KNOWLEDGE ORGANISER GUIDANCE

It is advised that you print the relevant subject knowledge organisers and have them available to you when needed at all times.

An alternative recommendation would be to download the knowledge organisers for your subjects onto your electronic devices so you can access them when needed.

With the knowledge organiser you should make revision cards to help revise and build in time during independent study to test yourself weekly on the content.

While you have independent study, you should use your Knowledge Planner to study the relevant subject's Knowledge Organiser and learn the information provided.

Haggerston School

SIXTH FORM KNOWLEDGE ORGANISER

Physics

2023/2024

Aspiration Creativity Character

Physics

Modules 1 and 2 - Practical Skills & Foundations of Physics

Definitions and Concepts

Absolute Uncertainties	The interval that a value is said to lie within, with a given level of confidence.
Accuracy	A measure of how close a measurement is to the true value.
Analogue Apparatus	Measuring apparatus such as rulers, beakers and thermometers that rely on the experimenter reading off a scale to determine the measurement.
Anomalies	Data points that don't fit the pattern of the data. You should determine why an anomalous result has occurred before removing it. Repeat readings help remove anomalies.
Control Variables	Variables that must remain the same throughout an experiment so as to not affect the results.
Dependent Variables	The variable being measured in an experiment. It is dependent on the independent variable. The dependent variable should be plotted on the y-axis of a graph.
Digital Apparatus	Measuring apparatus such as ammeters, voltmeters and digital calipers that digitally measure and display a measurement.
Fiducial Marker	A thin marker, such as a splint, that is used to ensure readings are taken from the same place each time. They are used to improve the accuracy of measurements.
Gradient	The change in the y-axis value over the change in the x-axis value between two points. If the graph is curved, a tangent can be drawn to calculate the gradient at a specific point.
Independent Variables	The variable that is changed by the experimenter in an experiment. The independent variable should be plotted on the x-axis of a graph.
Line of Best Fit	A line drawn on a graph to demonstrate the pattern in the plotted data points.
Percentage Uncertainties	The uncertainty of a measurement, expressed as a percentage of the recorded value.
Precision	A measure of how close a measurement is to the mean value. It only gives an indication of the magnitude of random errors, not how close data is to the true value.
Prefixes	Added to the front of units to represent a power of ten change.
Random Errors	Unpredictable variation between measurements that leads to a spread of values about the true value. Random error can be reduced by taking repeat measurements.
Repeatable	The same experimenter can repeat a measurement using the same method and equipment and obtain the same value.
Reproducible	An experiment can be repeated by a different experimenter using a different method and different apparatus, and still obtain the same results.
Resolution	The smallest change in a quantity that causes a visible change in the reading that a measuring instrument records.
Resolution of Forces	The splitting of a force into its horizontal and vertical components.
Scalar Quantities	A quantity that only has a magnitude, without an associated direction. Examples include speed, distance and temperature.
SI Units	The standard units used in equations. They are: metres, kilograms, seconds, amps, Kelvin and moles.
Significant Figures	A measure of a measurement's resolution. All numbers except zero are counted as a significant figure. When zeros are found immediately after a decimal place, they too are counted.
Systematic Errors	Causes all readings to differ from the true value by a fixed amount. Systematic error cannot be corrected by repeat readings, instead a different technique or apparatus should be used.
Triangle of Forces	A method of finding the resultant force of two forces. The two forces are joined tip to tail and the result is then the vector that completes the triangle.
Vector Quantities	A quantity that has both a magnitude and an associated direction. Examples include velocity, displacement and acceleration.
Vernier Scales	The type of scale used on calipers and micrometers, that involve reading from a fixed scale and a moving scale to produce accurate measurements.
Zero Errors	A form of systematic error, caused when a measuring instrument doesn't read zero at a value of zero. This results in all measurements being offset by a fixed amount.

