Bottisham Village College

KNOWLEDGE ORGANISER

PHYSICS

YEAR 10 ALL YEAR

KNOWLEDGE ORGANISERS

At Bottisham Village College, we are striving to create a five-year curriculum plan that builds effective revision strategies into homework and lessons, to ensure that students are able to place powerful knowledge into their long-term memories. Additionally, we hope that this will help build effective learning strategies from early in their time here at the college.

Based on evidence, we know that regular recall activities are the best way of achieving this goal and committing powerful knowledge into the students' memories.

At the start of each term, we shall publish all the knowledge organisers that students will require for their studies in each curriculum area. These will cover a range of aspects: facts, dates, characters, quotes, precise definitions and important vocabulary. We are clear: if this fundamental knowledge is secured, students can then develop their higher-level skills of analysis and critical understanding with greater depth.

They will be given an electronic A4 Knowledge Organiser (KO) booklet for each term containing all of the knowledge required. In lessons, Bottisham staff will be regularly testing this fundamental knowledge, using short -quizzes or even more formal "Faculty Knowledge Tests".

The best way to use these organisers at home, is to follow a simple mantra:

1. Look at a certain aspects of a particular knowledge organiser
2. Cover up part of their knowledge organiser
3. Write it out from memory
4. Check and correct any spelling mistakes, missing bits or mistakes

So simple but so effective.

Energy
Year 10 Combined

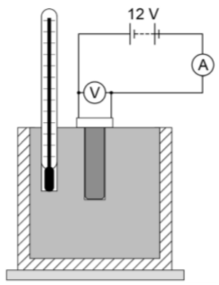
A. Keywords.

Energy system	An object or group of objects that when changed there is a change in the way the energy is stored.
Thermal insulator	A material that prevents the transfer of thermal energy via conduction, convection or radiation.
Specific Heat Capacity	The amount of energy required to raise the temperature of one kilogram of a substance by one degree Celsius.
Power	1.The rate that energy is transferred. 2.The rate that work is done.
Work Done	When a force causes an object to move through a distance
Efficiency	How good a device is at transferring input energy into useful energy.
Dissipated	The transfer of input energy into less useful forms (wasted energy)

B. Equations

Change in thermal energy	= mass x specific heat capacity x temperature change $[\Delta E = m\,c\,\Delta\theta]$
Power	= energy transferred / time $\left[P = \frac{E}{t}\right]$
Power	= work done / time $\left[P = \frac{W}{t}\right]$
Efficiency	efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ Efficiency may also be calculated using the equation: efficiency = $\frac{\text{useful power output}}{\text{total power input}}$

C. Required Practical: Specific Heat Capacity



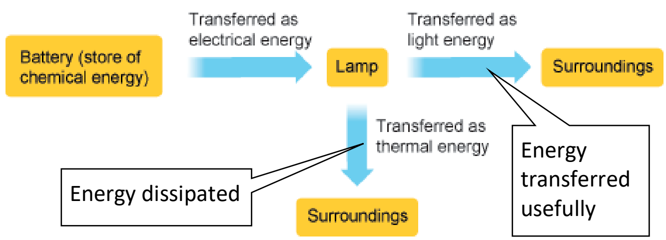
- Connect the heater, ammeter, voltmeter and power supply.
- Record the current and potential difference and use these to calculate the Power of the heater (Power = IV)
- Record the temperature increase of the block every minute.
- Calculate the Work Done each minute (Work Done = Power x time)
- Plot a graph of your results and calculate the gradient of the straight section
- The heat capacity = 1 / gradient
- Calculate Specific Heat Capacity by completing us the change in thermal energy equation and rearranging it to make Specific Heat Capacity the subject.

D. Energy Transfers in a System

Energy can be transferred usefully, stored or dissipated.

Energy cannot be created or destroyed.

Energy transfers can be improved by reducing the dissipation of energy. E.g. lubricating a device to reduce friction or using thermal insulation.



E. Work Done and Power

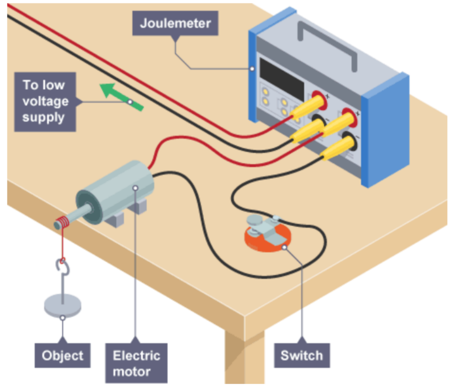
A more powerful device will be able to move an object faster than less powerful one.

A more powerful device transfers more energy per second.

Two electric motors are used to lift a 2 N weight through a vertical height of 10 m.

Motor one does this in 5 seconds.

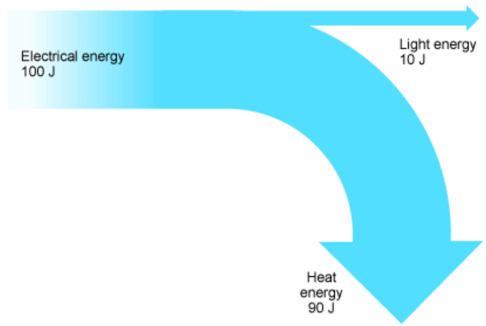
Motor two does this in 10 seconds.



F. Efficiency

An efficient device does not waste energy, it transfer most energy into useful energy stores.

In an inefficient device most of the input energy is dissipated. E.g. a light bulb is inefficient because most of the energy is dissipated as infrared radiation into a thermal store.



Efficiency calculations will always produce an answer between 0 and 1 because nothing can be more than 100% efficient.

Energy
Year 10 Separate

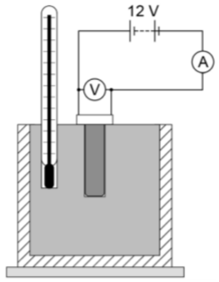
A. Keywords.

