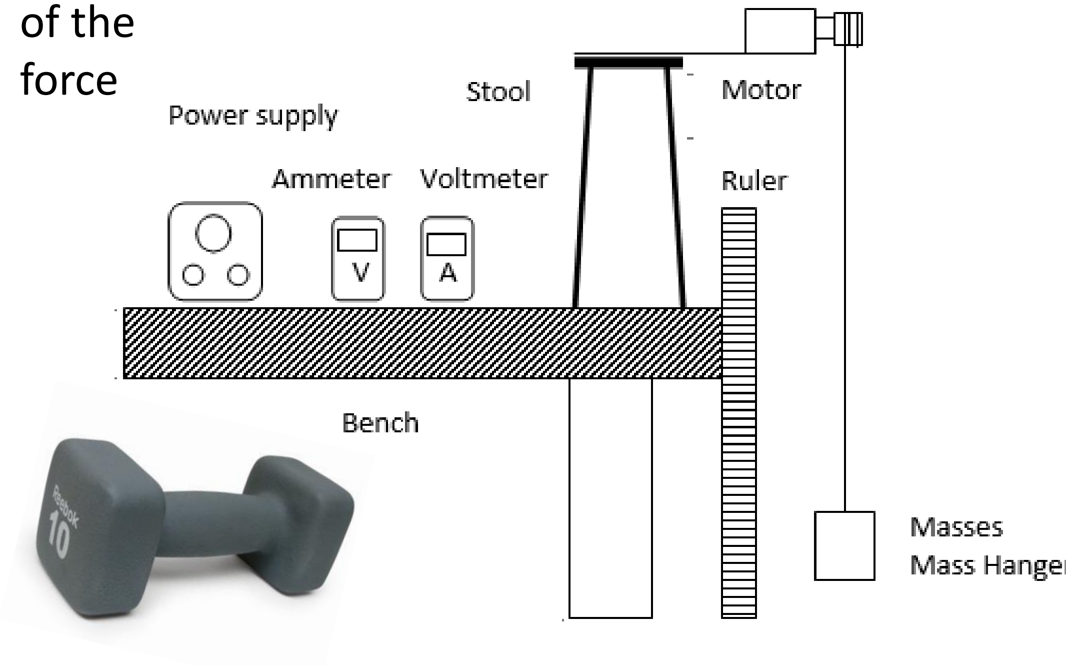
Distance moved in the direction of the force

Using a motor to lift a weight:

Electrical energy in = I x V x t

G.P.E. gained = m x g x h

= Force x distance



There will be energy lost. The motor is not 100% efficient and some energy will be **lost as heat and sound**

Investigation: Investigate power by moving up the stairs, step-ups onto a low platform or lifting objects of different weights

Topic 8: KE & GPE

Formula you need to know:

ΔGPE = mass x gravitational field strength x Δvertical height

$$\Delta GPE = m \times g \times \Delta h$$

(joule, J) = (kilogram, kg) x (newton per kilogram, N/kg) x (metre, m)

Kinetic energy = ½ x mass x velocity ^{2}

$$KE = \frac{1}{2} m \times v^2$$

(joule, J) = (kilogram, kg) x ((metre per second)^2, (m/s)^2)

Often questions will be asked about roller coasters, a swing, a pendulum or a bouncing spring. In each case the energy changes from GPE to KE and back again though the total energy of the system remains constant.

Topic 8: Mechanical Power

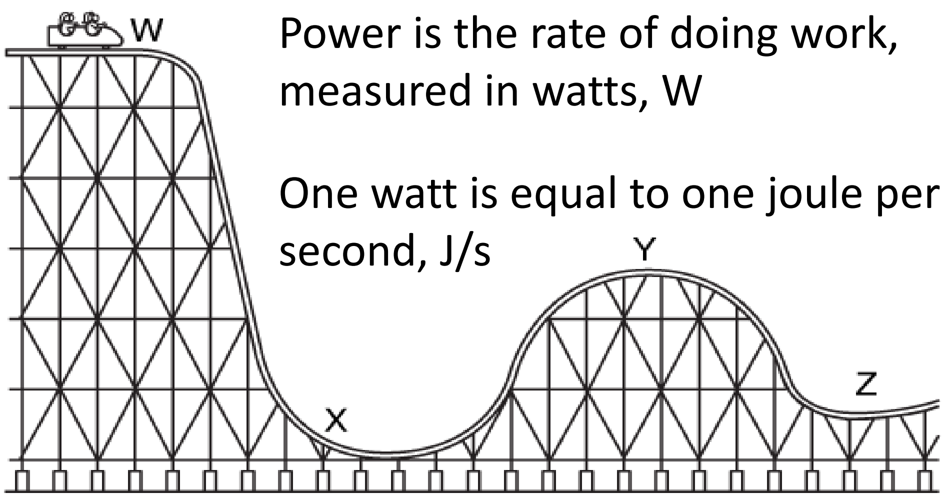
Formula you need to know:

power = work done / time taken

$$P = E / t$$

(watt, W) = (joule, J) x (time taken, s)

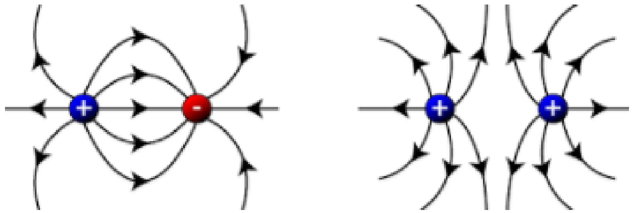
Roller coaters are great for asking questions – work done in raising the car to the top of the slope, GPE gained at the top or lost to KE at the bottom of the slope. You could even work out the velocity when the car reaches the bottom.



Power is the rate of doing work, measured in watts, W

One watt is equal to one joule per second, J/s

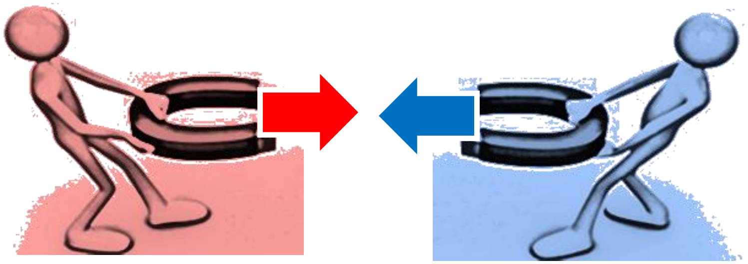
Topic 9: How objects interact



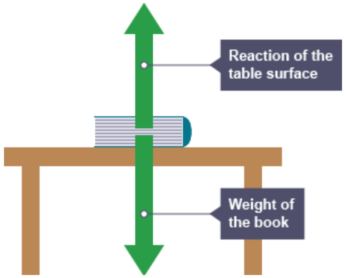
Electrostatic: Like charges repel, unlike cnarges attract

Gravitational field acts on the mass of the apple.

Terminal velocity



Magnetic fields



Friction is a contact force. Unwanted energy transfer can be reduced through lubrication.

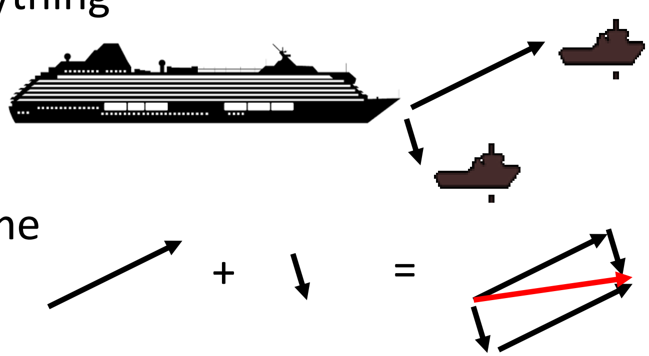
Pairs of forces and normal contact forces can be represented in **free body force diagrams**

Topic 9: Scalar & Vector

Common scalar quantities	**VECTOR quantities**
have magnitude (size):	**have magnitude and direction:**
Distance (m)	**DISPLACEMENT (m)**
Speed (m/s)	**VELOCITY (m/s)**
	ACCELERATION (m/s/s)
Mass (kg)	**FORCE (N)** **WEIGHT (N)**
Density (kg/m^3)	
	MOMENTUM (kg m/s)
Energy (J)	
Time (s)	

Just learn the 5 vectors, everything else will be a scalar !

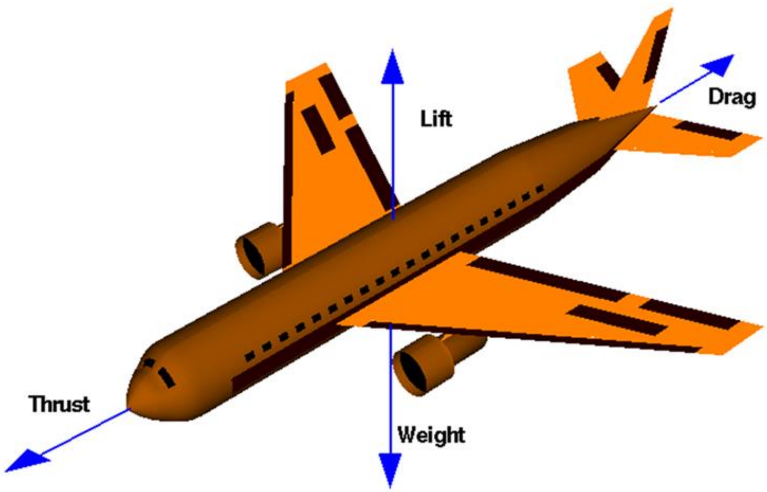
Distance / Displacement and Speed / Velocity have the same units



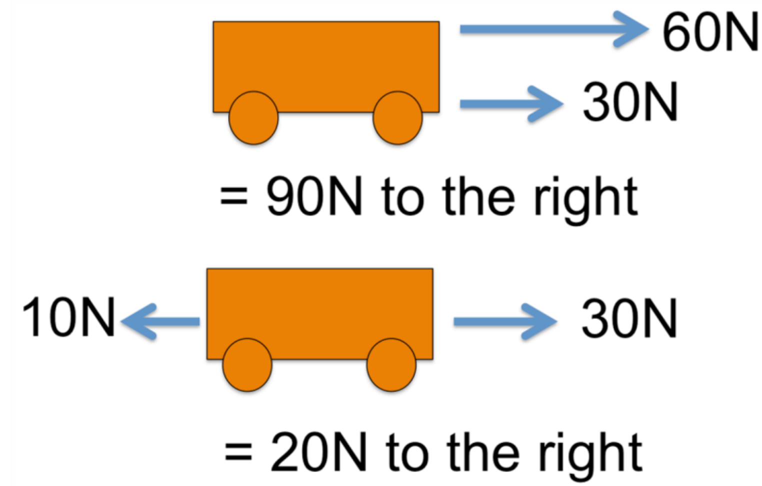
All forces can be resolved to one resultant (red) by adding the vectors

Topic 9: Forces interaction **(H)**

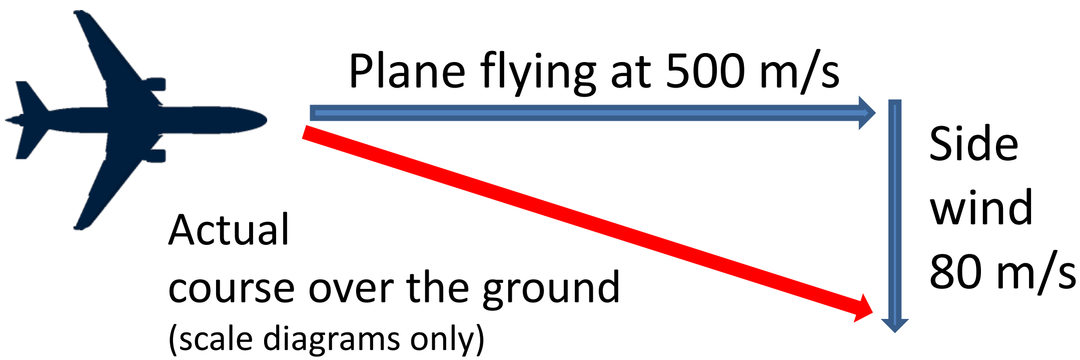
In this diagram, forces are in equilibrium:



In this diagram there are net forces:



The plane is flying in a straight line but the side wind means that the resultant final direction is different:



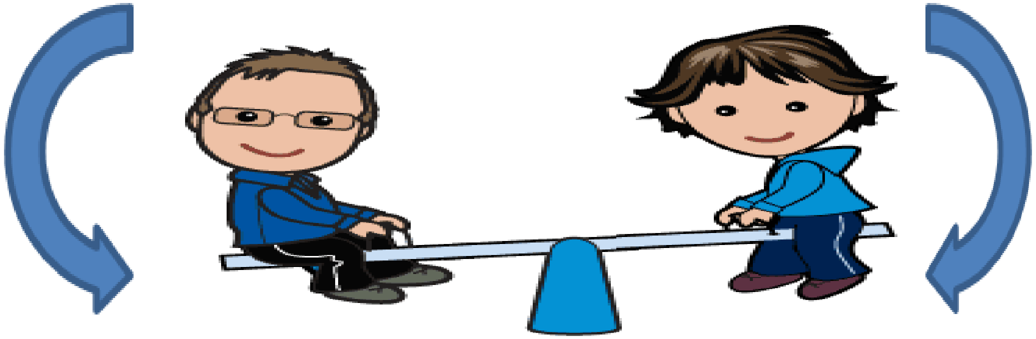
If the forces are balance, these guys don't move

Topic 9: Moments (Physics only)

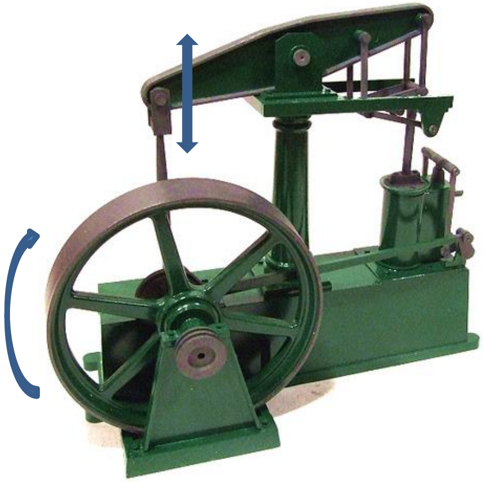
moment = force x distance

(of a force) **(normal to the direction of the force)**

(Newton metre, N m) = (Newton, N) x (metre, m)



Levers and gears can be used to transmit the rotational effects of forces:

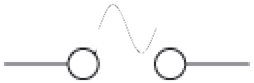


At equilibrium:
The sum of the clockwise moments equals the sum of the anticlockwise moments.
If the moments are unbalanced, rotation occurs

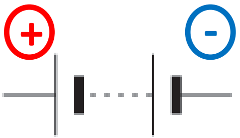
Topic 10: Circuit components

Cell (DC)

Fuse



a.c.



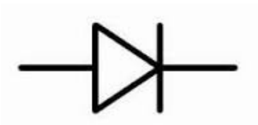
Battery

Switch

Motor

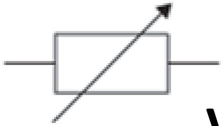
Voltmeter

Resistor

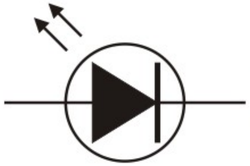


Diode

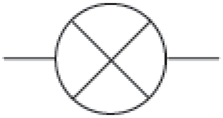
Ammeter



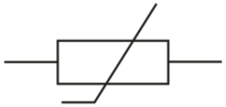
Variable resistor



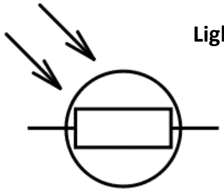
L.E.D.
Light Emitting Diode



Lamp



Thermistor



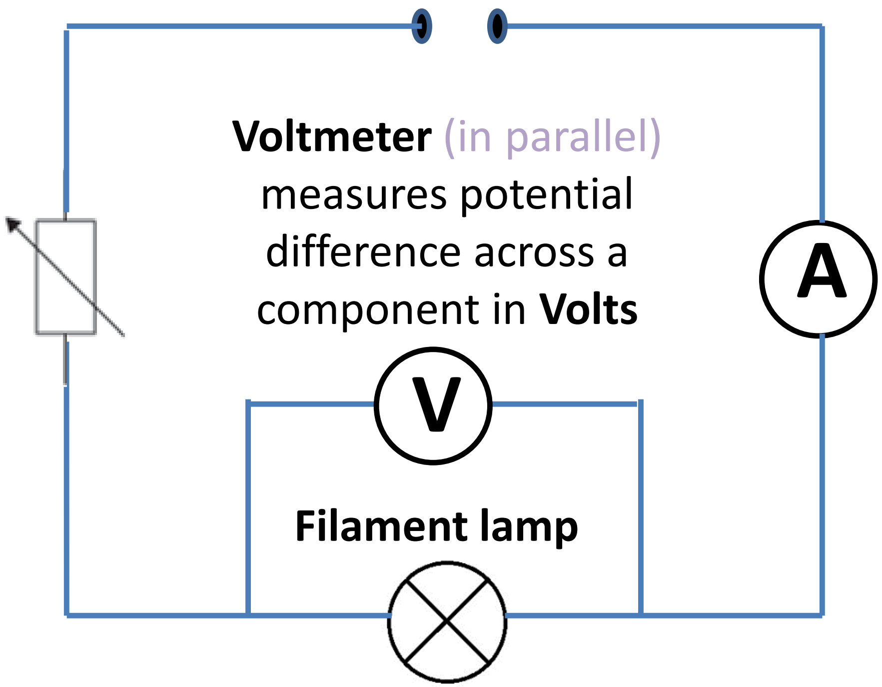
L.D.R.
Light Dependent Resistor

Topic 10: Simple circuits

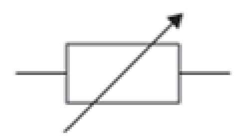
The bigger the potential difference (in Volts), the larger the current (for the same resistance). If there is a P.D. in a circuit, there will always be a current

Potential Difference (volts) is **the energy transferred per unit charge** passed and hence the **Volt is a Joule per Coulomb**

Power supply



Ammeter (in series) measures current in **Amps**



A variable resistor can change the current

Greater resistance (R) = lower current (I)

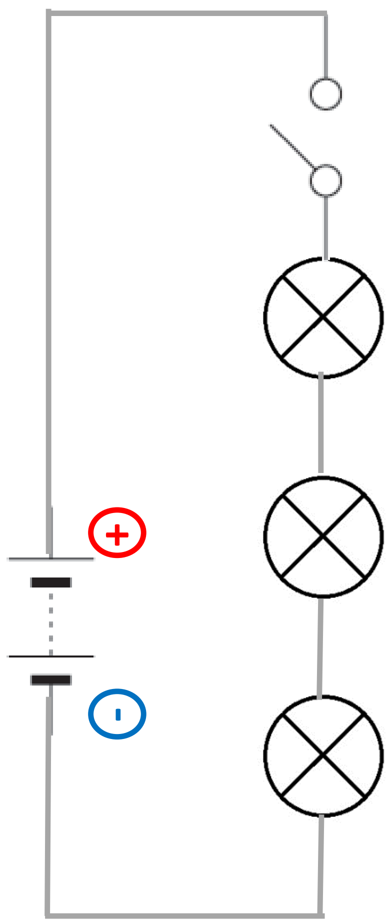
Topic 10: Series circuits

Placing the lamps in series means that one switch controls all the lamps and the more lamps there are, the less bright each one is.

If one lamp 'blows', they all go out.

Current is the **rate of flow of charge** (electrons in a metal) and the same everywhere in a series circuit.

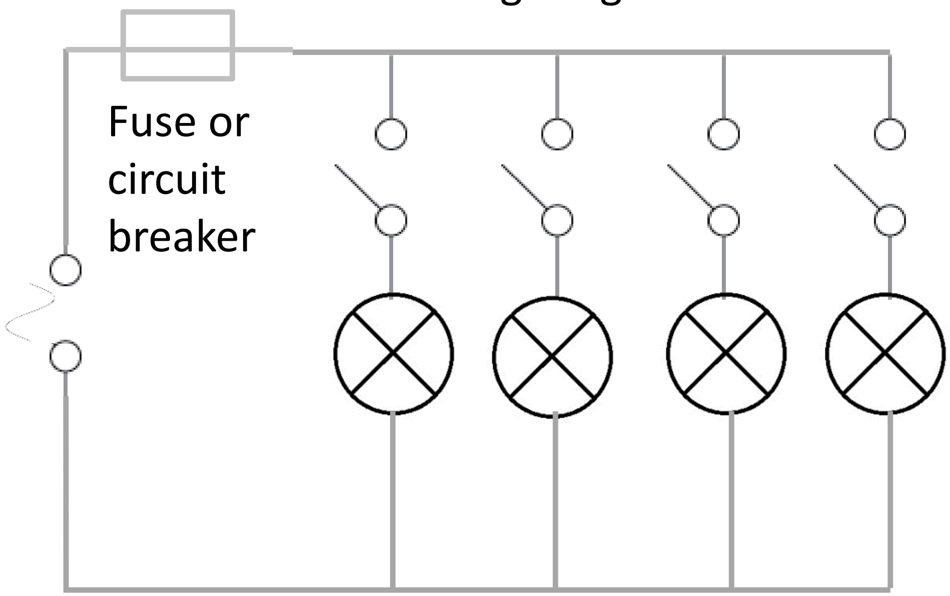
In a series circuit, net resistance is doubled because the current has twice the number of resistors to pass through



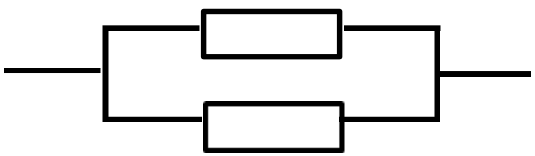
Christmas tree lights

Topic 10: Parallel circuits

House lighting circuit

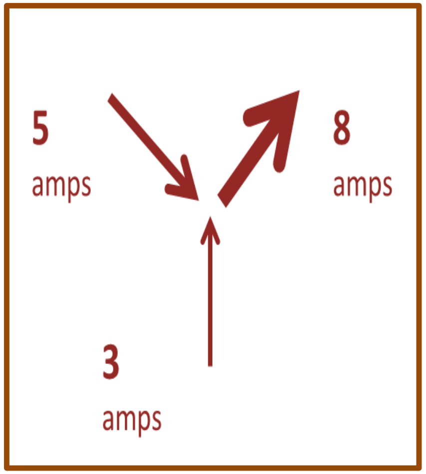


**In a parallel circuit,
net resistance is halved
because the current has
two paths it can take.**



Placing the lamps in parallel allows each lamp to be switched independently.
If one lamp blows it will not affect the others.