Module 3 - Forces and Motion

Chemistry

Definitions and Concepts

3.1: Motion

Acceleration	The rate of change of velocity.
Average Speed	Distance over time for the entire region of interest.
Braking Distance	The distance travelled between the brakes being applied and the vehicle coming to a stop. It is affected by the vehicle and road conditions.
Displacement	The direct distance between an object's starting and ending positions. It is a vector quantity and so has both a direction and a magnitude.
Displacement-Time Graphs	Plots showing how displacement changes over a period of time. The gradient gives the velocity. Curved lines represent an acceleration.
Free-Fall	An object is said to be in free fall when the only force acting on it is the force of gravity.
Instantaneous Speed	The exact speed of an object at a specific given point.
Projectile Motion	The motion of an object that is fired from a point and then upon which only gravity acts. When solving projectile motion problems, it is useful to split the motion into horizontal and vertical components.
Reaction Time	The time taken to process a stimulus and trigger a response to it. It is affected by alcohol, drugs and tiredness.
Stopping Distance	The sum of thinking distance and braking distance for a driven vehicle.
Thinking Distance	The distance travelled in the time it takes for the driver to react. It is affected by alcohol, drugs and tiredness
Velocity-Time Graphs	Plots showing how velocity changes over a period of time. The gradient gives acceleration. Curved lines represent changing acceleration.
Velocity	The rate of change of displacement. It is a vector quantity and so has both a direction and a magnitude.

3.2: Forces in Action

Archimedes' Principle	The upwards force acting on an object submerged in a fluid, is equal to the weight of the fluid it displaces.
Centre of Gravity	The single point through which the object's weight can be said to act.
Centre of Mass	The single point through which all the mass of an object can be said to act.
Couple	Two equal and opposite parallel forces that act on an object through different lines of action. It has the effect of causing a rotation without translation.
Density	The mass per unit volume of a material.
Drag	The frictional force that an object experiences when moving through a fluid.
Equilibrium	For an object to be equilibrium, both the resultant force and resultant moment acting on the object must be equal to zero.
Free-Body Diagram	A diagram showing all the forces acting on an object. It is a good starting point to any mechanics problem.
Friction	The resistive force produced when there is relative movement between two surfaces.
Moment of Force	The product of a force and the perpendicular distance from the line of action of the force to the pivot.
Newton	The unit of force.
Newton's Second Law	The sum of the forces acting on an object is equal to the rate of change of momentum of the object. It is also expressed as the net force acting an object equaling the product of the object's mass and acceleration.
Normal Contact Force	The reaction force between an object and surface.
Pressure	The force that a surface experiences per unit area. It is measured in Pascals (Pa).
Principle of Moments	For an object to be in equilibrium, the sum of the clockwise moments acting about a point must be equal to the sum of the anticlockwise moments acting about the point.

Module 3 - Forces and Motion

Chemistry

Definitions and Concepts

3.2: Forces in Action continued

Tension	The result of two forces acting on an object in opposite, outwards directions.
Terminal Velocity	The maximum velocity of an object that occurs when the resistive and driving forces acting on the object are equal to each other.
Triangle of Forces	A method of determining the resultant force of two forces. The two forces are joined tip to tail and the resultant force is given by the force that would complete the triangle.
Upthrust	The upwards force that a fluid applies on an object.
Weight	The product of an object's mass and the gravitational field strength at its location.

3.3: Work, Energy and Power

Conservation of Energy	In a closed system with no external forces the total energy of the system before an event is equal to the total energy of the system after the event. The energy does not need to be in the same form after the event as it was before the event.
Efficiency	The useful output (e.g. power, energy) of a system divided by the total output.
Gravitational Potential Energy	The energy gained by an object when it is raised by a height in a gravitational field.
Kinetic Energy	The energy an object has due to its motion. It is the amount of energy that would be transferred from the object when it decelerates to rest.
Power	The work done or energy transferred by a system divided by the time taken for that to be done.
Work Done	The energy transferred when a force moves an object over a distance.