Energy system	An object or group of objects that when changed there is a change in the way the energy is stored.
Thermal insulator	A material that prevents the transfer of thermal energy via conduction, convection or radiation.
Specific Heat Capacity	The amount of energy required to raise the temperature of one kilogram of a substance by one degree Celsius.
Power	1.The rate that energy is transferred. 2.The rate that work is done.
Work Done	When a force causes an object to move through a distance
Efficiency	How good a device is at transferring input energy into useful energy.
Dissipated	The transfer of input energy into less useful forms (wasted energy)

B. Equations

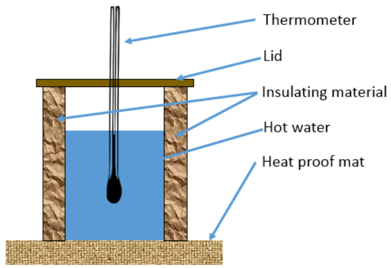
Change in thermal energy	= mass x specific heat capacity x temperature change $[\Delta E = m\,c\,\Delta\theta]$
Power	= energy transferred / time $\left[P = \frac{E}{t}\right]$
Power	= work done / time $\left[P = \frac{W}{t}\right]$
Efficiency	efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ Efficiency may also be calculated using the equation: efficiency = $\frac{\text{useful power output}}{\text{total power input}}$

C. Required Practical: Specific Heat Capacity



- Connect the heater, ammeter, voltmeter and power supply.
- Record the current and potential difference and use these to calculate the Power of the heater (Power = IV)
- Record the temperature increase of the block every minute.
- Calculate the Work Done each minute (Work Done = Power x time)
- Plot a graph of your results and calculate the gradient of the straight section
- The heat capacity = 1 / gradient
- Calculate Specific Heat Capacity by completing us the change in thermal energy equation and rearranging it to make Specific Heat Capacity the subject.

D. Required practical: Thermal Insulation



Test 1. The effectiveness of different materials as thermal insulators

Test 2. How thickness of a material affects thermal insulation.

E. Work Done and Power

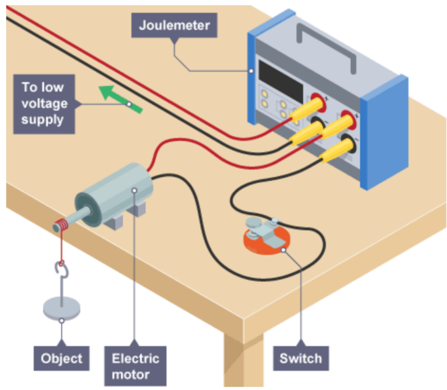
A more powerful device will be able to move an object faster than less powerful one.

A more powerful device transfers more energy per second.

Two electric motors are used to lift a 2 N weight through a vertical height of 10 m.

Motor one does this in 5 seconds.

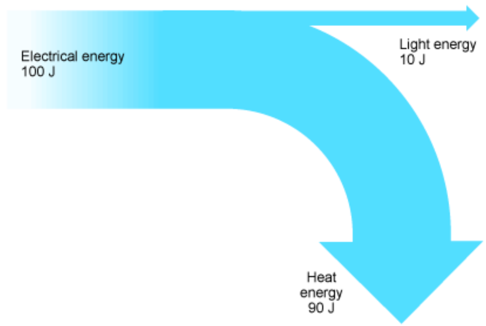
Motor two does this in 10 seconds.



F. Efficiency

An efficient device does not waste energy, it transfer most energy into useful energy stores.

In an inefficient device most of the input energy is dissipated. E.g. a light bulb is inefficient because most of the energy is dissipated as infrared radiation into a thermal store.



Efficiency calculations will always produce an answer between 0 and 1 because nothing can be more than 100% efficient.

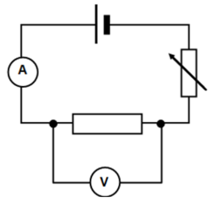
Electricity Year 10 Combined

A. Keywords.

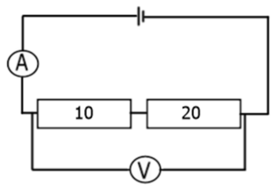
Ammeter	Used to measure the current flowing through a component/ part of a circuit. Must be connected in series.
Cell/battery	Component that provides the potential difference to make a current flow.
Current	Rate of flow of electric charge. Measured in amps (A).
Diode	Component that only allows current to flow in one direction through it.
Efficiency	The proportion of energy supplied to an appliance that is transferred into a useful store.
Filament lamp	Common type of light bulb that contains a thin coil of wire called the filament
Light dependent resistor (LDR)	Component whose resistance decreases as light intensity increases.
Mains electricity	UK mains electricity is an ac supply (used when plugging appliances in). It is 230V and has a frequency of 50 Hz.
Ohmic conductor	A conductor in which the resistance remains constant. This means the current flowing through it will be directly proportional to the potential difference.
Parallel circuit	There are two or more parallel 'branches' providing more than one path the electrons can follow around the circuit.
Potential difference	The potential difference between two points in a circuit is the work done when a coulomb of charge passes between the points. Measured in volts (V). A potential difference is needed for a current to flow.
Power	The rate at which energy is tranferrred (energy transferred per second).
Resistance	A measure of how hard it is for electrons to flow. Measured in ohms (Ω). If the resistance increases it is harder for electrons to flow so current decreases.
Series circuit	All of the components are in a single loop. There is only one path that electrons can follow around the circuit.
Thermistor	Component whose resistance decreases as temperature increases.
Transformer	Device that changes (increases or decreases) the potential difference of the electrical supply.
Voltmeter	Used to measure the potential difference across a component. Must be connected in parallel.

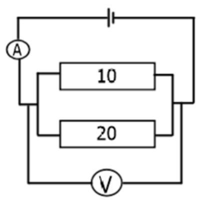
B. Required Practical

1. You need to be able to set up a circuit to investigate the relationship between current and potential difference for a variety of components (filament lamp, diode and resistor at constant temperature).



2. You need to be able to set up a circuit to investigate the total resistance in circuits where there are resistors in series or in parallel, e.g.:





C. Equations

Potential difference = Current x Resistance
[V] [A] [W]

Resistance = potential difference / current
[Ω] [V] [A]

Power = current x potential difference
[W] [A] [V]

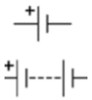
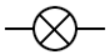
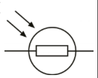
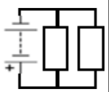
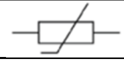
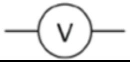
Power = current^2 x resistance
[W] [A] [Ω]

Energy transferred = power x time
[J] [W] [s]

Energy transferred = charge x potential difference
[J] [C] [V]