**The sum of the
current leaving a junction
must equal
the sum of the current
entering that junction.**



Topic 10: Energy and charge

Formula you need to know:

Energy transferred =
charge moved x potential difference

$$E = Q \times V$$

(joule, J) = (coulomb, C) x (volts, V)

charge = current x time

$$Q = I \times t$$

(coulomb, C) = (ampere, A) x (seconds, s)

Topic 10: Potential difference

Formula you need to know:

Potential difference = current x resistance

$$V = I \times R$$

(volts, V) = (ampere, A) x (ohms, Ω)

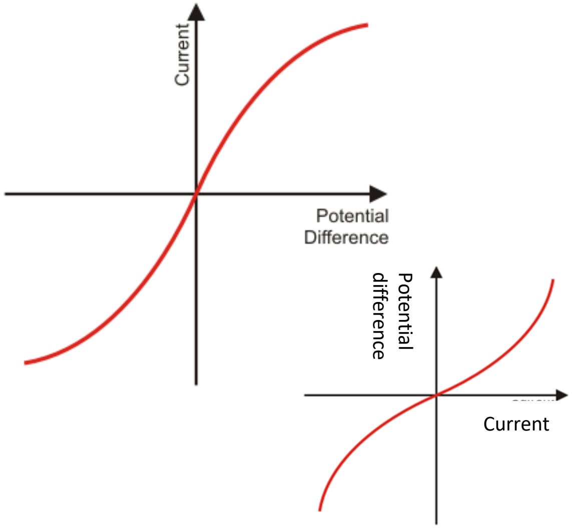
(So for the same V, as R goes UP, I goes DOWN)

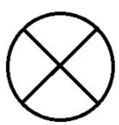
This equation can be re-arranged to find the resistance:
R = V / I

(provided the temperature is constant)

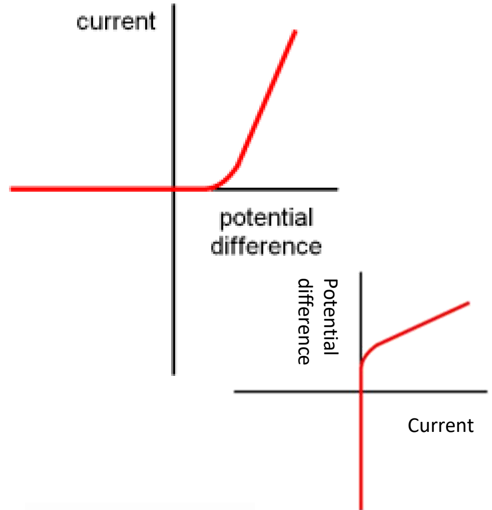
Topic 10: I vs V graphs

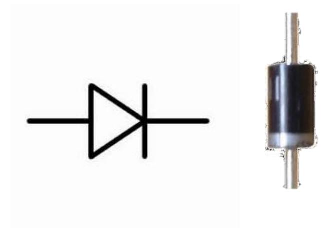
Filament lamp



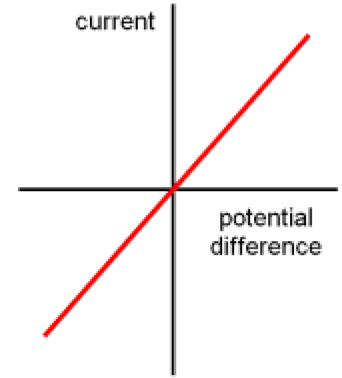


Diode

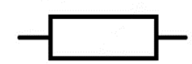




Fixed resistor



Watch the axis!

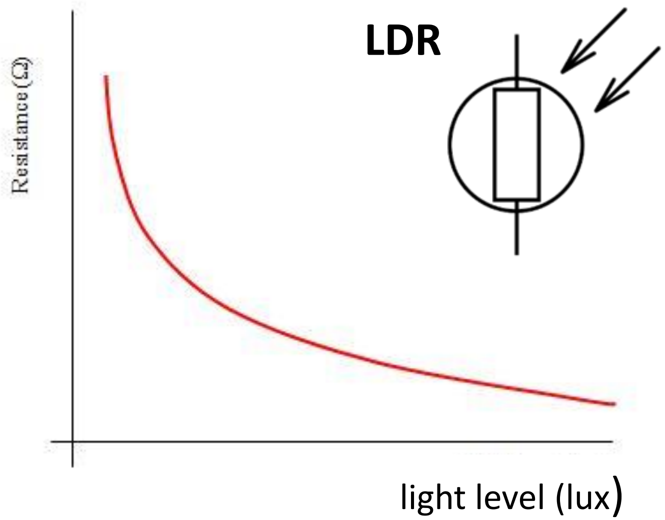


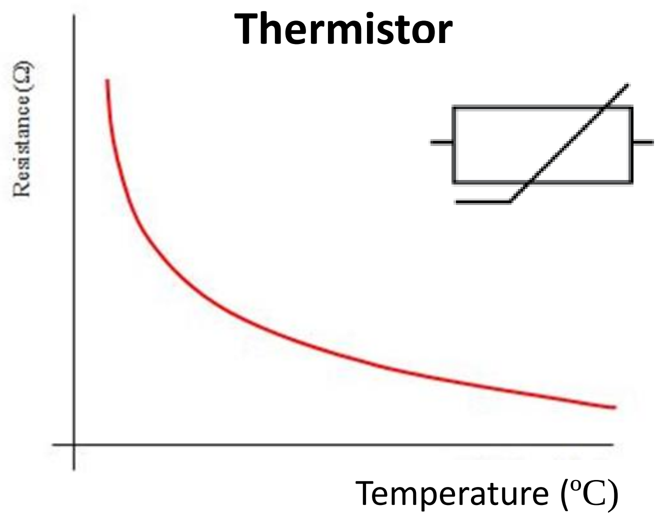
As V goes up, I goes up. It is <u>not directly proportional</u>. The line curves because the *resistance is increasing* with increasing heat.

Once a threshold voltage is reached, as V goes up, I goes up in proportion. Current only flows in one direction.

This is a straight line graph. I and V are directly proportional, the gradient and therefore the resistance is constant.

Topic 10: LDR and thermistor





As the light intensity increases, the resistance decreases. As the resistance decreases, the current increases. It is a curve, the rate of change is greatest at low light intensity.

For a fair test, darken the room or shield the LDR from background light.

As the temperature increases, the resistance decreases. As the resistance decreases, the current increases. It is a curve, the rate of change is greatest at low temperatures.

For a fair test, stir the water, place a thermometer close to the thermistor (better still use a digital thermometer) and allow the temperature to equalise.

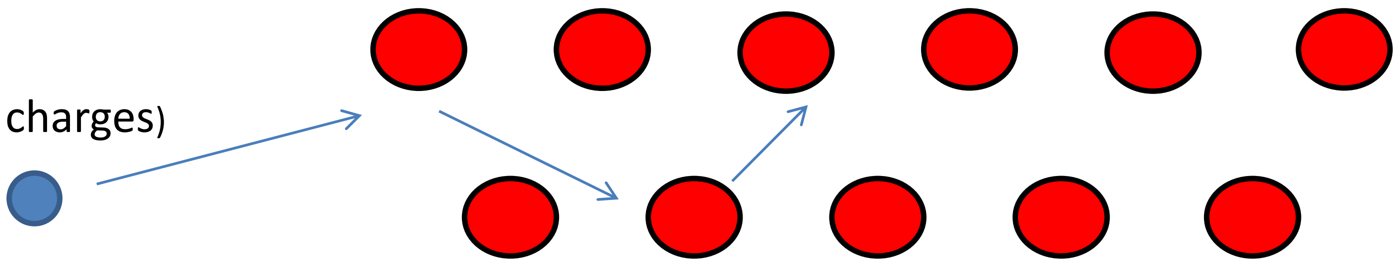
Topic 10: Current and heat

Current flowing in a resistor results in an energy transfer

Metal lattice

Metal ions / atoms

Electrons
(negative charges)



Electrons (negative charges) collide with the (positive) ions in the metal lattice. When there is an electric current, the kinetic energy of the electrons is transferred to thermal (Heat) energy in the resistor as the current does work against the electrical resistance.

Describe the advantages and disadvantages of the heating effect of an electric current – link to energy loss / efficiency and explain how to reduce unwanted loss through low resistance wires.

a.c. mains heating devices

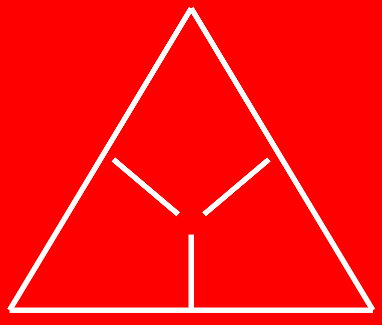
Batteries and motors

Topic 10: Energy, power & time

Formula (given to you):

energy transfer = current x p.d. x time

$$E = I \times V \times t$$



(joules, J) = (ampere, A) x (volts, V) x (secs, s)

Formula you need to know:

power = energy transferred / time taken

$$P = E / t$$

power (watt, W) = energy used (joule, J) / time (second, s)

Power is the “rate of transfer of energy”, measured in watts.
Low energy lamps use the same P.D. so to save energy they must use less current.

Topic 10: Electrical power

Formulae you need to know:

electrical power = current x p.d

$$P = I \times V$$

(watts, W) = (ampere, A) x (volts, V)

electrical power = current² x resistance

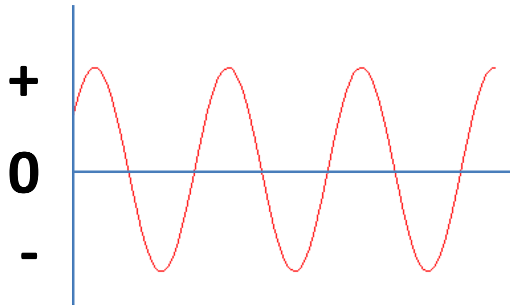
$$P = I^2 \times R$$

(watts, W) = (ampere, A) x (volts, V)

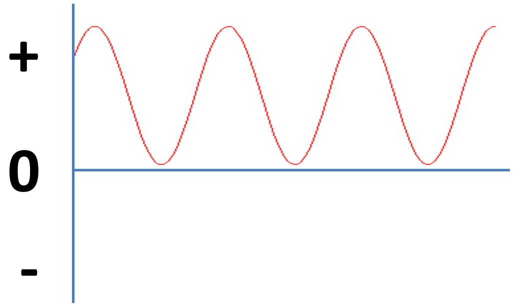
(Electricity distribution: For the same Power, if V goes UP, I goes DOWN)

Investigate: Power consumption of low-voltage electrical items

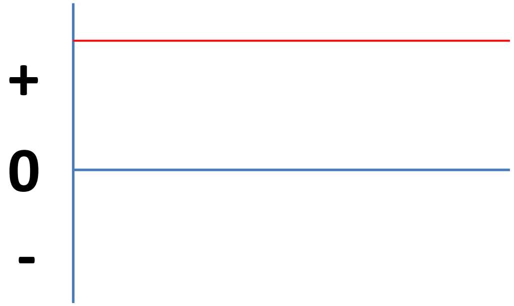
Topic 10: ac & DC



Alternating current/voltage (ac): The current or voltage is above and below zero.
The movement of charge changes direction.
(Generators and transformers)

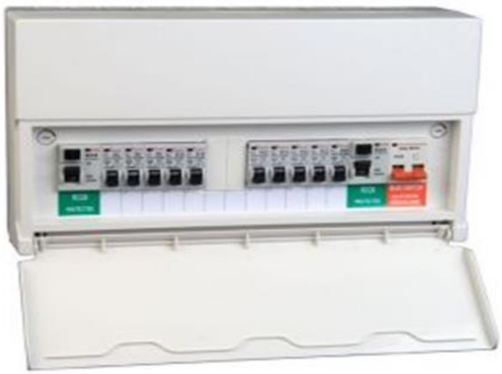


Direct current/voltage (D.C.): Despite the same shape, the curve **does not** go below the zero. Example: photocells
Movement of charge in one direction only.



Direct current / voltage (DC):
The line is always positive.
Examples: Cells batteries

Topic 10: Mains electricity 1



Energy enters through the (brown) live wire. Current returns via the blue neutral wire

UK supply is 230V, 50Hz a.c.

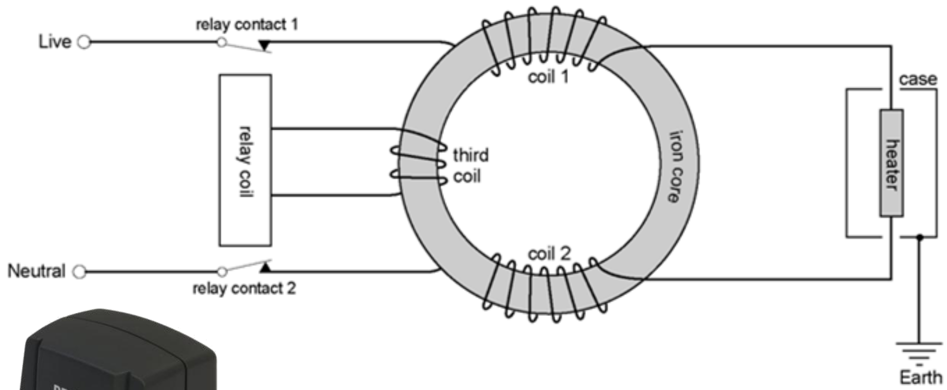
From the meter, electricity passes directly to the fuses or RCCB (fast circuit breaker) these protect the equipment. If the current gets too high, the fuse melts breaking the circuit and preventing overheating

Fuses should have a rating greater than the current used by the appliance in normal conditions.

Switches and fuses come before any appliance to reduce the risks of touching a live wire.