3.4: Materials

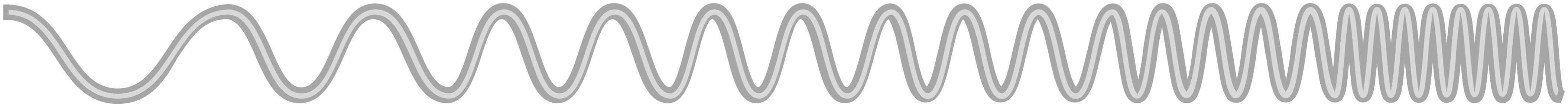
Brittle	A brittle object is one that shows very little strain before reaching its breaking stress.
Compression	The result of two coplanar forces acting into an object. Compression usually results in a reduction in the length of the object.
Compressive Deformation	The changing of an object's shape due to compressive forces.
Ductile	A material is ductile if it can undergo very large extensions without failure. Ductile materials can be stretched into wires.
Elastic Deformation	If a material deforms with elastic behaviour, it will return to its original shape when the deforming forces are removed. The object will not be permanently deformed.
Elastic Potential Energy	The energy stored in an object when it is stretched. It is equal to the work done to stretch the object and can be determined from the area under a force-extension graph.
Extension	The increase of an object's length.
Force-Extension Graph	A plot showing how an object extends as the force applied increases. For an elastic object, the gradient should be linear up to the limit of proportionality. The gradient gives the spring constant.
Hooke's Law	The extension of an elastic object will be directly proportional to the force applied to it up to the object's limit of proportionality.
Plastic Deformation	If a material deforms with plastic behaviour, it will not return to its original shape when the deforming forces are removed. The object will be permanently deformed.
Polymeric	A material made from polymers.
Spring Constant	The constant of proportionality for the extension of a spring under a force. The higher the spring constant, the greater the force needed to achieve a given extension.
Strain	The ratio of an object's extension to its original length. It is a ratio of two lengths and so has no unit.
Stress	The amount of force acting per unit area. Its unit is the Pascal (Pa).
Tensile Deformation	The changing of an object's shape due to tensile forces.
Ultimate Tensile Strength	The maximum stress than an object can withstand before fracture occurs.
Young Modulus	The ratio of stress to strain for a given material. Its unit is the Pascal (Pa).

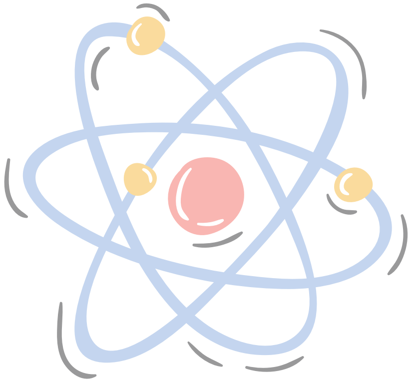
Module 3 - Forces and Motion

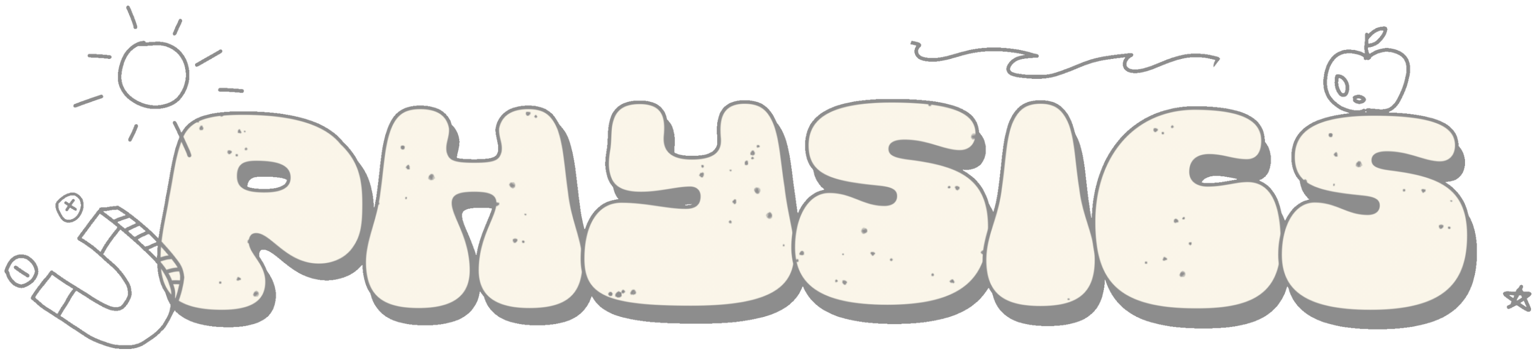
Definitions and Concepts

3.5: Momentum

Conservation of Momentum	The total momentum of a system before an event must be equal to the total momentum of the system after the event, assuming no external forces act.
Elastic Collisions	A collision in which the total kinetic energy of the system before the collision is equal to the total kinetic energy of the system after the collision.
Impulse	The change of momentum of an object when a force acts on it. It is equal to the product of the force acting on the object and the length of time over which it acts.
Inelastic Collisions	A collision in which the total kinetic energy of the system before the collision is not equal to the kinetic energy of the system after the collision.
Linear Momentum	The product of an object's mass and linear velocity.
Newton's First Law	An object will remain in its current state of motion, unless acted on by a resultant force. An object requires a resultant force to be able to accelerate.
Newton's Second Law	The sum of the forces acting on an object is equal to the rate of change of momentum of the object.
Newton's Third Law	Every action has an equal and opposite reaction. If an object exerts a force on another object, then the other object must exert a force back, that is opposite in direction and equal in magnitude.