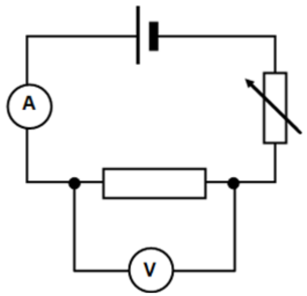
Electricity Year 10 Separate

A. Keywords.

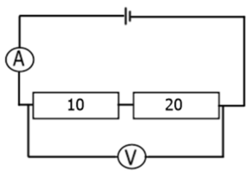
Ammeter 	Used to measure the current flowing through a component/ part of a circuit. Must be connected in series.
Cell/battery 	Component that provides the potential difference to make a current flow.
Current	Rate of flow of negative charge. Measure in amps (A).
Diode 	Component that only allows current to flow in one direction through it.
Efficiency	The proportion of energy supplied to an appliance that is transferred into a useful store.
Electric field	The area around a charged object where its force can be felt. The field is strongest when close to the charged object.
Filament lamp 	Common type of light bulb that contains a thin coil of wire called the filament
Light dependent resistor (LDR) 	Component whose resistance decreases as light intensity increases.
Mains electricity	UK mains electricity is an ac supply (used when plugging appliances in). It is 230V and has a frequency of 50 Hz.
Ohmic conductor 	A conductor in which the resistance remains constant. This means the current flowing through it will be directly proportional to the potential difference.
Parallel circuit 	There are two or more parallel 'branches' providing more than one path the electrons can follow around the circuit.
Potential difference	The potential difference between two points in a circuit is the work done when a coulomb of charge passes between the points. Measured in volts (V). A potential difference is needed for a current to flow.
Power	The rate at which energy is transferred (energy transferred per second).
Resistance	A measure of how hard it is for electrons to flow. Measured in ohms (Ω). If the resistance increases it is harder for electrons to flow so current decreases.
Series circuit	All of the components are in a single loop. There is only one path that electrons can follow around the circuit.
Thermistor 	Component whose resistance decreases as temperature increases.
Transformer	Device that changes (increases or decreases) the potential difference of the electrical supply.
Voltmeter 	Used to measure the potential difference across a component. Must be connected in parallel.

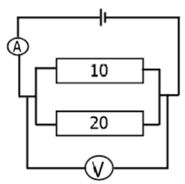
B. Required Practical

1. You need to be able to set up a circuit to investigate the relationship between current and potential difference for a variety of components (filament lamp, diode and resistor at constant temperature).



2. You need to be able to set up a circuit to investigate the total resistance in circuits where there are resistors in series or in parallel, e.g.:





C. Static Electricity

Static electricity: When certain insulating materials are rubbed against each other they become electrically charged.

- Negatively charged electrons are rubbed off one material and on to the other.
- The material that gains electrons becomes negatively charged.
- The material that loses electrons is left with an equal positive charge.
- Opposite charges attract, while like charges repel.

D. Equations

Potential difference = Current x Resistance
[V] [A] [W]

Resistance = potential difference / current
[Ω] [V] [A]

Power = current x potential difference
[W] [A] [V]

Power = current^2 x resistance
[W] [A] [Ω]

Energy transferred = power x time
[J] [W] [s]

Energy transferred = charge x potential difference
[J] [C] [V]

Particle Model
Year 10
Combined

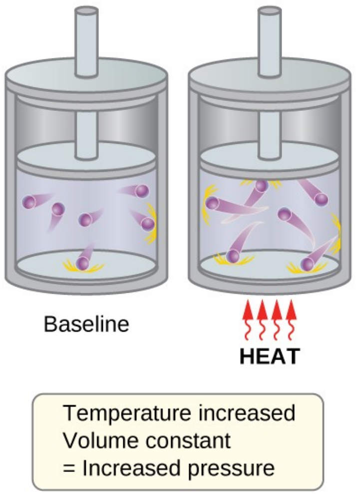
A. Keywords

Internal energy	The total kinetic and potential energy of all of the particles that make up the system.
Specific heat capacity	The amount of energy needed to increase the temperature of 1 kg of a substance by 1°C.
Specific latent heat	The energy needed to change the state of 1 kg of a substance with no change in temperature.
Specific latent heat of fusion	The energy needed to change 1 kg of liquid to gas at constant temperature.
Specific latent heat of vaporisation	The energy needed to change 1 kg of solid to liquid at constant temperature.

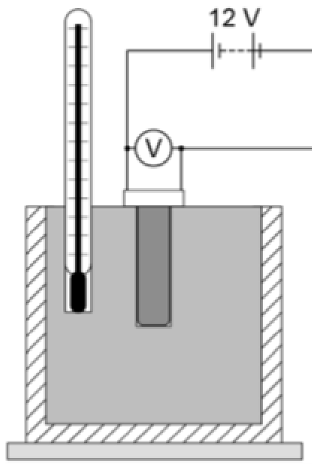
B. Gases

Molecules in a gas constantly move randomly. The temperature of a gas is related to the average kinetic energy of the molecules.

Increasing the temperature of a gas at a constant volume increases the pressure exerted by the gas.



C. Required Practical: Specific Heat Capacity



The increase in temperature of a system depends on three things:

- The mass of the substance
- The energy input to the system
- The type of material

1. Different substances require more energy than others to heat them up. The amount of energy required to heat up different substances can be compared by calculating the specific heat capacity.
2. A circuit is set up connecting to a small heater.
3. The heater is placed into a 1kg block of the material being tested and switched on. The current and potential difference are recorded so that Power can be calculated (Power = IV)
4. A thermometer is used to measure the increase in temperature every minute.
5. Work done each minute is calculated

(Work Done = Power x time)

6. A graph is plotted and the formula 1/gradient is used to calculate the heat capacity of the block. This is the amount of heat energy used to increase the temperature by 1°C.
7. All of the data gathered can be used to calculate the specific heat capacity.

D. Equations

Density = Mass ÷ Volume

(Kg/m^3) (Kg) (m^3)

Be able to use:

$\Delta E = m\, c\, \Delta\theta$

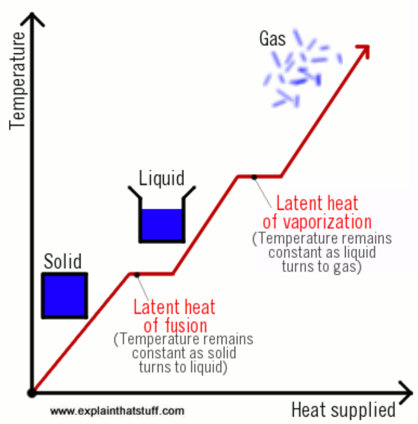
(change in thermal energy = mass x specific heat capacity x temperature change)

$E = m\, L$

(thermal energy of a change in sate = mass x specific latent heat)

$p\, V = constant$

E. Specific Latent Heat



Latent heat is the energy needed for a substance to change state.

When a substance changes state the internal energy changes but the temperature remains the same.

Specific latent heat is the energy required to make 1kg of a substance change state with no change in temperature.

