Bottisham Village College

KNOWLEDGE ORGANISER

PHYSICS

YEAR 11 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

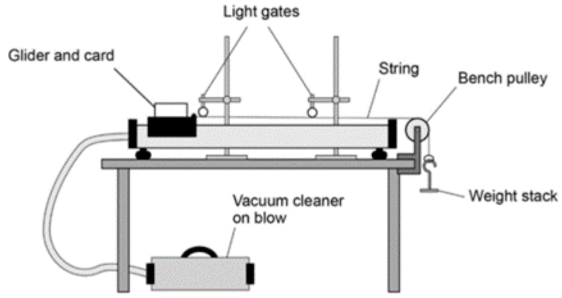
So simple but so effective.

Forces Year 11a
Combined Foundation

A. Keywords.

Acceleration	Rate of change of velocity
Braking distance	Distance travel between brakes being applied and vehicle coming to a stop. Affected by adverse road and weather conditions and poor condition of the vehicle.
Deceleration	Slowing down
Displacement	Distance covered in a certain direction. Vector quantity.
Force	A push or a pull on an object caused by interacting with something . Measured in Newtons.
Mass	A measure of the amount of matter in an object. Measured in kg.
Scalar quantity	A quantity that has magnitude but no direction e.g. speed, mass
Speed	How fast something is moving. Measured in m/s. Scalar quantity.
Stopping distance	Thinking distance + braking distance
Thinking distance	Distance travelled between seeing a need to stop and applying the brakes. Affected by reaction time, which varies from person to person and is altered by tiredness and use of drugs (including alcohol).
Typical speed	Normal speeds for an something: Walking = 1.5m/s Running = 3 m/s Cycling = 6 m/s Sound = 330 m/s
Vector quantity	A quantity which has both magnitude (size) and direction e.g. force, velocity
Velocity	Speed in a certain direction. Measured in m/s. Vector quantity.

B. Required Practical: Acceleration



1) Investigate the effect of varying the force on the acceleration of an object of constant mass.

In this practical, you will:

- Attach a weight to the object to exert a force on it, let it go and measure the speed at 2 points
- Calculate the acceleration of the object
- Repeat the experiment with different forces
- Plot a graph of force against acceleration

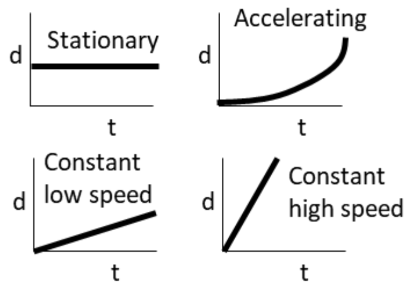
2) Investigate the effect of varying the mass of an object on the acceleration produced by a constant force (similar experiment to above, but changing mass).

C. Newton's Second Law

The acceleration of an object is directly proportional to the resultant force on the object, and inversely proportional to the mass of an object.

D. Distance-time graphs

Distance-time graphs:



Speed can be calculated by working out the gradient (change in speed / change in time) of the distance-time graph.

E. Equations to learn

distance travelled = speed x time
[m] [m/s] [s]

speed = distance travelled [m] / time taken [s]
[m/s]

acceleration = change in velocity [m/s] / time taken [s]
[m/s^2]

resultant force = mass x acceleration
[N] [kg] [m/s^2]

Forces Year 11a Combined Higher

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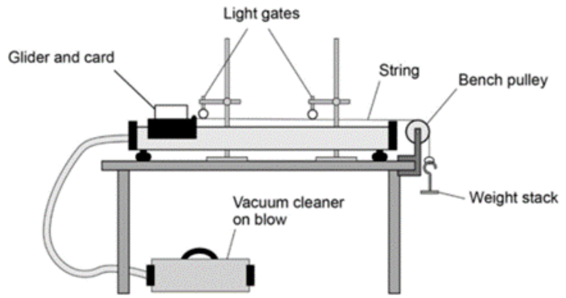

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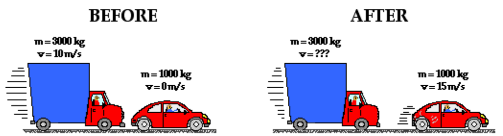
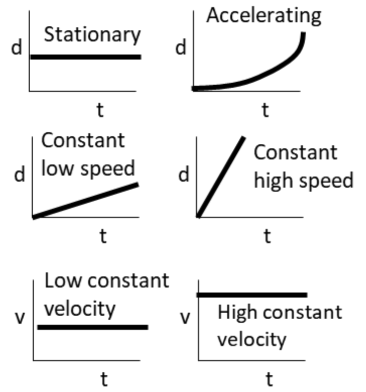
C. Conservation of momentum

In a closed system (system that is not affected by external forces) the total momentum before an event is equal to the total momentum after the event.