Chemistry

Module 4 - Electrons, Waves and Photons

Physics

Definitions and Concepts

4.1: Charge and Current

Conductors	A material that allows the flow of electrical charge. Good conductors have a larger amount of free charge carriers to carry a current.
Conservation of Charge	The total charge in a system cannot change.
Conventional Current	The flow from positive to negative, used to describe the direction of current in a circuit.
Coulomb	The unit of charge.
Electric Current	The rate of flow of charge in a circuit.
Electrolytes	Substances that contain ions that when dissolved in a solution, act as charge carriers and allow current to flow.
Electron Flow	The opposite direction to conventional current flow. Electrons flow from negative to positive.
Elementary Charge	The smallest possible charge, equal to the charge of an electron.
Insulators	A material that has no free charge carriers and so doesn't allow the flow of electrical charge.
Kirchhoff's First Law	A consequence of the conservation of charge. The total current entering a junction must equal the total current leaving it.
Mean Drift Velocity	The average velocity of an electron passing through an object. It is proportional to the current, and inversely proportional to the number of charge carriers and the cross-sectional area of the object.
Quantisation of Charge	The idea that charge can only exist in discrete packets of multiples of the elementary charge.
Semiconductors	A material that has the ability to change its number of charge carriers, and so its ability to conduct electricity. Light dependent resistors and thermistors are both examples.

4.2: Energy, Power and Resistance

Diode	A component that allows current through in one direction only. In the correct direction, diodes have a threshold voltage (typically 0.6 V) above which current can flow.
Electromotive Force	The energy supplied by a source per unit charge passing through the source, measured in volts.
Filament Lamp	A bulb consisting of a metal filament, that heats up and glows to produce light. As the filament increases in temperature, its resistance increases since the metal ions vibrate more and make it harder for the charge carriers to pass through.
I-V Characteristics	Plots of current against voltage, that show how different components behave.
Kilowatt-Hour	A unit of electrical energy. It is usually used to measure domestic power consumption.
Light-Dependent Resistor	A light sensitive semiconductor whose resistance increases when light intensity decreases.
Negative Temperature Coefficient Thermistor	
Ohm	The unit of resistance.
Ohmic Conductor	A conductor for which the current flow is directly proportional to the potential difference across it, when under constant physical conditions.
Ohm's Law	The current and potential difference through an ohmic conductor held under constant physical conditions are directly proportional, with the constant of proportionality being resistance.
Potential Difference	The difference in electrical potential between two points in a circuit. It is also the work done per coulomb to move a charge from the lower potential point to the higher potential point. It is measured in Volts.
Power	The rate of energy transfer in a circuit. It can be calculated as the product of the current and the potential difference between two points. It is measured in Watts.

Module 4 - Electrons, Waves and Photons

Physics

Definitions and Concepts

4.2: Energy, Power and Resistance continued

Resistance	A measure of how difficult it is for current to flow through a material.
Resistivity	A measure of how difficult it is for charge to travel through a material. It is proportional to the object's resistance and cross-sectional area, and inversely proportional to the object's length. It is measured in Ohm metres.
Resistor	A device that has a fixed resistance and follows Ohm's law.
Volt	The unit of potential difference.