The earth wire is connected to the nearest earth (often a metal stake in the ground) whereas the neutral returns to earth at the substation,

Topic 10: Mains electricity 2



Circuit breakers work faster (instantly), they monitor the current between live and neutral and don't require an earth wire. RCCBs can be easily re-set and are more sensitive.

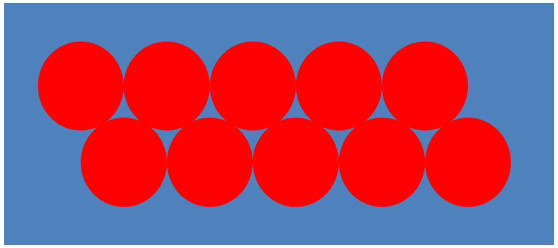
Circuit breakers (RCCBs) detect any difference in potential between the Live and Neutral wires (due to loss). These circuit breakers protect people.

Earth wires connect to the metal case and provide a low resistance path to ground. If the live wire touches the casing, the resulting high current will blow the fuse.

The power rating shows how much electrical energy is converted to heat energy – it also reflects how quickly the water will heat up.

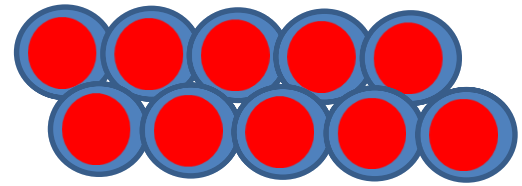
Topic 11: Static and electrons (P)

Conductor:



'sea' of electrons

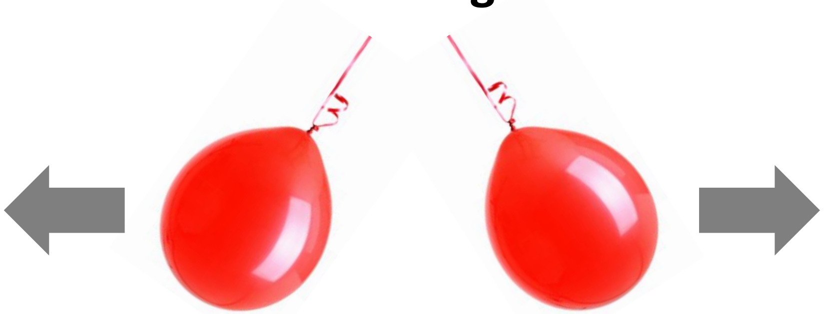
Insulator:



Only insulators can gain a static charge.

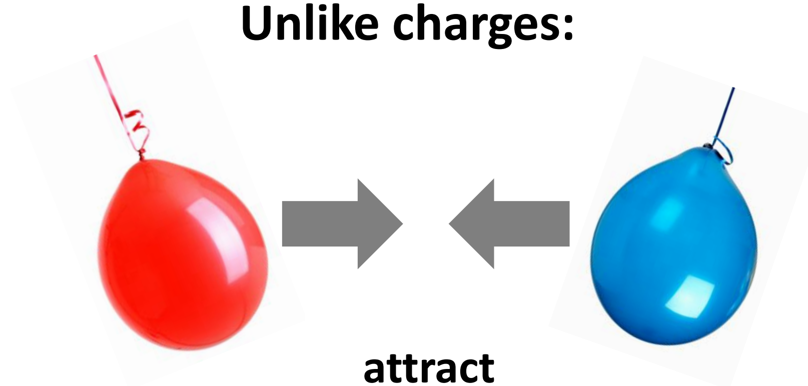
Friction / rubbing a rod will result in either a
LOSS of (-ve) electrons (resulting in a **POSITIVE** charge) or
GAIN of (-ve) electrons resulting in a **NEGATIVE** overall charge.
(Note: The cloth will gain or lose an **EQUAL** charge.)

Like charges:



repel

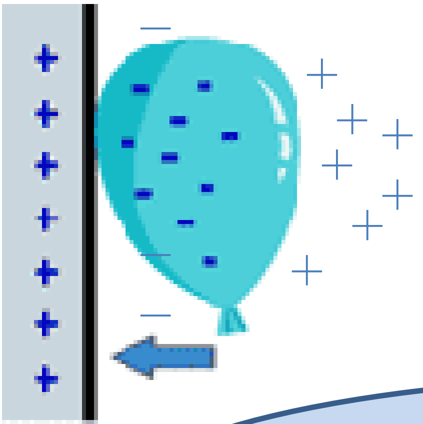
Unlike charges:



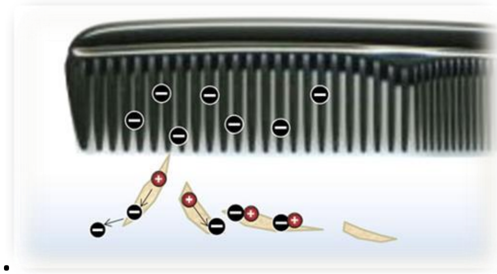
attract

Investigate: Forces of attraction and repulsion between charged objects

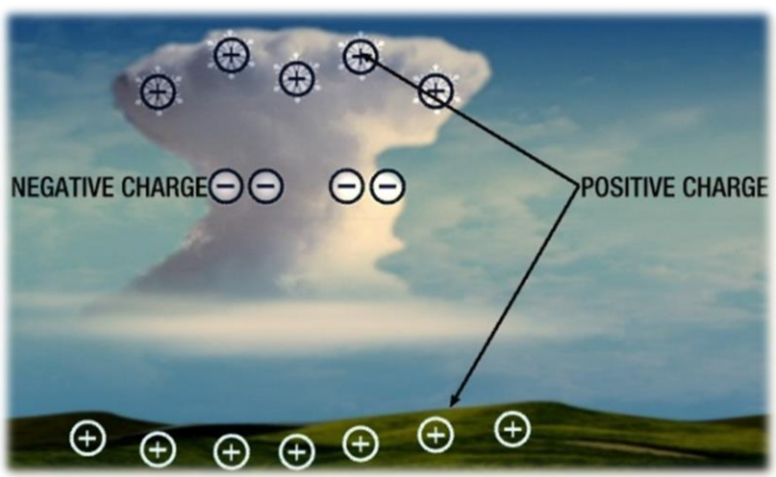
Topic 11: Static charge (Physics only)



The **static charge** on the balloon, comb or cloud **induces** an opposite charge in the wall, paper or ground.



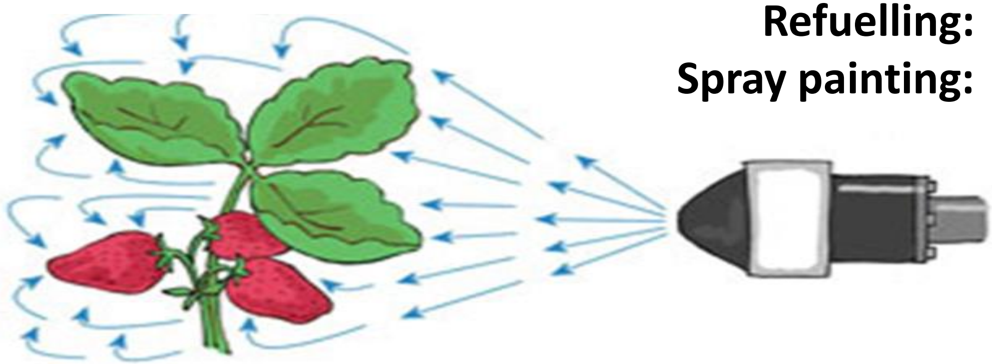
Opposite charges attract,
Objects are attracted to each other and sparks of (negative) electrons can jump between them (static shocks).



Clouds become charged due to friction with ice crystals moved by convection currents inside the cloud. The negative charge on the underside induces a positive charge in the ground. High potential difference means that electrons can jump as lightning.

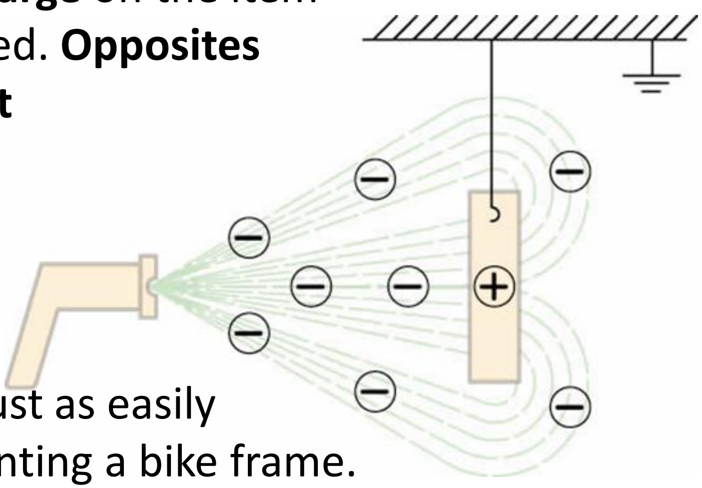
Allowing electrons a path to run to earth / ground eliminates the risk of damage.

Topic 11: Uses and dangers (Physics)



Spray painting:

All the spray particles have the **same charge** so they will **repel** each other and spread out. This produces an even spray. The charge on the spray **induces an opposite charge** on the item Being sprayed. **Opposites** again **attract** producing an even coating.



This could just as easily apply to painting a bike frame.

Refuelling:

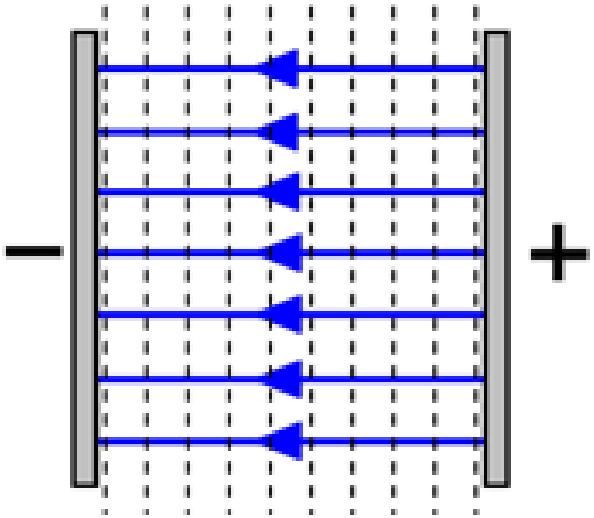
A car, insulated on rubber tyres can build up a **static** charge **due to friction** with the air.

Fuel flowing down a rubber pipe can rub off electrons and cause charges to build up in the fuel nozzle

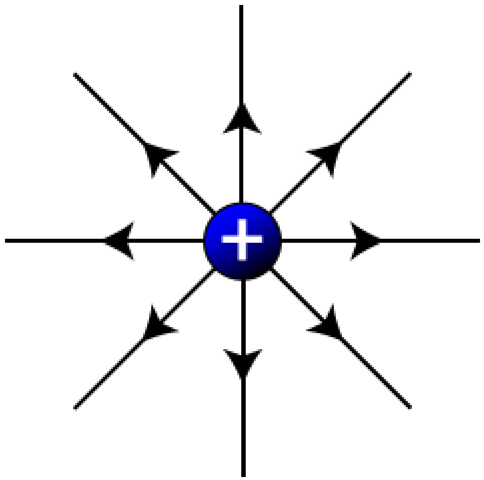
Earthing or Grounding prevents charge building up.

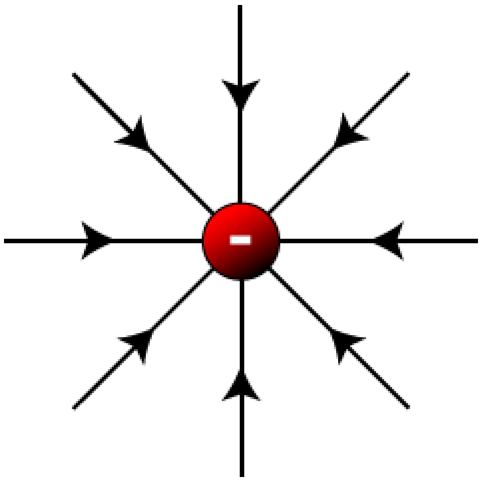
Topic 11: Electric fields (Physics)

An electric field is a region where an electric charge experiences a force.