D. Motion graphs



Distance-time graphs:

Speed can be calculated by working out the gradient (change in speed / change in time) of the distance-time graph.

E. Newton's Second Law:

Acceleration of an object is directly proportional to resultant force, and inversely proportional to mass.

F. Equations to learn

distance travelled = speed x time
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speed = <u>distance travelled</u> [m]
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acceleration = <u>change in velocity</u> [m/s]
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resultant force = mass x acceleration
[N] [kg] [m/s^2]

momentum = mass x velocity
[kg m/s] [kg] [m/s]

Forces Year 11a
Separate Foundation

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Inertial mass (inertia)	A measure of how difficult it is to change the velocity of an object. The ratio of force over acceleration.
Momentum	Mass x velocity. A measure of how hard it is to stop something.
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Terminal velocity	Highest velocity attainable by an object as it falls through a fluid. It occurs when the upwards force of air resistance is equal to the downward force of weight
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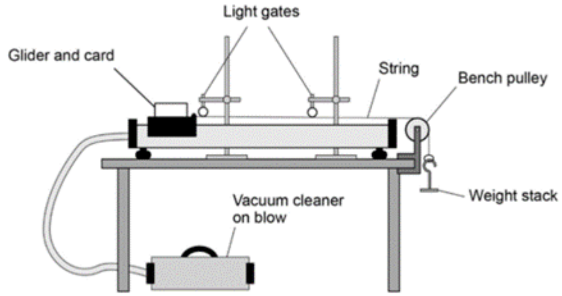

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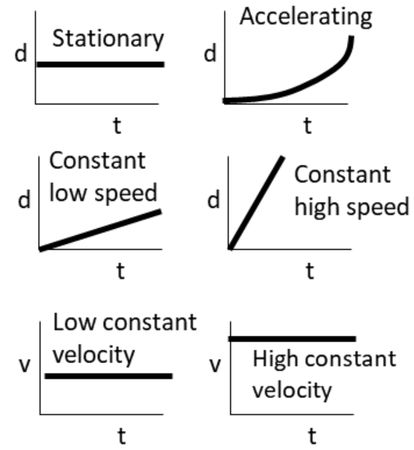

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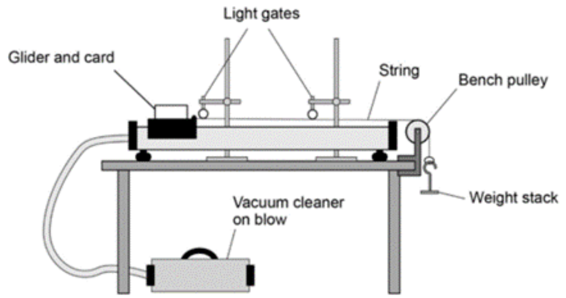

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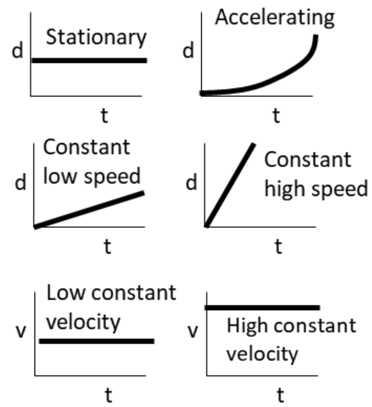

Speed can be calculated by working out the gradient (change in speed / change in time) of the distance-time graph.

You will need to be able to calculate the gradient from a tangent if the object is speeding up

Area under a v-t graph gives you distance travelled.

F. Equations to learn

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Waves Year 11a
Combined Foundation

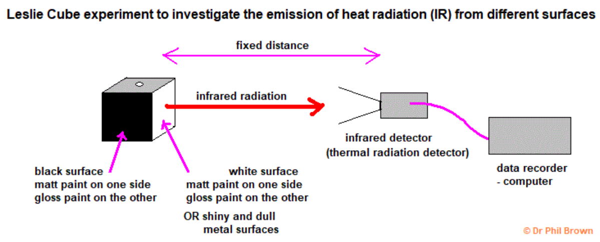
A. Keywords.

Absorb	Take in/soak up.
Electromagnetic radiation	A kind of radiation including visible light, radio waves, gamma rays, and X-rays, in which electric and magnetic fields vary simultaneously.
Emit	Give out.
Frequency	Number of waves passing a point each second. Measured in Hertz (Hz).
Ionising	Type of radiation that converts atoms or molecules into ions, typically by removing one or more electrons.
Medium	Material through which waves travel.
Oscillation	Movement back and forth.
Radiated	Given out in all directions.
Radiation dose	A measure of the risk of harm resulting from an exposure of the body to radiation.
Refraction	When waves change direction as they pass from one medium to another.
Spectrum	Range of things in order.
Transmit	Let through.
Wavelength	Length of one complete wave. Measured in metres.