Particle Model
Year 10
Separate Foundation

A. Keywords

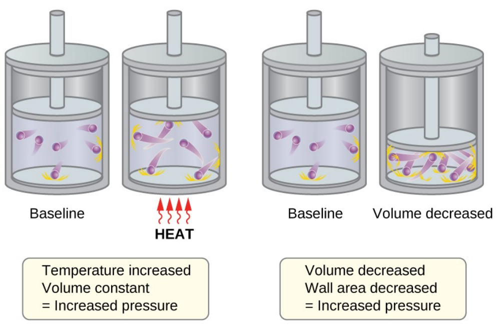
Internal energy	The total kinetic and potential energy of all of the particles that make up the system.
Specific heat capacity	The amount of energy needed to increase the temperature of 1 kg of a substance by 1°C.
Specific latent heat	The energy needed to change the state of 1 kg of a substance with no change in temperature.
Specific latent heat of fusion	The energy needed to change 1 kg of liquid to gas at constant temperature.
Specific latent heat of vaporisation	The energy needed to change 1 kg of solid to liquid at constant temperature.

B. Gases

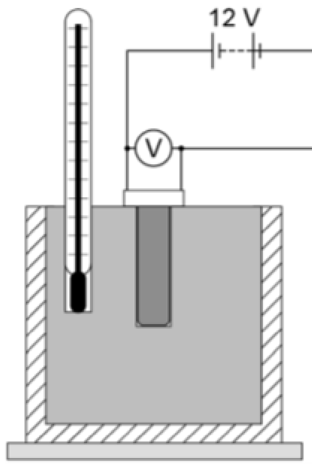
Molecules in a gas constantly move randomly. The temperature of a gas is related to the average kinetic energy of the molecules.

Increasing the temperature of a gas at a constant volume increases the pressure exerted by the gas.

Increasing the volume of the container of a gas at a constant temperature causes the pressure to decrease.



C. Required Practical: Specific Heat Capacity



The increase in temperature of a system depends on three things:

- The mass of the substance
- The energy input to the system
- The type of material

1.Different substances require more energy than others to heat them up. The amount of energy required to heat up different substances can be compared by calculating the specific heat capacity.

2.A circuit is set up connecting to a small heater.

3.The heater is placed into a 1kg block of the material being tested and switched on. The current and potential difference are recorded so that Power can be calculated (Power = IV)

4.A thermometer is used to measure the increase in temperature every minute.

5.Work done each minute is calculated

(Work Done = Power x time)

6. A graph is plotted and the formula 1/gradient is used to calculate the heat capacity of the block. This is the amount of heat energy used to increase the temperature by 1°C.

7. All of the data gathered can be used to calculate the specific heat capacity.

D. Equations

Density = Mass ÷ Volume

(Kg/m^3) (Kg) (m^3)

Be able to use:

$\Delta E = m\, c\, \Delta\theta$

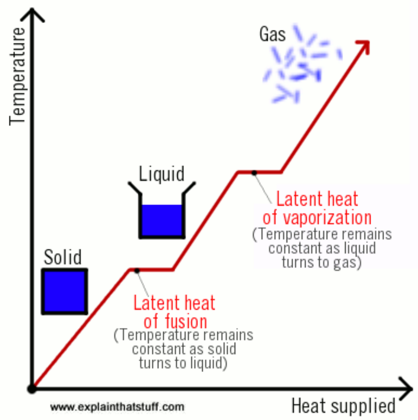
(change in thermal energy = mass x specific heat capacity x temperature change)

$E = m\, L$

(thermal energy of a change in sate = mass x specific latent heat)

$p\, V = constant$

E. Specific Latent Heat



Latent heat is the energy needed for a substance to change state.

When a substance changes state the internal energy changes but the temperature remains the same.

Specific latent heat is the energy required to make 1kg of a substance change state with no change in temperature.

Particle Model
Year 10 Separate Higher

A. Keywords

Internal energy	The total kinetic and potential energy of all of the particles that make up the system.
Specific heat capacity	The amount of energy needed to increase the temperature of 1 kg of a substance by 1°C.
Specific latent heat	The energy needed to change the state of 1 kg of a substance with no change in temperature.
Specific latent heat of fusion	The energy needed to change 1 kg of liquid to gas at constant temperature.
Specific latent heat of vaporisation	The energy needed to change 1 kg of solid to liquid at constant temperature.

B. Gases

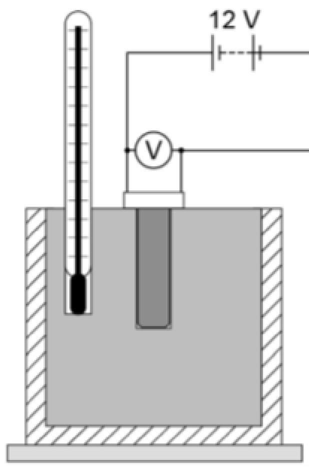
Molecules in a gas constantly move randomly. The temperature of a gas is related to the average kinetic energy of the molecules.

Increasing the temperature of a gas at a constant volume increases the pressure exerted by the gas.

Increasing the volume of the container of a gas at a constant temperature causes the pressure to decrease.

When energy is transferred by a force (doing work) this increases the internal energy of the gas and can cause a temperature increase e.g. using a bicycle pump to inflate a tyre.

C. Required Practical: Specific Heat Capacity



The increase in temperature of a system depends on three things:

- The mass of the substance
- The energy input to the system
- The type of material

1. Different substances require more energy than others to heat them up. The amount of energy required to heat up different substances can be compared by calculating the specific heat capacity.
2. A circuit is set up connecting to a small heater.
3. The heater is placed into a 1kg block of the material being tested and switched on. The current and potential difference are recorded so that Power can be calculated (Power = IV)
4. A thermometer is used to measure the increase in temperature every minute.
5. Work done each minute is calculated

(Work Done = Power x time)

6. A graph is plotted and the formula 1/gradient is used to calculate the heat capacity of the block. This is the amount of heat energy used to increase the temperature by 1°C.
7. All of the data gathered can be used to calculate the specific heat capacity.

D. Equations

Density = Mass ÷ Volume

(Kg/m^3) (Kg) (m^3)

Be able to use:

$\Delta E = m\, c\, \Delta\theta$

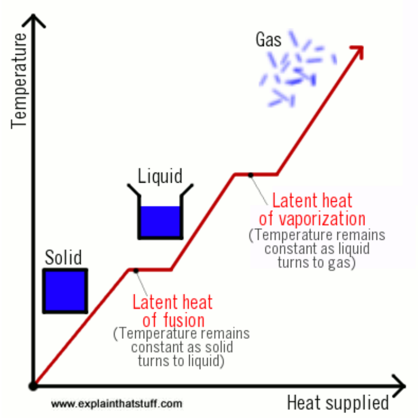
(change in thermal energy = mass x specific heat capacity x temperature change)

$E = m\, L$

(thermal energy of a change in sate = mass x specific latent heat)

$p\, V = constant$

E. Specific Latent Heat



Latent heat is the energy needed for a substance to change state.