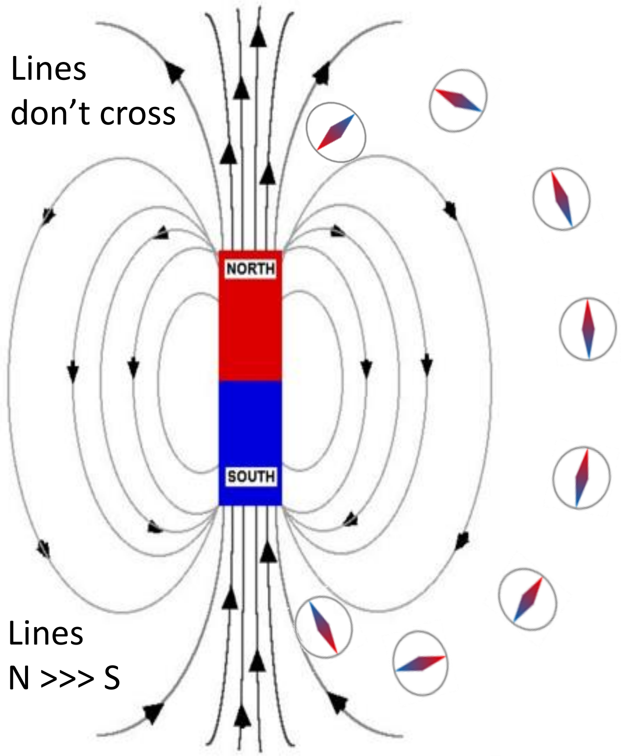
The field is represented by the lines, lines travel from positive to negative and the closer together they are, the stronger the field strength.





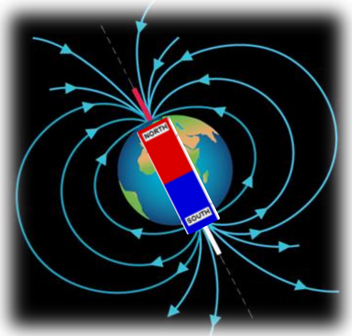
If the field strength is strong enough, it can cause **electrons** to 'jump', hence **sparks** and static electricity.

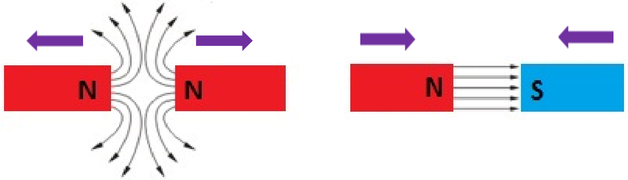
Topic 12: Magnets



In a uniform magnetic field the lines are evenly spaced

The similar behaviour of a compass around the earth suggests that the core of the earth must be magnetic.





Like poles repel   Unlike poles attract

A permanent magnet has a persistent magnetic field. When a piece of unmagnetised magnetic material touches or is brought near to the pole of a permanent magnet, it becomes a magnet itself. The magnetism is **induced.**

A plotting compass can be used to follow the magnetic field lines from the North to the South pole. The closer together the lines, the stronger the magnetic field.

Magnetic materials like iron, steel, cobalt and nickel are used in headphones, hard drives and motors. Iron is a 'soft' material, it loses magnetism quickly and easily.

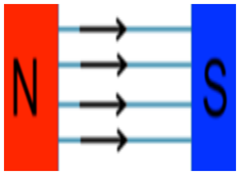
Topic 12: Current and field

Formula (given to you):

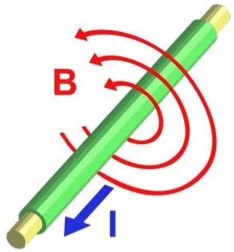
Force on a current-carrying conductor

$$F = B \times I \times L$$

(newtons, N) = (newton per amp metre, N/Am) x (Amp, A) x (metre, m)



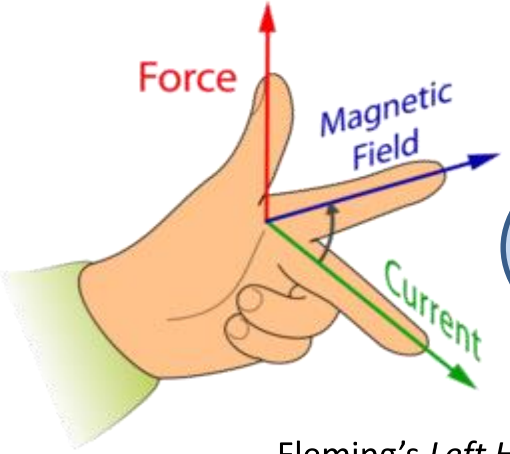
+



Current travelling in a wire generates a magnetic field.

A current-carrying conductor when placed in a magnetic field will experience a force. The magnet will experience an equal and opposite force to the conductor. The bigger the current, or the nearer the field is to the wire, the larger the force experienced.

Fleming's left hand rule is used to give the relative directions of force, current and magnetic field.

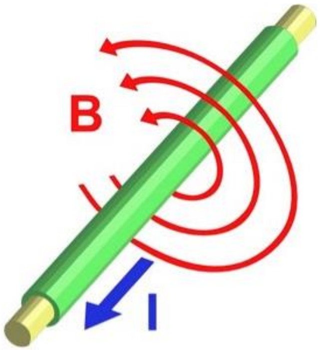


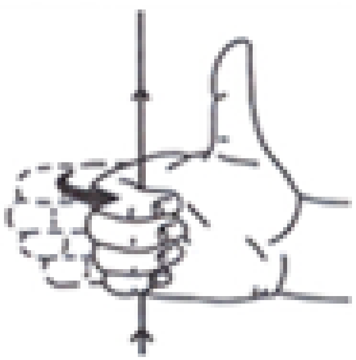
Fleming's *Left Hand Rule*

First finger = **F**ield
Se**c**ond finger = **c**urrent
Thu**m**b = **m**otion

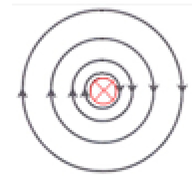
Topic 12: Solenoids

The **Right Hand** or **Corkscrew** rule gives the direction of the field around a current carrying wire.

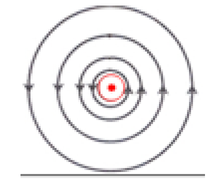




Current into and out of the paper is represented by the following:

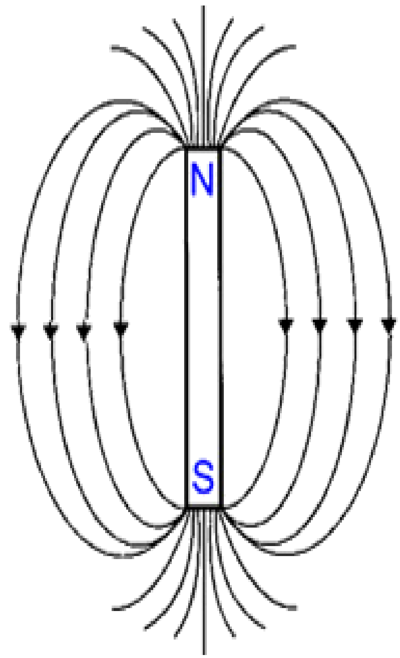


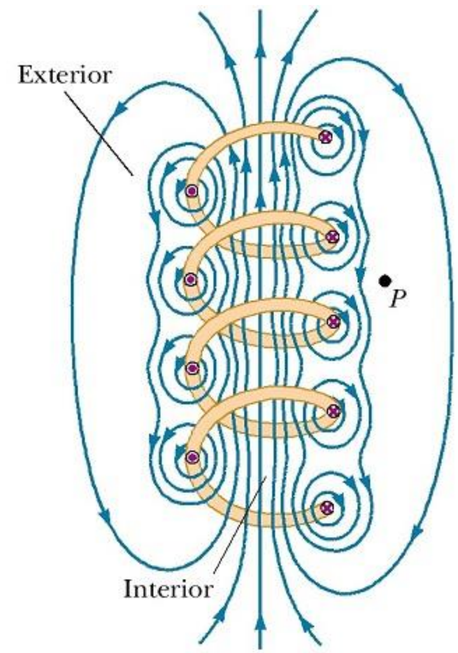
IN – (tail fins)



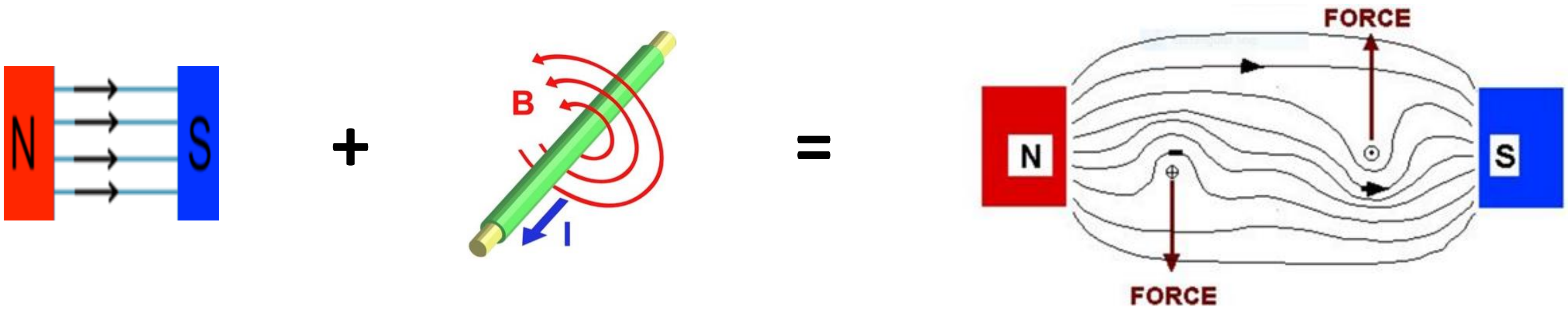
OUT – (nose cone)

This is a **solenoid** where the individual field patterns add to give something resembling the field pattern for a bar magnet:



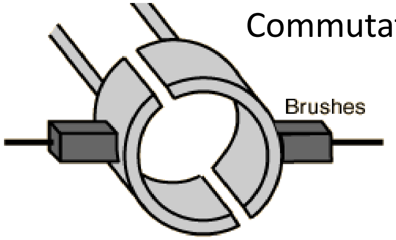


Topic 12: Motor effect (Physics only)

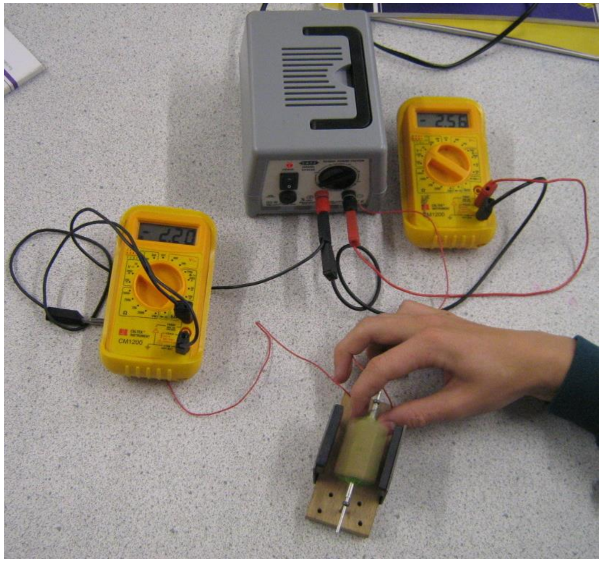


The current in the left hand wire, travelling into the paper, generates a clockwise field. The wire on the right, an anticlockwise field. As the lines can't cross, and using Flemming's left hand rule, the wire on the left 'kicks' down whilst the one on the right 'kicks' up. This creates a turning effect.

D.C. motors are kept spinning by use of a commutator which changes the direction of the current every half turn.