B. Required practical: Waves

You will investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature (colour or shininess) of that surface.

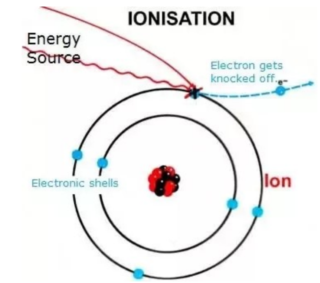
You can use a Leslie cube:



Or you can wrap boiling tubes containing hot water in different materials (different colours or textures) and measure the rate of heat loss.

D. Harmful radiation

UV, X-rays and gamma rays have enough energy to remove electrons from atoms or molecules, turning them into ions This is called ionisation, and it can cause damage to tissue. If DNA is damaged in this way, it can lead to uncontrolled cell division (cancer).



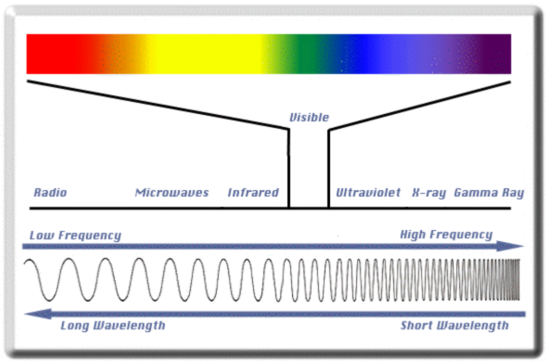
UV also causes skin ageing.

E. Equations

wave speed = frequency x wavelength

[m/s] [Hz] [m]

C. Electromagnetic Spectrum



Electromagnetic waves have many uses: broadcasting (radio waves), satellite communication and cooking (microwaves), electrical heaters, cooking and thermal imaging (infrared), fibre optic communications (visible), sun tanning and energy efficient lamps (UV), medical imaging and treatment (X rays and gamma rays).

Waves Year 11a Combined Higher

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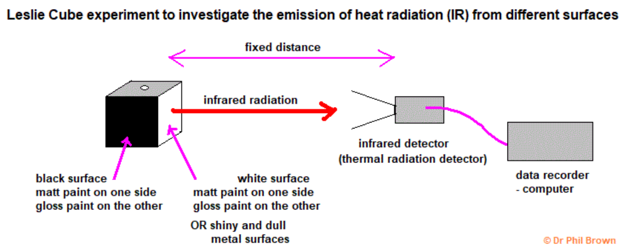

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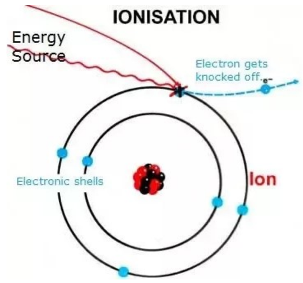

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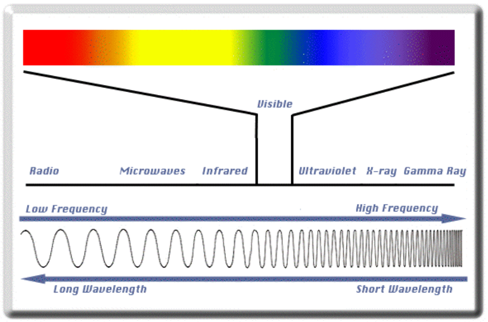

Radio waves are produced by oscillations in electrical circuits.

When radio waves are absorbed, they produce an alternating current with the same frequency as the radio wave itself.

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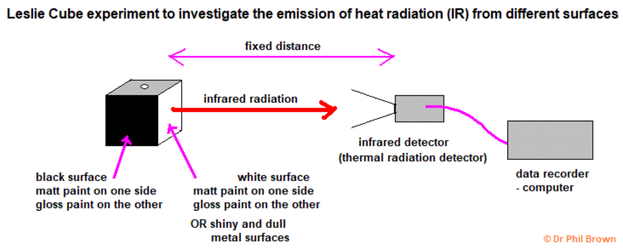

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D. Blackbody radiation

All bodies (objects), no matter what temperature, emit and absorb infrared radiation. The hotter the body, the more infrared radiation it radiates in a given time.

A perfect black body is an object that absorbs all of the radiation incident on it. A black body does not reflect or transmit any radiation. Since a good absorber is also a good emitter, a perfect black body would be the best possible emitter.