When a substance changes state the internal energy changes but the temperature remains the same.

Specific latent heat is the energy required to make 1kg of a substance change state with no change in temperature.

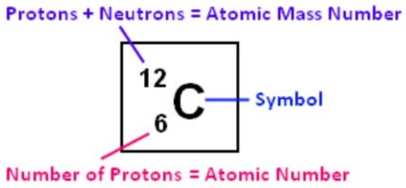
Atomic Structure
Year 10 Combined

A. Keywords

Activity	The rate at which a source of unstable nuclei decays. Measured in becquerel (Bq).
Alpha particle	Made up of two protons and two neutrons (the same as a helium nucleus).
Atomic number	The number of protons in an atom
Beta particle	A fast moving electron given out by the nucleus
Contamination	The unwanted presence of radioactive atoms either on or in an object (including humans!) These atoms could decay which could cause harm.
Electron	Negatively charged particles which orbit the nucleus.
Gamma ray	Electromagnetic radiation given out by the nucleus.
Half - life	The time it takes for the number of radioactive nuclei in a sample to halve or the time it takes for the count rate/activity of a sample to fall to half its initial value.
Ion	An atom becomes a positive ion if it loses one or more electrons. An atom becomes a negative ion if it gains one or more electrons.
Irradiation	Process of exposing an object to nuclear radiation. The object itself does not become radioactive e.g. sterilising surgical instruments
Isotopes	Isotopes of the same element have the same number of protons but different numbers of neutrons.
Mass number	The number of protons and neutrons in the nucleus.
Neutron	Particles found in the nucleus that have no electrical charge (they are neutral).
Nucleus	Positively charged, found at the centre of the atom. Contains protons and neutrons. Most of the mass of an atom is found here.
Proton	Positively charged particles found in the nucleus of an atom.

B. Protons, neutrons, electrons

Particle	Relative Mass	Relative Charge
Proton	1	+1
Neutron	1	0
Electron	(almost) 0	-1



C. Alpha, Beta and Gamma Radiation

	Alpha	Beta	Gamma
What it is	2 protons and 2 neutrons	High speed electron	Electromagnetic wave
Penetrating Power	Least – stopped by paper	Medium—stopped by thin sheet of aluminium	Most—Stopped by a thick sheet of lead
Ionising Power	Strong	Moderate	Very weak
Range in Air	A few cm	Approx. 1 m	At least 1 km

D. Decay equations

Nuclear equations show the changes in mass number and proton number when radioactive decay occurs.

In an equation alpha and beta particles are written like this:

The bottom number shows there are two protons. The top number shows the number of protons and neutrons.

Alpha

$${}^{4}_{2}\mathrm{He}$$

The top number shows the mass is 0. The bottom number shows the charge is negative.

Beta

$${}^{0}_{-1}\mathrm{e}$$

The emission of the different types of nuclear radiation may cause a change in the mass and /or the charge of the nucleus. For example:

- Alpha decay causes both the mass and charge of the nucleus to decrease.

$${}^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$$

- Beta causes the charge of the nucleus to increase.

$${}^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}\text{e}$$

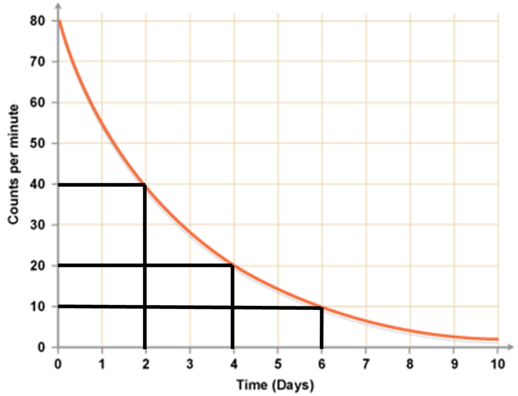
- Gamma emission does not cause any change in mass or charge.

E. Half life

The half-life of a radioactive isotope is the time it takes for the count rate (or activity) from a sample of a radioactive isotope to halve.

When the count rate halves this is an indication that half of the radioactive nuclei of the isotope have decayed.

Half life can be measured using a graph. And finding out the time taken for the count rate to halve.



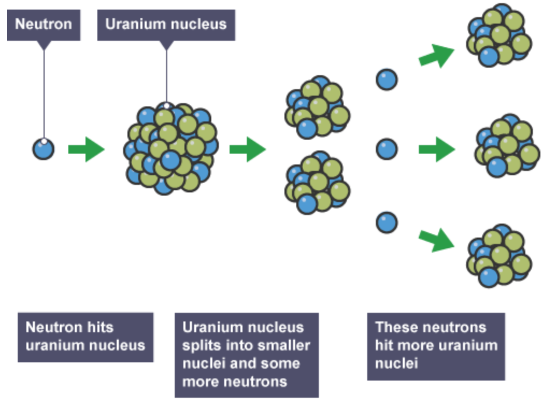
Atomic Structure

Year 10 Separate

A. Keywords

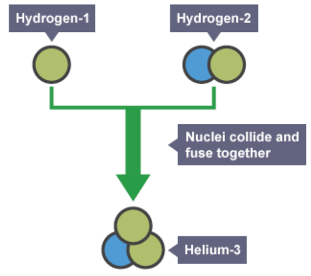
Activity	The rate at which a source of unstable nuclei decays. Measured in becquerel (Bq).
Alpha particle	Made up of two protons and two neutrons (the same as a helium nucleus).
Atomic number	The number of protons in an atom
Background radiation	Radiation that is around us all of the time. It comes from both natural sources (e.g. rocks, cosmic rays from space) and man - made sources (e.g. fall out from nuclear weapons testing and nuclear accidents)
Beta particle	A fast moving electron given out by the nucleus
Contamination	The unwanted presence of radioactive atoms either on or in an object (including humans!) These atoms could decay which could cause harm.
Gamma ray	Electromagnetic radiation given out by the nucleus.
Half - life	The time it takes for the number of radioactive nuclei in a sample to halve or the time it takes for the count rate/activity of a sample to fall to half its initial value.
Ion	An atom becomes a positive ion if it loses one or more electrons. An atom becomes a negative ion if it gains one or more electrons.
Irradiation	Process of exposing an object to nuclear radiation. The object itself does not become radioactive e.g. sterilising surgical instruments
Isotopes	Isotopes of the same element have the same number of protons but different numbers of neutrons.
Mass number	The number of protons and neutrons in the nucleus.
Nucleus	Positively charged, found at the centre of the atom. Contains protons and neutrons. Most of the mass of an atom is found here.
Nuclear Fusion	Nuclear fusion is the joining of two light nuclei to form a heavier nucleus. In this process some of the mass may be converted into the energy of radiation.