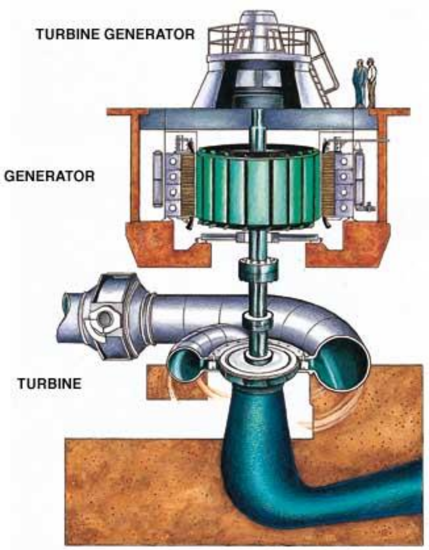
Westminster motor kit



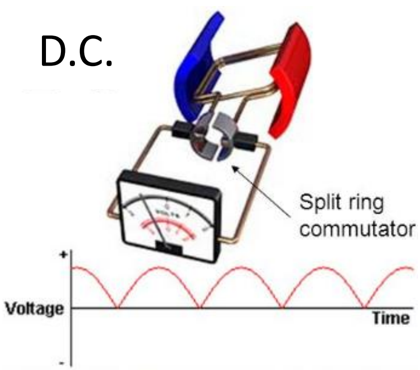
Investigate: Construct an electric motor

Topic 13: Generating current (P)

Moving a coil of wire in a magnetic field, or moving a magnet in a coil of wire, will produce a current. This is easy to demonstrate in the laboratory but the same principle, on a much larger scale, is used in all power stations. Moving blades, or water, or steam are used to spin a **turbine** which is in turn connected to an electrical **generator**.

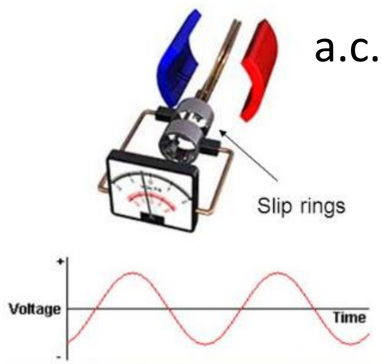


D.C.

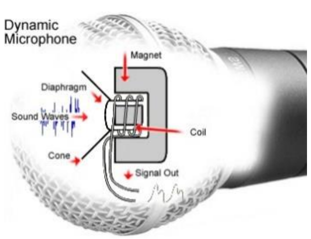


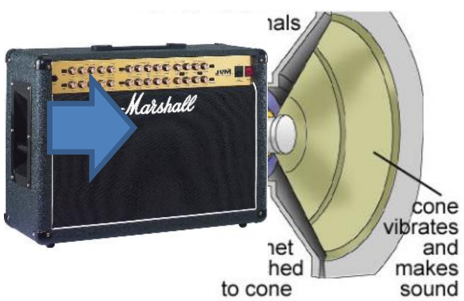
D.C. is always above the line. a.c. goes above and below.

a.c.



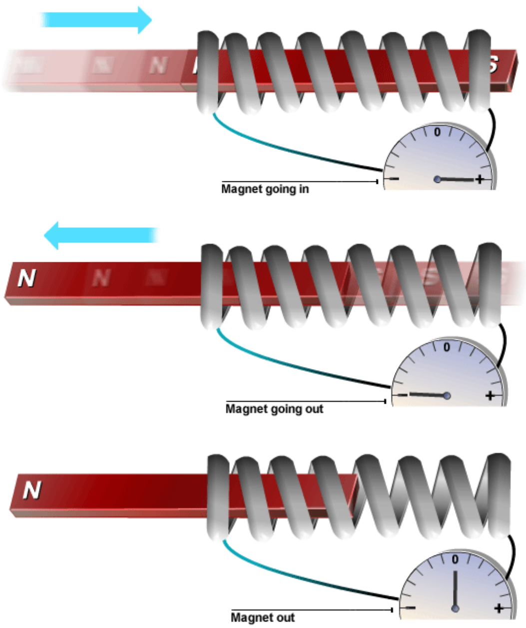
The same idea, moving coil and magnet, is used in a simple microphone or loudspeaker:





Topic 13: Electromagnetic induction

The magnet moves in and out of the coil inducing a potential difference. The magnetic field induced in the coil now opposes this movement.
The **greater the size** of the magnet or the **faster it moves** in the field, the **greater the potential difference** produced
- If there is no movement, there is no potential difference



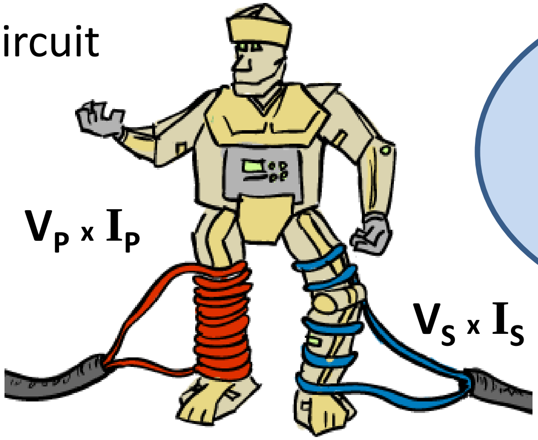
Transformer equation (100% efficient)

$$V_P \times I_P = V_S \times I_S$$

(volts, V)$_{PRIMARY}$ x (ampere, A)$_{PRIMARY}$ = (volts, V)$_{SEC}$ x (ampere, A)$_{SEC}$

The **alternating current** in the **primary** circuit induces an **alternating magnetic field** in the transformer.

The **alternating magnetic field** in the transformer induces an **alternating current** in the **secondary** circuit.

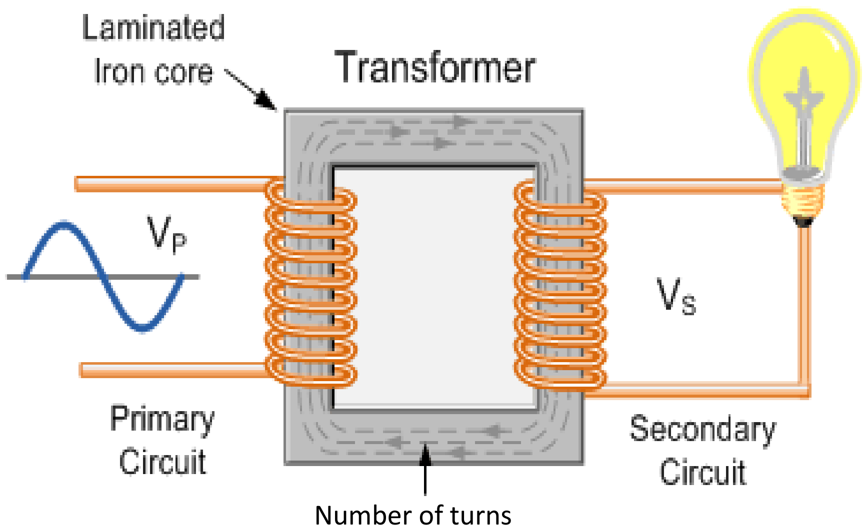


A transformer only changes the size of an alternating voltage.

Investigate: Investigate factors affecting the generation of electric current by induction

Topic 13: Transformers (Physics)

Transformers change alternating voltage:



STEP UP – Increases voltage
High voltage improves efficiency and reduces heat losses on the National Grid

STEP DOWN – Decreases voltage
Voltage are reduced when they get to the user reducing the risks of electrocution.

$$\frac{\text{Potential difference across primary coil}}{\text{Potential difference across secondary coil}} = \frac{\text{number of turns in primary coil.}}{\text{number of turns in secondary coil.}}$$

Formula (given to you):

Transformer turns ratio equation

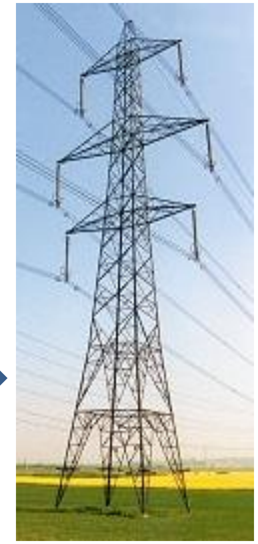
$$V_P / V_S = N_P / N_S$$

(volts, V)$_{PRIM}$ / (volts, V)$_{SEC}$ = (turns)$_{PRIM}$ (turns)$_{SEC}$

Topic 13: Electricity transmission (P)

National Grid

Power Station



Consumer

STEP UP

Transformer

STEP DOWN

Transformer

High voltage = Low current

Low current = Reduced heat loss

Reduced heat loss = Improved efficiency (H)

Though you may have had to recall some of these equations earlier, you will also be expected to use them in the context of power transmission in high voltage cables.

$P = E / t$

$P = I \times V$

$P = I^2 \times R$

$V_P / V_S = N_P / N_S$

$V_P \times I_P = V_S \times I_S$

Topic 14: Density

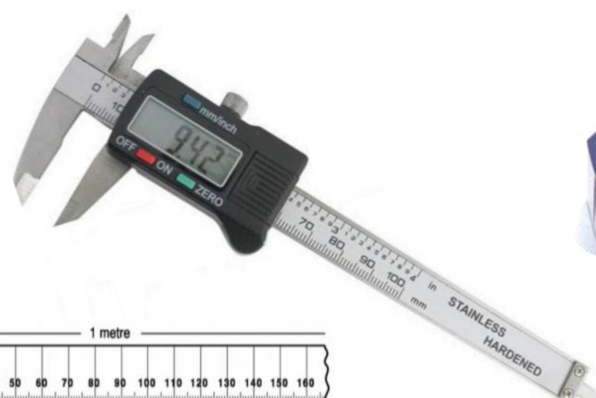
Formula you need to learn:

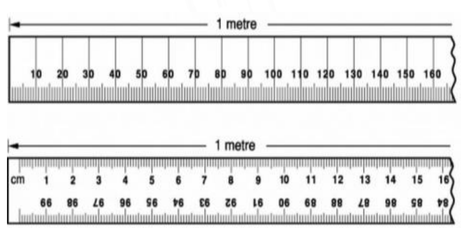
Density = mass / volume

$$\rho = m / V$$

Kilograms per cubic metre, kg/m^3 = kilograms, kg / cubic metres, m^3

Different instruments read to different precisions:
The rule to the nearest mm (0.001m),
the micrometer to 0.01 mm
and the balance to $1/100^{th}$ of a gram (0.01g)

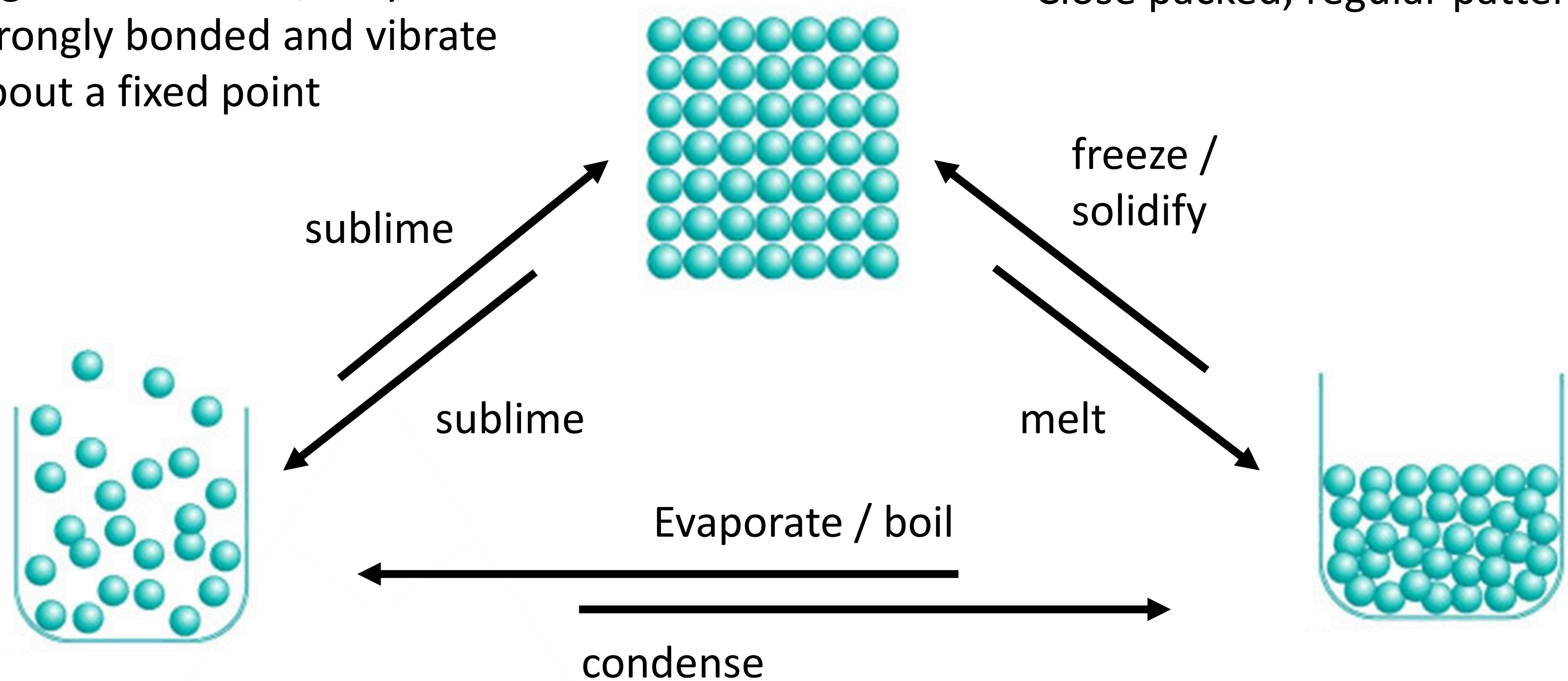




Topic 14: Kinetic theory

Solid: Particles are arranged in regular formation, they are strongly bonded and vibrate about a fixed point