E. Equations

wave speed = frequency x wavelength

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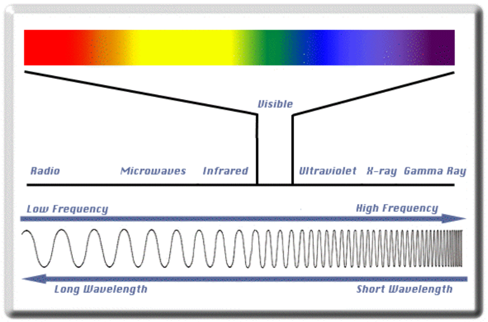

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Magnetism and Electromagnetism Year 11a Higher

A. Keywords.

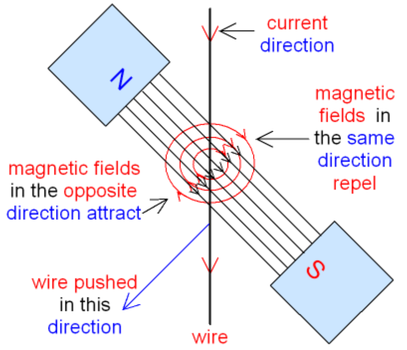
Magnetic poles	The ends of magnets, where they are strongest. Called North and South.
Magnetic field	The area around a magnetic object where another magnetic object will have a force exerted upon it.
Permanent magnet	An object that is always magnetic, and cannot be made non-magnetic.
Current	Rate of flow of negative charge (electrons). Measured in Amperes/ Amps (A).
Conductor	A material that will allow an electric current to flow through it.
Magnetic flux density	A measure of the strength of a magnetic field.

B. Motor effect

This is the force experienced by a current carrying conductor when it is placed in a magnetic field.

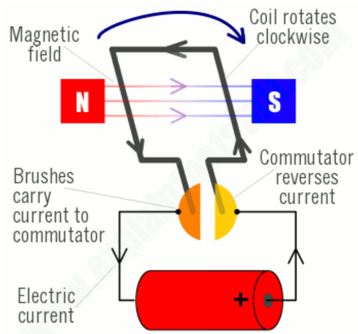
A current carrying wire has it's own magnetics field. When this field overlaps with the magnetic field of a permanent magnet, they will exert forces on each other, and we will see the wire move.

This diagram shows the overlapping magnetic fields of a current carrying wire placed between a north and south pole of 2 magnets.



C. Electric motors

The motor effect is what causes an electric motor to turn.

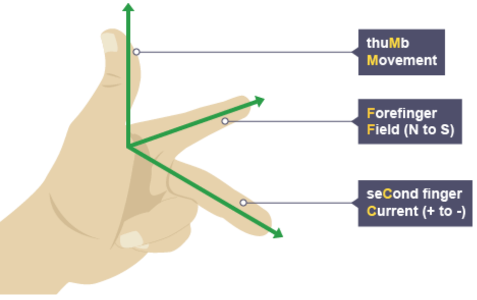


When a current flows through the coil, it generates a magnetic field. This interacts with the magnetic field from the permanent magnets either side of the coil. The forces acting on each side are in opposite directions, causing it to spin.

To make sure that the coil continues to turn, the commutator switches the direction that current flows through the coil every half rotation.

D. Flemming's left hand rule

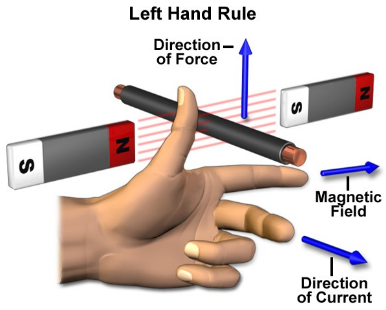
This shows the relationship between the direction of current through the wire, the direction of the magnetic field the wire is in, and the direction the wire moves in. If you know 2 of these, you can work out the 3rd.



You need to remember what each finger shows you.

Using the left hand rule

Work out which 2 fingers you know the direction of. Line your fingers up in those directions, and your hand will tell you the one you are looking for. **You can use this hand shape in your exam.**



The size of the force

The size of the force can be calculated using this formula.

force, F (newtons, N) = magnetic flux density, B (tesla, T) × current, I (amperes, A) × length, l (metres, m)

You are given this equation in the exam. You need to remember what each represents. You can see that the force exerted can be increased by using a stronger magnetic field, higher current, or placing more of the wire into the magnetic field.

The length refers specifically to the length of the wire that is in the magnetic field, **not** the entire length of the wire.

Forces Year 11b Separate

A. Keywords.

Acceleration	Rate of increase of velocity.
Atmosphere	A thin layer or air around the Earth. Atmos = air, sphere = ball. Gets less dense with increasing altitude.
Atmospheric pressure	Force due to air molecules colliding with a surface.
Conservation of momentum	In a closed system, the total momentum before an event is equal to the total momentum after the event.
Density	Amount of mass per unit volume.
Equilibrium	When forces are in balance (clockwise moment = anticlockwise moment.
Fluid	A substance that has no fixed shape and yields easily to external pressure; a gas or (especially) a liquid.
Force	A push or a pull on an object caused by interacting with something . Measured in Newtons.A push or a pull on an object caused by interacting with something . Measured in Newtons.
Gear	A toothed wheel that works with others to alter the relation between the speed of a driving mechanism (such as the engine of a vehicle) and the speed of the driven parts (the wheels).
Lever	A rigid bar resting on a pivot, used to move a heavy load with one end when a force is applied to the other.
Mass	A measure of the amount of matter in an object. Measured in kg.
Moment	Turning effect of a force. Depends on force applied and perpendicular distance from pivot.
Momentum	Mass x velocity. A measure of how hard it is to stop something.
Pressure	Force exerted on a surface per unit area. Depends on size of force and area.
System	Group of objects that interact.
Upthrust	Upwards resultant force caused by greater pressure on the bottom