B. Nuclear Fission and Fusion



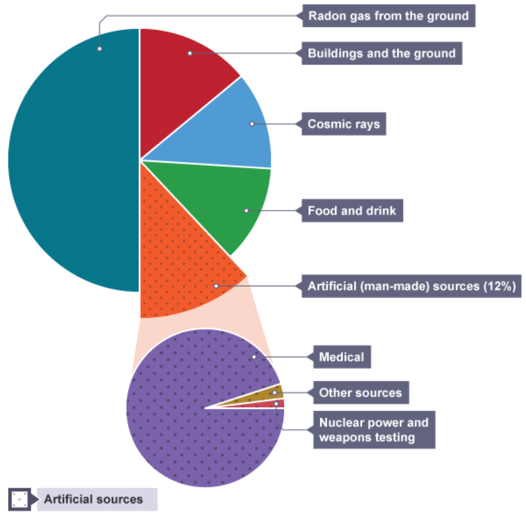
Nuclear fission is when a large unstable nucleus into smaller nuclei.

Nuclear fusion is when two small, light nuclei join together to make one heavy nucleus



C. Background Radiation

Background radiation is around us all of the time. It comes from natural and man-made sources.



D. Decay equations

Nuclear equations show the changes in mass number and proton number when radioactive decay occurs.

In an equation alpha and beta particles are written like this:

The bottom number shows there are two protons. The top number shows the number of protons and neutrons.	Alpha $^{4}_{2}\mathrm{He}$	The top number shows the mass is 0. The bottom number shows the charge is negative.	Beta $^{0}_{-1}\mathrm{e}$

The emission of the different types of nuclear radiation may cause a change in the mass and /or the charge of the nucleus. For example:

- Alpha decay causes both the mass and charge of the nucleus to decrease.

$$^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$$

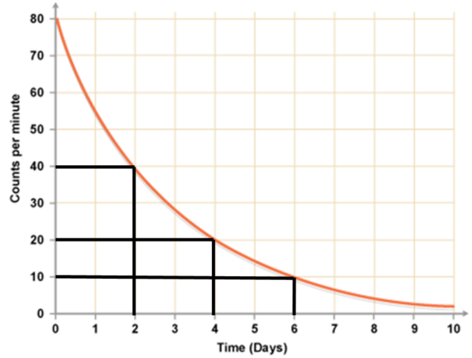
- Beta causes the charge of the nucleus to increase.

$$^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}\text{e}$$

- Gamma emission does not cause any change in mass or charge.

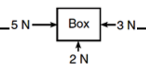
E. Half life

Can be determined from a graph by seeing how long it takes for the number of counts to halve.



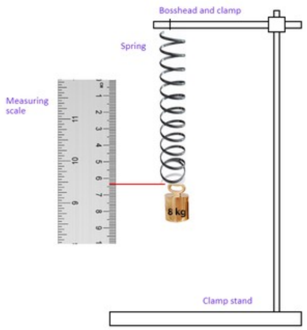
Forces Year 10 Foundation

A. Keywords.

Air resistance	The frictional force caused by air on a moving object
Contact force	A force acting between/on objects that are touching
Drag	The frictional force caused by any fluid (a liquid or gas) on a moving object
Elastic object	An object which can be elastically deformed
Extension	How far an object has been stretched
Force	A push or a pull on an object caused by interacting with something
Free body diagram 	A diagram that shows all the forces acting on an isolated object, the direction the forces are acting and their relative magnitudes
Friction	A force that opposes an object's motion. It acts in the opposite direction to motion.
Gravitational field strength	Force exerted by gravity on each kilogram of mass
Mass	A measure of the amount of matter in an object
Resultant force	A single force that can replace all forces acting on an object to give the same effect as the original forces acting altogether
Scalar quantity	A quantity that has magnitude but no direction e.g. speed, mass
Vector quantity	A quantity which has both magnitude (size) and direction e.g. force, velocity
Weight	The force acting on an object due to gravity
Work done	When energy is transferred

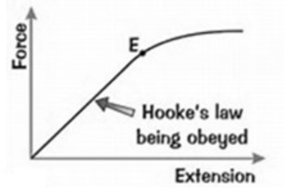
B. Required Practical

Investigate the relationship between force and extension of a spring.



In this practical you will:

- hang different masses from a spring and measure the extension of the spring for each mass used
- convert mass into weight
- use your results to plot a graph of extension against weight
- describe the relationship between force and extension



D. Newton's First Law

Newton's First Law (opposing forces on one object):

An object at rest stays at rest, and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an resultant force

E. Newton's Third Law

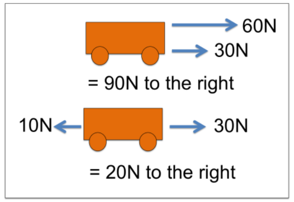
Newton's Third Law (one force on each object):

Whenever two objects interact, they exert an equal and opposite force on each other. For example, when you exert a force backwards on the ground, the ground reacts by exerting an equal and opposite force back on your foot. This force propels you forwards.

C. Resultant Forces

Resultant forces:

You need to be able to calculate the resultant of a pair of forces in the same or opposite directions.



F. Equations

Weight = mass x gravitational field strength

[N] [kg] [N/kg]

Force = spring constant x extension

F = k x e

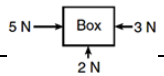
[N] [N/m] [m]

Work done = force x distance

[J] [N] [m]

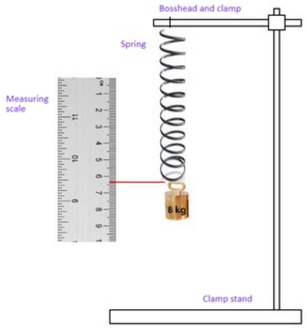
Forces Year 10 Higher

A. Keywords.

Air resistance	The frictional force caused by air on a moving object
Contact force	A force acting between/on objects that are touching
Drag	The frictional force caused by any fluid (a liquid or gas) on a moving object
Elastic object	An object which can be elastically deformed
Extension	How far an object has been stretched
Force	A push or a pull on an object caused by interacting with something
Free body diagram 	A diagram that shows all the forces acting on an isolated object, the direction the forces are acting and their relative magnitudes
Friction	A force that opposes an object's motion. It acts in the opposite direction to motion.
Gravitational field strength	Force exerted by gravity on each kilogram of mass
Inertia	The tendency of objects to continue in their state of rest or of uniform motion
Mass	A measure of the amount of matter in an object
Resultant force	A single force that can replace all forces acting on an object to give the same effect as the original forces acting altogether
Scalar quantity	A quantity that has magnitude but no direction e.g. speed, mass
Vector quantity	A quantity which has both magnitude (size) and direction e.g. force, velocity
Weight	The force acting on an object due to gravity
Work done	When energy is transferred

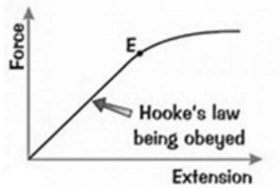
B. Required Practical

Investigate the relationship between force and extension of a spring.