Fixed shape, fixed size
Close packed, regular pattern

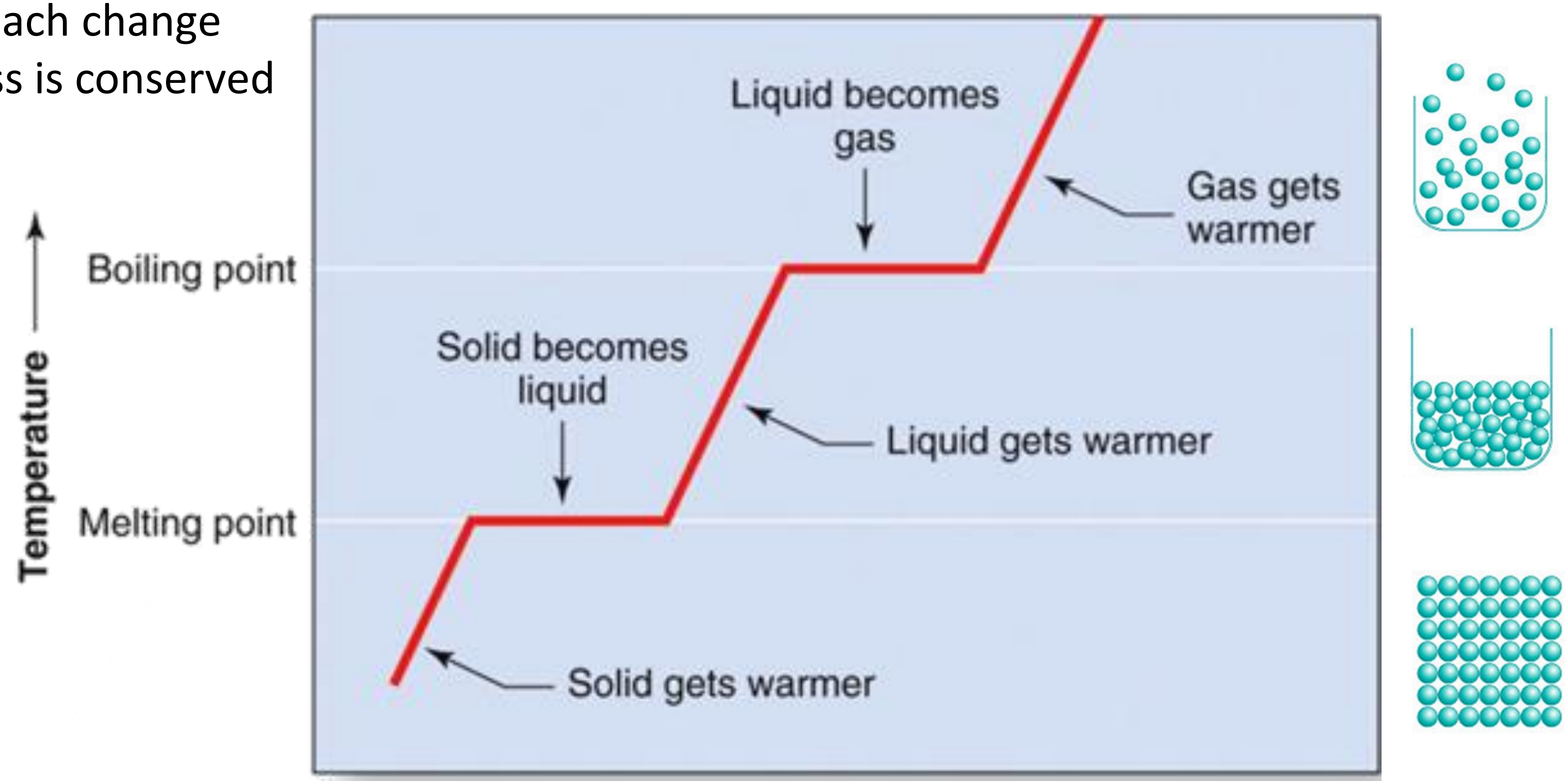


Gas: Density is less, there is no pattern, particles are far apart and move randomly. There is a large space between particles and they take the shape of the container.

Liquid: The density is similar to a solid but particles are able to move past other particles. Liquids take the shape of the container.

Topic 14: Energy change with state

At each change mass is conserved



Increasing the temperature changes the energy stored or produces a change in state e.g. solid to liquid = melting, liquid to solid = freezing, liquid to gas = vaporisation

Topic 14: Specific heat

Specific Heat Capacity: The amount of thermal energy needed to raise the temperature of 1 kg of the substance by 1°C

Formula (given to you):

$$\Delta Q = m \times c \times \Delta\theta$$

ΔQ = change in thermal energy (joules, J)
m = mass (kilogram, kg)
c = specific heat capacity
(joules per kilogram degree Celsius, J / kg °C)
$\Delta\theta$ = change in temperature (degree Celsius, °C)

Specific Latent Heat: The amount of thermal energy needed (or released) when 1 kg of substance changes state (e.g. liquid to gas - vaporisation) without a change in temperature.

Formula (given to you) (H):

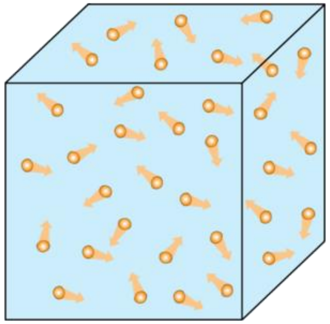
$$Q = m \times L$$

Q = thermal energy for a change of state (joules, J)
m = mass (kilogram, kg)
L = specific latent heat (joules per kilogram, J/kg)

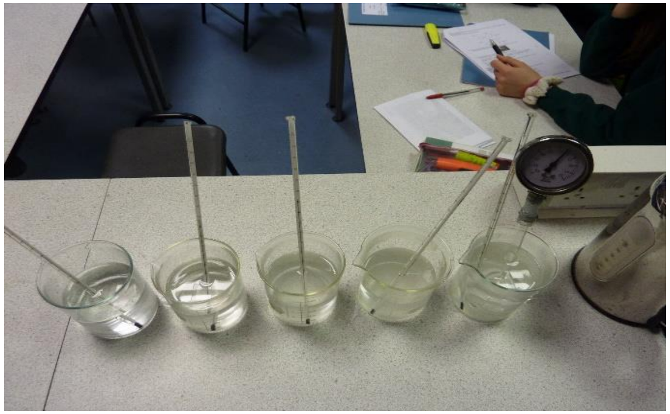
Investigation: Investigate latent heat of vaporisation

Topic 14: Pressure and temperature

In a container, the continuous random motion of the particles results in collisions with the walls. These bombarding molecules produce a force and as pressure = Force / area they exert pressure on the container walls.



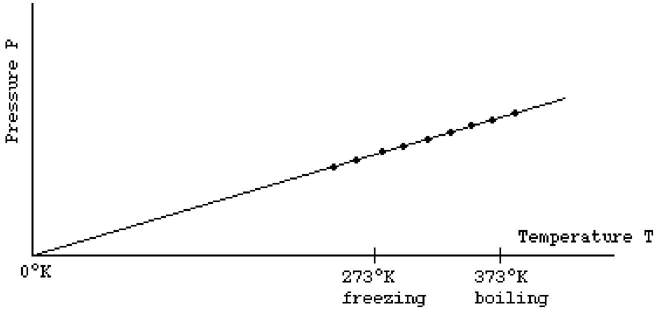
Increasing the temperature increases the average speed of the molecules in the gas and therefore the pressure exerted.



It is possible to plot the pressure exerted by a gas at different temperatures on a graph and this can be extended back to zero pressure.

When the particles have no pressure, there are no collisions, the particles are not moving and therefore they have no temperature. This point is called Absolute Zero (0 Kelvin).

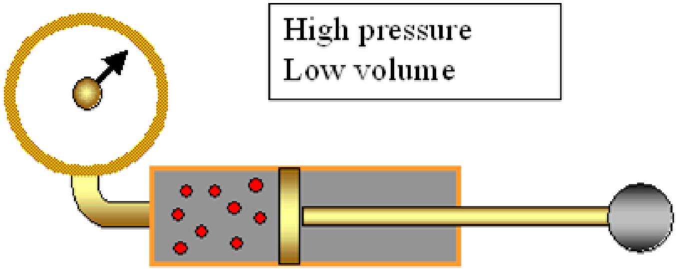
0 kelvin =	-273° Centigrade
273 kelvin =	0° Centigrade
293 kelvin =	20° Centigrade
373 kelvin =	100° Centigrade



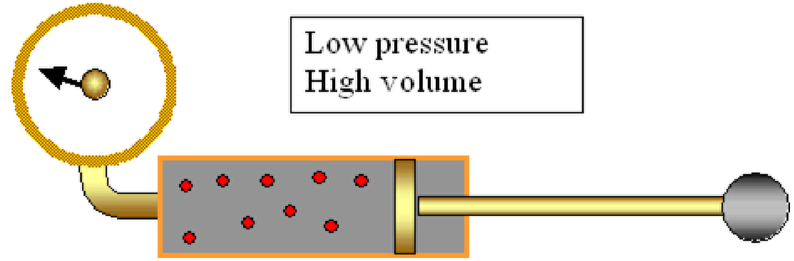
Topic 14: Pressure, volume & temp (P)

Gases can be compressed or expanded by pressure changes:

Compressed



Expanded



Collisions with the wall can be resolved (vectors) to find the net force at right angles to a surface (force is pressure / area). So if the volume decreases, for the same temperature, the rate of collisions with the wall increases and hence a greater pressure.

Formula (given to you):

$$P_1 \times V_1 = P_2 \times V_2$$

(Pressure x Volume)

Same mass at constant temperature

(H) In a pump, if the gas is compressed (work is done on the gas) there will be more collisions with the wall, with more energy. This energy is converted to thermal energy – the pump gets hot.