B. Changing momentum safely

The equations

$F = m \times a$ and $a = \frac{v - u}{t}$

combine to give the equation

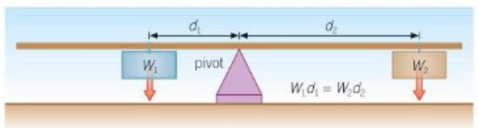
$F = \frac{m \, \Delta v}{\Delta t}$

This equation shows that the greater the time taken for the momentum to change, the smaller the force, for the same change in momentum.

This concept is useful in airbags, seatbelts and crumple zones.

C. The principle of moments

If an object is balanced, the total clockwise moment about a pivot equals the total anticlockwise moment about that pivot.



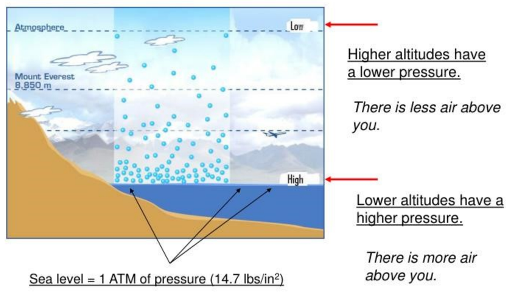
D. Pressure

The pressure in fluids causes a force normal (at right angles) to any surface.

In a liquid, pressure at a point increases with the height of the column of liquid above that point and with the density of the liquid.

Air molecules colliding with a surface create atmospheric pressure.

Atmospheric Pressure



The number of air molecules (and so the weight of air) above a surface decreases as the height of the surface above ground level increases. So as height increases there is always less air above a surface than there is at a lower height. So atmospheric pressure decreases with an increase in height.

E. Equations to learn

moment of a force = force x distance
[Nm] [N] [m]

pressure = $\frac{\text{force [N]}}{\text{area [m}^2\text{]}}$
[Pa]

momentum = mass x velocity
[kg m/s] [kg] [m/s]

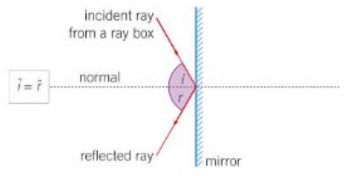
Waves Year 11b Separate Foundation

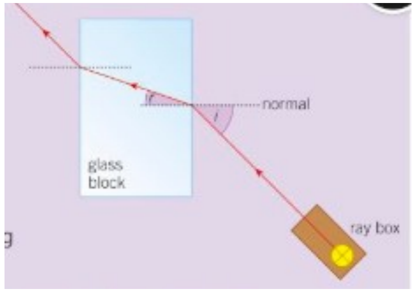
A. Keywords.

Absorb	Soak up/take in.
Concave lens	Lens that makes parallel rays diverge.
Convex lens	Lens that makes parallel rays converge to a focus.
Focal length	The distance between the centre of a lens or curved mirror and the Principal Focus.
Focal point	The point at which rays or waves meet after reflection or refraction, or the point from which diverging rays or waves appear to proceed.
Frequency	Number of waves per second. Measured in Hertz, Hz.
Lens	A piece of glass or other transparent material with curved sides for concentrating or dispersing light .
Longitudinal	Wave in which the vibrations are in the same plane as the direction the energy travels.
Opaque	Object or material that absorbs or reflects all incident light.
Reflection	When waves bounce back without being absorbed.
Refraction	When waves change direction on passing into a more or less dense medium due to a change in speed.
Seismic wave	Earthquake wave.
Translucent	Object or material that transmits light, but scatters it.
Transmit	Let through
Transparent	Object or material that transmits all incident light.
Transverse	Wave in which the vibrations are perpendicular to the direction the energy travels.
Wavelength	Length of one complete wave. Measured in metres.

B. Required practical: Reflection and Refraction

Mirrors will reflect light in a predictable way (specular reflection). Rough surfaces scatter light (diffuse reflection).



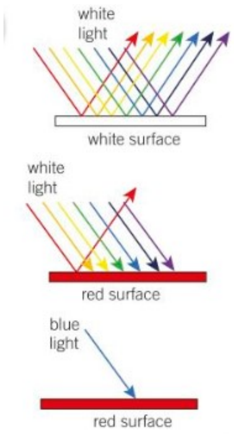


Different materials can be tested using this method. Each one will refract by a different amount depending on density.