In this practical you will:

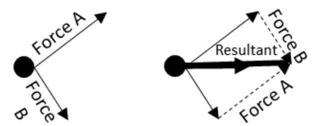
- hang different masses from a spring and measure the extension of the spring for each mass used
- convert mass into weight
- use your results to plot a graph of extension against weight



- describe the relationship between force and extension

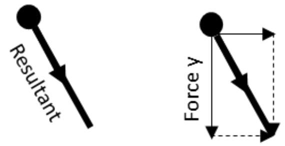
C. Resultant Forces

You need to be able to draw a scale diagram to show how to calculate the resultant force when 2 forces are perpendicular.



D. Resolving Forces

A single force can be resolved into two components acting at right angles to each other using a scale diagram.



E. Newton's Laws

Newton's First Law (opposing forces on one object):

An object at rest stays at rest, and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an resultant force

Newton's Third Law (one force on each object):

Whenever two objects interact, they exert an equal and opposite force on each other.

F. Equations

Weight = mass x gravitational field strength

[N] [kg] [N/kg]

Force = spring constant x extension

[N] [N/m] [m]

Work done = force x distance

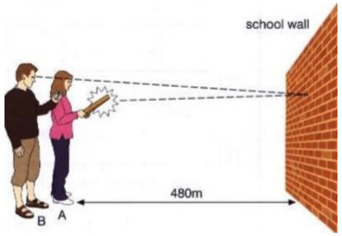
[J] [N] [m]

Waves Year 10

A. Keywords.

Amplitude	The maximum displacement of a point on a wave away from its undisturbed position.
Frequency	Number of waves passing a point each second. Measured in Hertz (Hz).
Longitudinal wave	Wave in which the energy travels in the same plane (direction) as the vibration (oscillation).
Medium	Material through which a wave travels
Oscillation	Movement back and forth
Period	Time for one complete wave.
Transverse wave	Wave in which the energy travels perpendicular to the direction of vibration (oscillation).
Wave	Disturbance in a medium that transfers energy from one place to another.
Wavelength	Length of one complete wave. Measured in metres.
Wave speed	The rate at which a wave travels. Measured in m/s.

B. Measuring the speed of sound



Make a sound and start the stopclock.

Stop the stopclock when you hear the echo.

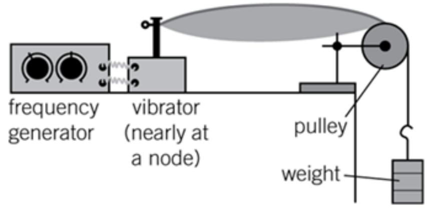
$$\text{Speed} = \frac{\text{distance}}{\text{Time}}$$

Remember: if you are using the echo method, the distance travelled by sound is twice the distance to the wall.

C. Required practical

You need to make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements.

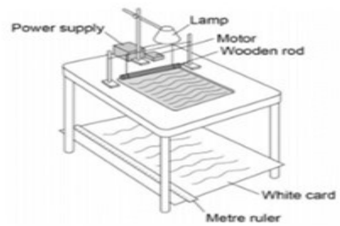
Investigating waves in a solid



In this practical, you set the frequency generator to make standing waves of a particular frequency. You can measure the wavelength of the wave, then calculate wave speed using the equation:

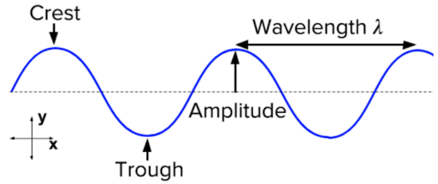
Wave speed = frequency x wavelength

Investigating waves in a liquid



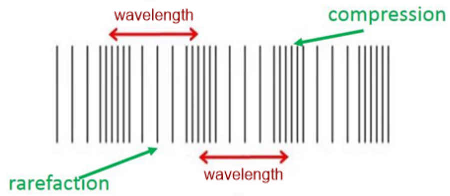
- In this practical, you place a ruler on the white card, then take a photo of the wave pattern.
- Wavelength can be calculated by measuring the length of 10 waves, then dividing by 10.
- To measure frequency, count the number of waves in 10 seconds, then divide by 10. Or take a video of the waves and slow them down to get a more accurate value.

D. Parts of a transverse wave



Examples of transverse waves are: water waves and electromagnetic waves e.g. light, microwaves.

E. Longitudinal waves



Examples of longitudinal waves are: sound waves.

F. Equations

Wave speed = frequency x wavelength

[m/s] [Hz] [m]

You need to be able to use this equation (but don't need to learn)

$$\text{wave period} = \frac{1}{\text{frequency}}$$

[s] **[Hz]**

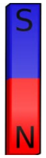
Magnetism and Electromagnetism Year 10 Combined

A. Keywords.

Non-contact	Forces that do not require objects to be touching (repulsion and attraction)
Magnetic	Property of certain metals allowing them to interact (iron, cobalt, nickel, steel)
Plotting compass	Small compass that can be placed near to a magnet to show the direction of the magnetic field
Current	Rate of flow of negative charge (electrons). Measured in Amperes/Amps (A).
Permanent magnet	An object that is always magnetic, and cannot be made non-magnetic.
Metal core	Any metal object which a wire can be wrapped around to form an electromagnet. This core acts as the magnet when the circuit is switched on.