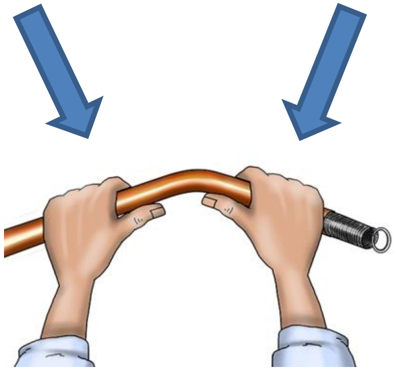
Investigation: Investigate the temperature and volume relationship for a gas

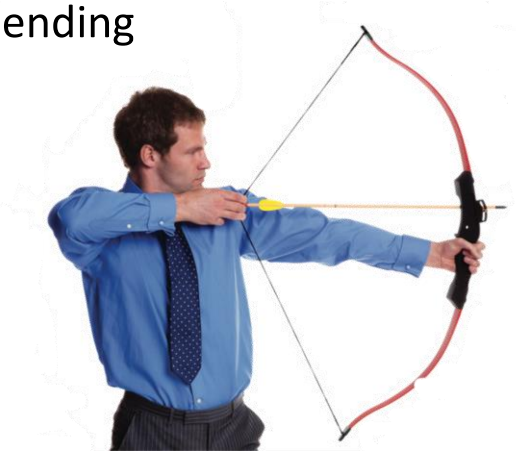
Investigation: Investigate volume and pressure relationship for a gas

Topic 15: Springs

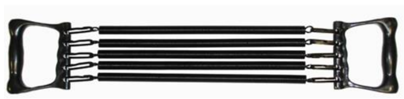
Compression, stretching and bending all require more than one force:

Compression





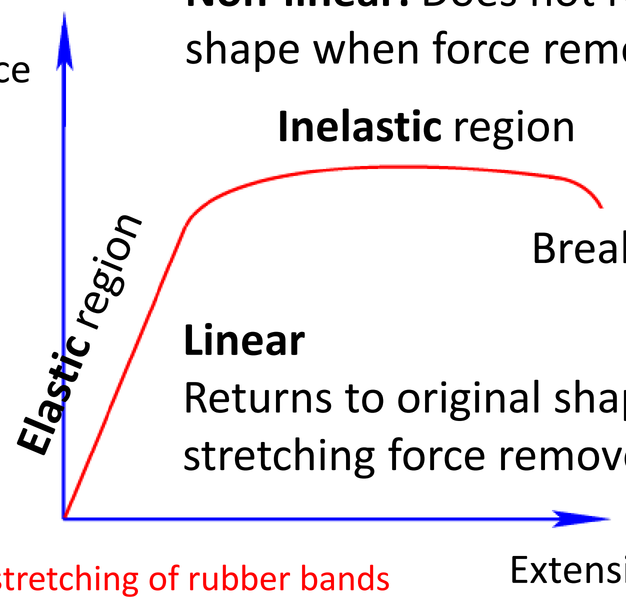
Bending



Stretch

The **elastic** region is a straight line with a gradient of k (spring constant). This region obeys Hooke's Law which says force is proportional to extension.

Non-linear: Does not return to shape when force removed



Linear
Returns to original shape when stretching force removed

Investigation: Investigate the stretching of rubber bands

Topic 15: Springs formula

Formula you need to know:

force on spring = spring constant x extension

$$F = k \times x$$

(newton, N) = (newton per metre, N/m) x (metres, m)

Formula (given to you):

Energy t/f = 0.5 x spring constant x extension^2

(Energy transferred in stretching)

$$E = \tfrac{1}{2} k \times x^2$$

(joules, J) = (newton per metre, N/m) x (metres, m)

Topic 15: Pressure (Physics only)

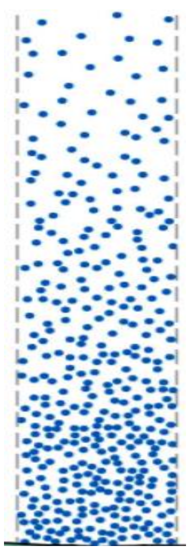
Formula you need to know:

Pressure = force / area

(Force normal to the surface)

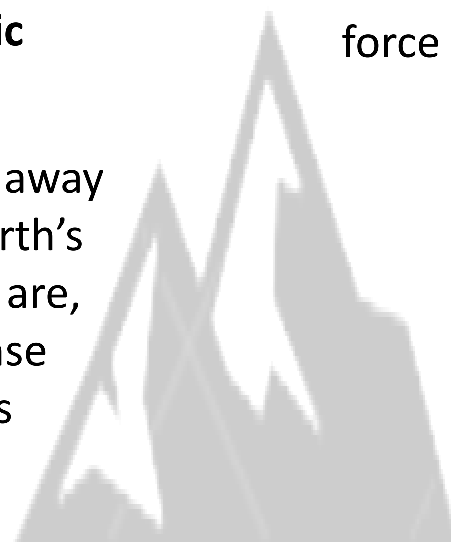
$$P = F / A$$

(pascal, Pa) = (newton, N) x (area of surface, m^2)



Atmospheric pressure:

The further away from the Earth's surface you are, the less dense the particles in the air



There are many practical examples of pressure, force and area:

Stiletto heel vs. elephant's foot

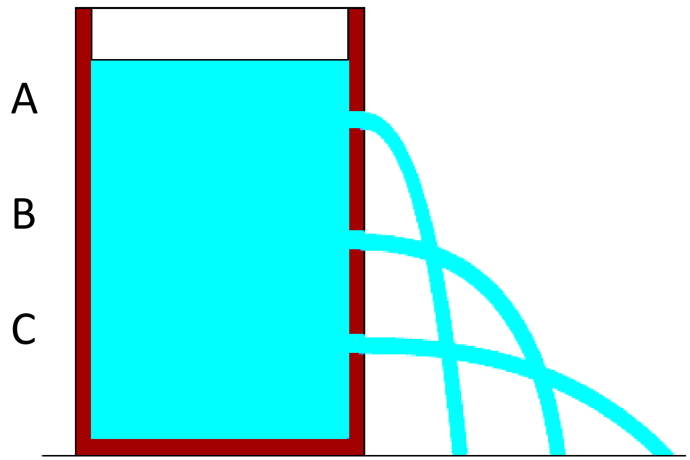
(60kg/2) / 0.0001m^2

= 3,000,000 n/m^2

(3,000kg/4) / 0.1m^2

= 125,000 n/m^2

Topic 15: Fluid pressure (P)



Pressure increases with depth.

Anything above the fluid will push down.
At A it is the air pressure pushing down on the surface whilst at B it is the air pressure plus the height of water above - this is greater.
Finally at C there is an even bigger column of water above and the pressure is higher still

(H) Liquids exert a pressure normal to the surface, just like a gas. In more dense liquids, the pressure is greater. If the density is higher, there are more particles (more mass) contained in the same volume.

The Cartesian diver demonstration is often used to show the impact of pressure on buoyancy

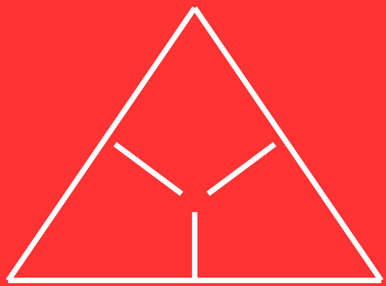
Topic 15: **Fluid pressure (P)**

Formula (given to you):

Pressure = height x density

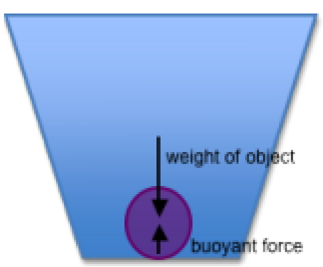
(in a column of liquid)

$$P = h \times \rho \times g$$

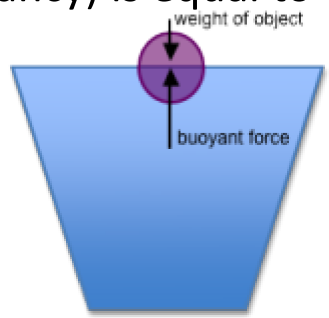


(pascal, Pa) = (metre, m) x (kilogram / cubic metre, kg/m^3) x (N / kg)

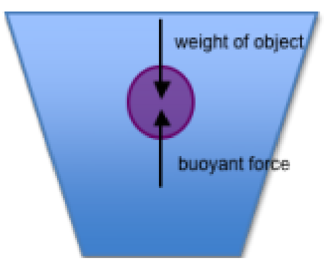
Upthrust (sometimes called buoyancy) is equal to the weight of fluid displaced



Negative



Positive



Neutral

The resultant buoyancy compares the weight of an object with weight of fluid displaced

Investigation: Investigate the upthrust of objects in different liquids

Equations to learn for Paper P2

8.6	work done = force x distance	$E = F \times d$	F = force
8.8 (3.1)	ΔG.P.E. = mass x g x height	$\Delta GPE = m \times g \times h$	h = height
8.9 (3.2)	Kinetic Energy = ½ x mass x speed^2	$K.E = \frac{1}{2} \times m \times v^2$	m = mass
8.13	Power = Work done (joule, J) / time taken	$P = E / t$	P = power
8.15 (3.11)	efficiency = useful energy transferred by the device / total energy supplied to the device		
9.7 (P)	moment= force x distance normal to force		d = distance
9.8 (P)	sum of clockwise moments = sum of anticlockwise moments		
10.6	energy transferred = charge x P.D.	$E = Q \times V$	E = energy (Work done) Q = charge V = potential difference
10.9	Charge = current x time	$Q = I \times t$	I = current t = time
10.13	Potential difference = current x resistance	$V = I \times R$	R = resistance
10.29 (8.13)	Power = Energy transferred (joule, J) / time taken	$P = E / t$	P = power
10.31	electrical power = current x potential difference	$P = I \times V$	
	electrical power = current squared x resistance	$P = I^2 \times R$	
14.2	density = mass / volume	$\rho = m / V$	ρ = density
15.3	force exerted on a spring = spring constant x extension	$F = k \times x$	k = spring constant x = extension
15.11 (P)	force normal to surface / area of surface	$p = F / A$	p = pressure F = force A = area

Beware of confusing similar symbols – especially ones that look like P and V !

Equations to use in Paper P2

10.27 energy transferred = current x p.d. x time $E = I \times V \times t$
E = energy
I = current

12.13 Force on a conductor at right angles to a magnetic field carrying a current =
magnetic flux density x current x length $F = B \times I \times l$
B = magnetic flux density
l = length

13.7 (P) Potential difference across primary coil / Potential difference across secondary coil = Number of turns in primary coil / Number of turns in secondary coil

$V_p / V_s = N_p / N_s$
N_p = primary turns
N_s = secondary turns

13.10 For transformers with 100% efficiency:
Potential difference across primary coil x current in primary coil =
Potential difference across secondary coil x current in secondary coil

$V_p \times I_p = V_s \times I_s$
V_p = primary p.d.
V_s = secondary p.d.
I_p = primary current
I_s = secondary current

14.8 change in thermal energy = mass x specific heat capacity x change in temperature

$\Delta Q = m \times c \times \Delta\theta$
$\Delta\theta$ = temperature change

14.9 thermal energy for a change in state = mass x specific latent heat

$Q = m \times L$
Q = thermal energy
L = specific latent heat

14.19 (P) to calculate pressure or volume for gases of fixed mass at constant temperature

$p_1 \times V_1 = p_2 \times V_2$
p = pressure

15.4 energy transferred in stretching = 0.5 x spring constant x (extension)^2

$E = \frac{1}{2} \times k \times x^2$
k = spring constant
x = extension

15.14 (P) pressure due to a column of liquid =
height of column x density of liquid x gravitational field strength

$p = h \times \rho \times g$
p = pressure due to column
ρ = density of liquid
g = gravitational field strength

Physics Core Practicals

	Practical	Expected outcomes / questions
2.19	Investigate the relationship between force, mass and acceleration by varying the masses added to trolleys	How will you measure mass (to calculate force), time and distance (to calculate acceleration)
4.17	Investigate the suitability of equipment to measure the speed, frequency and wavelength of a wave in a solid and a fluid	You will be expected to measure the frequency using appropriate apparatus and use the wave equation to find either speed or wavelength
5.9	Investigate refraction in rectangular glass blocks in terms of the interaction of electromagnetic waves with matter	Refraction as a change in direction (towards the normal) as light slows down in a glass block
5.19 P	Investigate how the nature of a surface affects the amount of thermal energy radiated or absorbed	Matt black is a good and silver a poor radiator or absorber of heat. Investigate using four colours.
10.17	Construct electrical circuits to: a. investigate the relationship between potential difference, current and resistance for a resistor and a filament lamp b. test series and parallel circuits using resistors and filament lamps	Position ammeter and voltmeter in a circuit using a filament lamp or a resistor. Record current for different voltages in the circuit and calculate the resistance. Repeat the readings adding more lamps in parallel
14.3	Investigate the densities of solid and liquids	Measure mass and volume (using a measuring cylinder). Calculate density.
14.11	Investigate the properties of water by determining the specific heat capacity of water and obtaining a temperature-time graph for melting ice	1. Graph the temperature as ice melts in a water bath of boiling water heated by a bunsen burner. 2. Use a joulemeter to calculate s.h.c. of water.
15.6	Investigate the extension and work done when applying forces to a spring	Hang masses from a spring. Measure the extension, calculate force and work done.