D. Colour

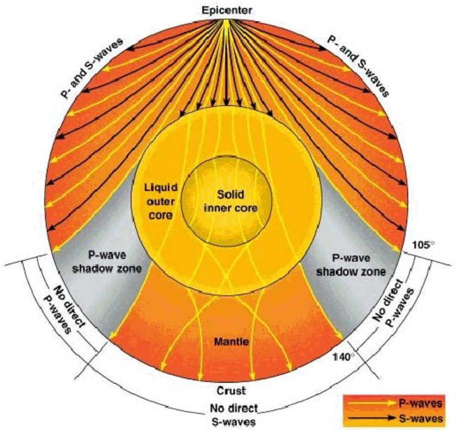
Each colour within the visible light spectrum has its own narrow band of wavelength and frequency.

Colour filters work by absorbing certain wavelengths (and colour) and transmitting other wavelengths (and colour). For example, if white light is directed at a red filter, the filter transmits only red light because it absorbs all the parts of the white light spectrum except for red.



The colour of an opaque object is determined by which wavelengths of light are more strongly reflected.

F. Seismic waves



Seismic waves are produced by earthquakes. P-waves are longitudinal, and travel at different speeds through solids and liquids. S-waves are transverse and cannot travel through a liquid. P-waves and S-waves provide evidence for the structure and size of the Earth's core.

G. Equations

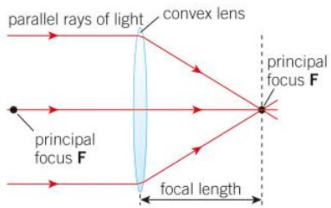
wave speed = frequency x wavelength

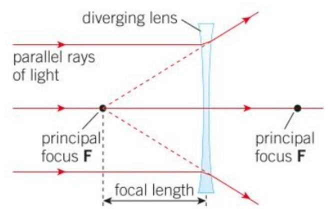
[m/s] [Hz] [m]

$$\text{Magnification} = \frac{\text{image height}}{\text{object height}}$$

D. Lenses

Convex





Concave

Waves Year 11b Separate Higher

A. Keywords.

Absorb	Soak up/take in.
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Convex lens	Lens that makes parallel rays converge to a focus.
Focal length	The distance between the centre of a lens or curved mirror and the Principal Focus.
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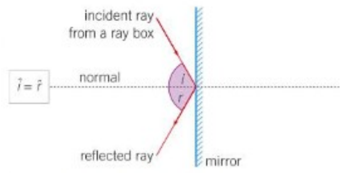
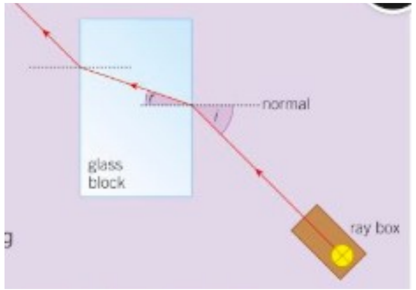
Seismic wave	Earthquake wave.
Translucent	Object or material that transmits light, but scatters it.
Transmit	Let through
Transparent	Object or material that transmits all incident light.
Transverse	Wave in which the vibrations are perpendicular to the direction the energy travels.
Ultrasound	Sound or other vibrations having an ultrasonic frequency (above the range of human hearing).
Wavelength	Length of one complete wave. Measured in metres.

B. Required practical: Reflection and Refraction

Mirrors will reflect light in a predictable way (specular reflection). Rough surfaces scatter light (diffuse reflection).





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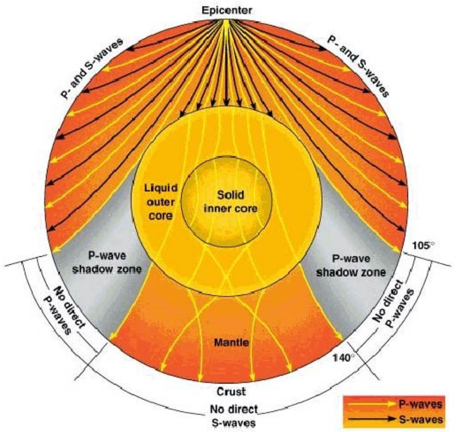
F. Seismic waves



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E. Colour

Each colour within the visible light spectrum has its own narrow band of wavelength and frequency.

Colour filters work by absorbing certain wavelengths (and colour) and transmitting other wavelengths (and colour).

The colour of an opaque object is determined by which wavelengths of light are more strongly reflected.