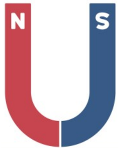
B. Magnetic poles

All magnets have 2 poles, no matter what shape the magnet is. The poles are called **north** and **south.**

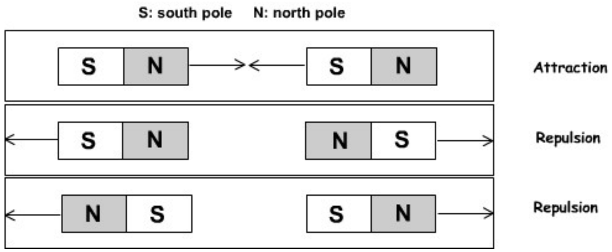


Bar magnet

Horseshoe magnet



When the poles of 2 magnets are brought together, they can interact in these ways:

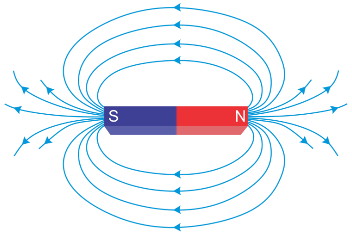


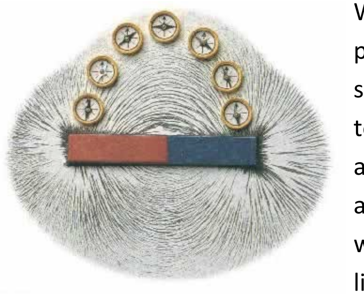
Like poles repel, opposite poles attract.

C. Magnetic fields

Magnets can interact because they have a field around them. This is the area in which another magnetic or charged object has a force exerted upon it.

Magnetic fields are drawn as arrows and **always** go from north to south.





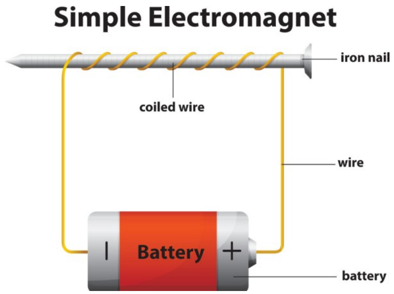
We can put a piece of paper over a magnet and sprinkle **iron filings** over it to show the field. We can also put **plotting compasses** around the magnet. They will line up with the field lines.

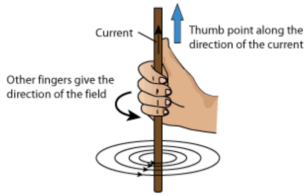
D. Electromagnets

These are magnets that require an electrical current in order to work. They are different to permanent magnets because:

1. They can be turned on and off
2. Their strength can be changed
3. They are able to be much stronger than permanent magnets

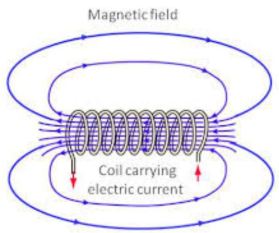
- To make an electromagnet, an insulated wire is coiled around a **metal core**.
- When a current is passed through the wire, it has a magnetic field which magnetises the iron core.





- When current flows though a wire, the moving charges generate a magnetic field around it.
- This field is made of concentric circles around the wire. We use the right hand screw rule to picture this.

A coil of wire is called a **solenoid**. The magnetic field around it is the same shape as the field around a bar magnet.



To change the strength of an electromagnet, we can change:

- The number of turns on the coil
- How close the turns are packed together
- The size of the current going through the wire.

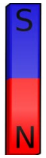
Magnetism and Electromagnetism Year 10 Separate

A. Keywords.

Non-contact	Forces that do not require objects to be touching (repulsion and attraction)
Magnetic	Property of certain metals allowing them to interact (iron, cobalt, nickel, steel)
Plotting compass	Small compass that can be placed near to a magnet to show the direction of the magnetic field
Current	Rate of flow of electrons through a conductor.
Permanent magnet	An object that is always magnetic, and cannot be made non-magnetic.
Metal core	Any metal object which a wire can be wrapped around to form an electromagnet. This core acts as the magnet when the circuit is switched on.

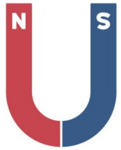
B. Magnetic poles

All magnets have 2 poles, no matter what shape the magnet is. The poles are called **north** and **south.**

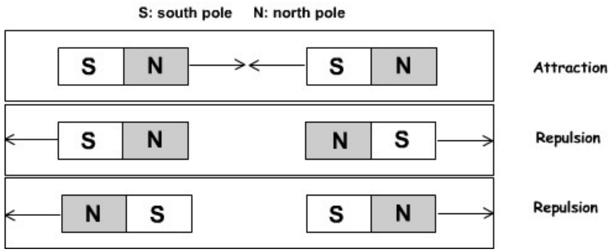


Bar magnet

Horseshoe magnet



When the poles of 2 magnets are brought together, they can interact in these ways:

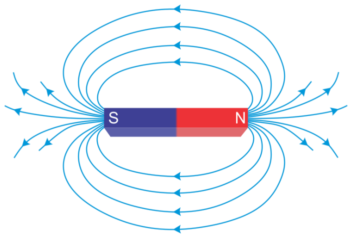


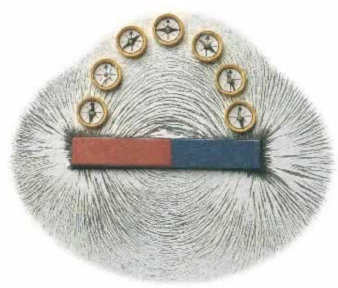
Like poles repel, opposite poles attract.

C. Magnetic fields

Magnets can interact because they have a field around them. This is the area in which another magnetic or charged object has a force exerted upon it.

Magnetic fields are drawn as arrows and **always** go from north to south.





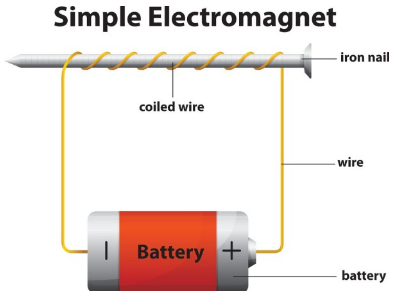
We can put a piece of paper over a magnet and sprinkle **iron filings** over it to show the field. We can also put **plotting compasses** around the magnet. They will line up with the field lines.

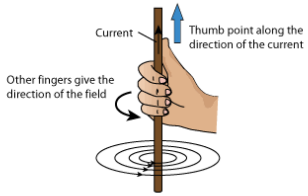
D. Electromagnets

These are magnets that require an electrical current in order to work. They are different to permanent magnets because:

1. They can be turned on and off
2. Their strength can be changed
3. They are able to be much stronger than permanent magnets

- To make an electromagnet, an insulated wire is coiled around a **metal core**.
- When a current is passed through the wire, it has a magnetic field which magnetises the iron core.





- When current flows though a wire, the moving charges generate a magnetic field around it.
- This field is made of concentric circles around the wire. We use the right hand screw rule to picture this.

A common use is in an alarm bell. When the current flows, the electromagnet is switched on. This exerts a force of **attraction** on the armature, pulling it towards the magnet and making the hammer strike the going, while simultaneously breaking the circuit. The magnet turns off and the arm springs back, resetting the circuit.