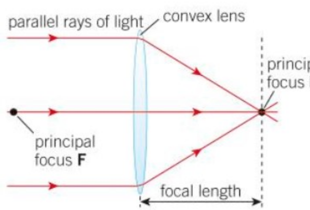
C. Sound waves and ultrasound

Within the ear, sound waves cause the ear drum and other parts to vibrate which causes the sensation of sound. The range of normal human hearing is from 20 Hz to 20 kHz.

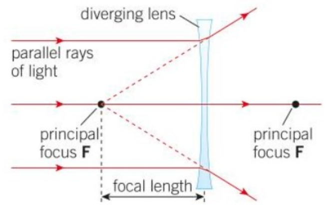
Ultrasound waves are partially reflected when they meet a boundary between two different media. The time taken for the reflections to reach a detector can be used to determine how far away such a boundary is. This allows ultrasound waves to be used for both medical and industrial imaging.

D. Lenses

Convex



Concave



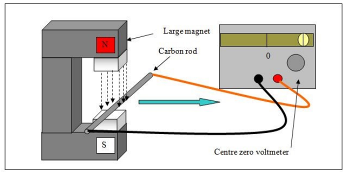
Magnetism and Electromagnetism
Year 11b
Separate Higher

A. Keywords.

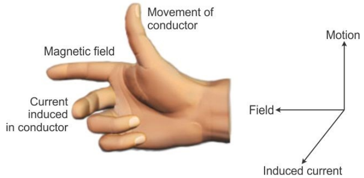
Motor effect	The force experienced by a current carrying conductor when it is placed in a magnetic field.
Alternating Current	Current that continually changes its direction of flow.
Direct current	Current that flows in one direction only through a wire.
Split-ring commutator	Ring connecting a turning coil to a circuit. The split ring has gaps in order to swap the polarity of the ends of the coil every half turn.
Diaphragm	In physics, this is a thin membrane that moves due to changes in air pressure, such as those caused by sound waves.

B. The generator effect

In essence this is the reverse of the **motor effect**. For the generator effect, when a wire (with no current running through it) is passed through a magnetic field, a potential difference is induced across it (electromagnetic induction).



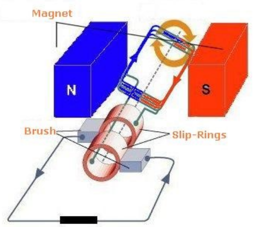
As with the motor effect, we can make predictions using a rule. As it is the reverse of the motor effect, our rule is reversed, and this time we use the **right hand rule**, which is a mirror image of the left hand rule.



C. Generators

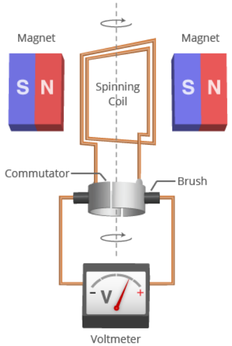
Alternating current (A.C) generators

Generators are used to generate electricity. These are found in power stations. They are a reverse of the electric motor. The coil is forced to rotate within the magnetic field, generating a potential difference across the coil.



Direct Current (D.C) dynamo

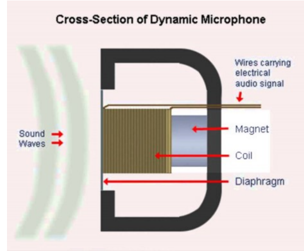
These generators contain a **split ring commutator**, which swaps the connections between the coil and the rest of the circuit every half turn. This results in e **direct current** being generated.



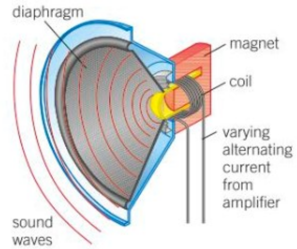
D. Microphones and loud speakers

Microphones use the generator effect to turn sound waves into electrical signals.

As sound waves hit the diaphragm, they cause the coil to vibrate. The coil is wrapped around a magnet, so vibrations generate a potential difference across the coil, inducing an A.C current. The size of the current and the frequency of the direction changes match the amplitude and frequency of the sound wave

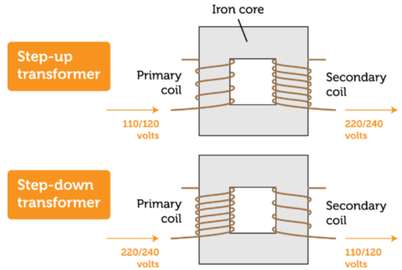


Loudspeakers are the reverse of this, and use the motor effect to transfer electrical signals into sound waves.



E. Transformers

Transformers are devices containing two separate coils of insulated wire wrapped around different parts of the same iron core. The primary coil acts as the input, with a current running through it, generating a magnetic field in the core. **Step-up** transformers have more turns on the **secondary coil**, which increases the output potential difference. **Step-down** transformers are the opposite.



$$\frac{\textbf{potential difference across primary coil, } V_p}{\textbf{potential difference across secondary coil, } V_s} = \frac{\textbf{number of turns on primary coil, } n_p}{\textbf{number of turns on secondary coil, } n_s}$$

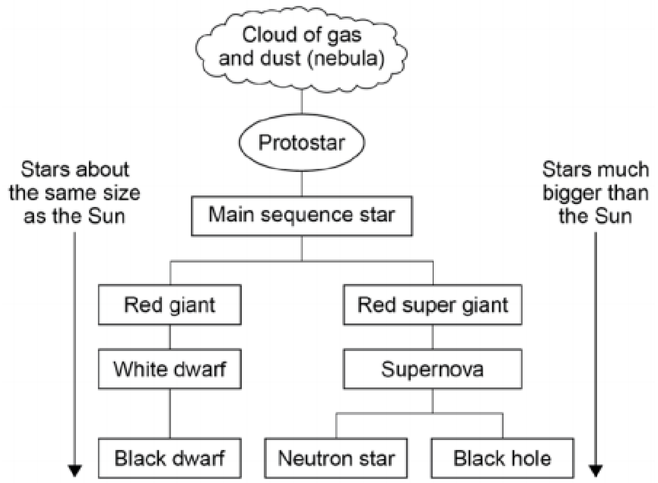
Space Physics Year 11
Separate Foundation

A. Keywords.

Big Bang Theory	The suggestion that the universe expanded from a very small region that was extremely hot and dense
Dwarf planet	A body in orbit around the Sun, that is approximately spherical, is not a satellite of another planet but does not meet other criteria to make it a planet
Fusion	The joining together of two lighter nuclei to form a larger nucleus
Main sequence star	A star during the stable period of its lifetime where the force of gravity pulling the star in are balanced by the outwards force created form the pressure of the fusion reactions are balanced
Milky Way	The name of our galaxy
Nebula	A cloud of gas and dust where new stars are formed
Red - shift	The observed increase in the wavelength of light received from distance galaxies. The further away the galaxy, the faster they are moving away so the bigger the red - shift
Satellite	An object that orbits a star or planet. Can be natural (e.g. the Moon) or man made (e.g. communication satellites)
Sun	The only star in our solar system
Supernova	The explosion of a massive star. This distributes the elements throughout the universe

B. Life cycle of stars

A star goes through a life cycle. The life cycle is determined by the size of the star.



C. Orbital motion, natural and artificial satellites

Gravity provides the force that allows planets and satellites (both natural and artificial) to maintain their circular orbits.

The moon is a natural satellite. Artificial satellites are used for communication or to collect information.

D. Our Solar System

- Within our solar system there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun.
- Natural satellites, the moons that orbit planets, are also part of the solar system.
- Our solar system is a small part of the Milky Way galaxy.
- The Sun was formed from a cloud of dust and gas (nebula) pulled together by gravitational attraction.

E. Red Shift

- There is an observed increase in the wavelength of light from most distant galaxies.
- The further away the galaxies, the faster they are moving and the bigger the observed increase in wavelength. This effect is called red-shift.
- The observed red-shift provides evidence that space itself (the universe) is expanding and supports the Big Bang theory.
- The Big Bang theory suggests that the universe began from a very small region that was extremely hot and dense.
- Since 1998 onwards, observations of supernovae suggest that distant galaxies are receding ever faster.

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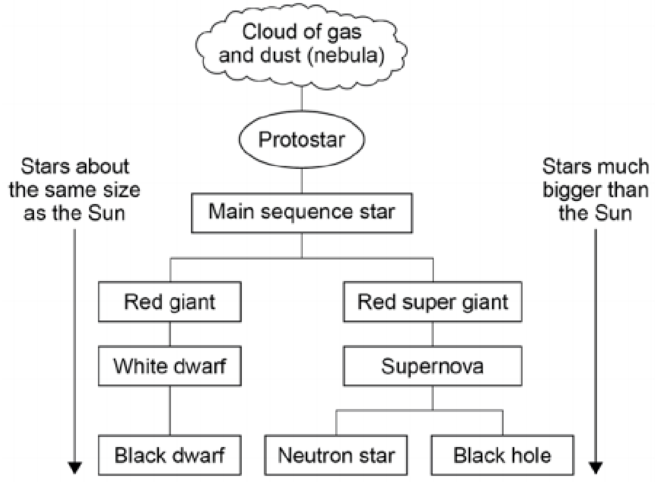

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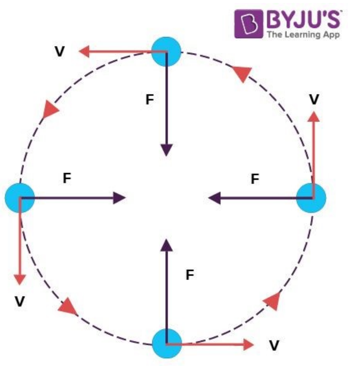

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