4.3: Electrical Circuits

Conservation of Energy	Energy cannot be created or destroyed - it can only be transferred into different forms.
Internal Resistance	The resistance to the flow of charge within a source. Internal resistance results in energy being dissipated within the source.
Kirchhoff's Second Law	A consequence of the conservation of energy. The sum of the voltages in any closed loop must equal zero.
Lost Volts	The difference between a source's emf and the terminal voltage. It is equal to the potential difference across the source's internal resistance.
Parallel Circuit	Components are said to be connected in parallel when they are connected across each other (separate loops).
Potential Divider	A method of splitting a potential difference, by connecting two resistors in series. The total potential difference is split in the ratio of their resistances.
Resistors in Parallel	The potential difference across resistors connected in parallel is identical for each resistor. The current is split between the resistors. The total resistance is equal to the inverse of the sum of the inverses of the resistances of the resistors.
Resistors in Series	The current through resistors connected in series is identical for each resistor. The potential difference is split in the ratio of their resistances. The total resistance is equal to the sum of the resistances of the resistors.
Sensor Circuits	A circuit that reacts to external conditions. They commonly involve a semiconductor connected in a potential divider arrangement.
Series Circuit	Components are said to be connected in series when they are connected end to end (in one loop).
Terminal PD	The potential difference across the terminals of a power source. It is equal to the source's emf minus any voltage drop over the source's internal resistance.

4.4: Waves

Amplitude	A wave's maximum displacement from its equilibrium position.
Antinodes	A position of maximum displacement in a stationary wave.
Coherence	Waves with the same frequency and constant phase difference.
Constructive Interference	The type of interference that occurs when two waves meet in phase. The wave amplitudes are superposed.
Critical Angle	The angle of incidence that results in an angle of refraction of exactly 90o . It is when the refracted ray travels along the boundary line.
Destructive Interference	The type of interference that occurs when the two waves are in antiphase. When one wave is at a peak and one is at a trough their addition results in a minimum point.
Diffraction	The spreading of waves as they pass through a gap of a similar magnitude to their wavelength.
Displacement	The distance that a point on a wave is from its equilibrium position.
Electromagnetic Spectrum	The spectrum of electromagnetic waves, consisting of Gamma Rays, X-Rays, Ultraviolet, Visible Light, Infrared, Microwaves and Radiowaves.
Electromagnetic Waves	Waves that consist of perpendicular electric and magnetic oscillations. All electromagnetic waves travel at the speed of light in a vacuum.
Frequency	The number of waves that pass a point in a unit time period. It is the inverse of the time period.

Module 4 - Electrons, Waves and Photons

Definitions and Concepts

4.4: Waves continued

Fundamental Mode of Vibration	The oscillation of a wave at its natural frequency.
Intensity	The power transferred per unit area. It is proportional to the square of a wave's amplitude.
Interference	The superposition of the amplitudes of waves when they meet.
Longitudinal Waves	A wave with oscillations that are parallel to the direction of energy propagation. Sound waves are an example of a longitudinal wave. They cannot travel through a vacuum.
Nodes	A position of minimum displacement in a stationary wave.
Oscilloscope	A device used to display and analyse waveforms.
Path Difference	A measure of how far ahead a wave is compared to another wave, usually expressed in terms of the wavelength.
Period	The time taken for a wave to complete one full cycle.
Phase Difference	The difference in phase between two points on a wave. It is usually expressed in radians.
Polarisation	The restriction of a wave so that it can only oscillate in a single plane. This can only occur for transverse waves.
Progressive Waves	Waves that transfer energy from one point to another without a transfer of matter.
Reflection	The bouncing of a wave at a boundary. The angle of incidence will equal to the angle of reflection.
Refraction	The changing of speed of a wave as it passes into a new medium. If it passes into an optically denser medium, it will slow down.
Refractive Index	A material property that is equal to the ratio between the speed of light in a vacuum, and the speed of light in a given material.
Stationary Wave	A wave that stores, but does not transfer, energy.
Superposition	When two waves meet at the same point in space their displacements combine and the total displacement at that point becomes the sum of the individual displacements at that point.
Total Internal Reflection	An effect that occurs in optical fibres, where full reflection occurs at the inside boundary of the fibre, meaning no radiation passes out. The angle of incidence must be greater than the critical angle for this to occur.
Transverse Waves	A wave with oscillations that are perpendicular to the direction of energy propagation. Electromagnetic waves are examples of transverse waves.
Wave Speed	The product of a wave's frequency and wavelength.
Wavelength	The distance between two identical positions on two adjacent waves. It is commonly measured from peak to peak or trough to trough.
Young Double-Slit Experiment	An experiment that demonstrates the diffraction of light by passing monochromatic light across two narrow slits and observing the resulting pattern of bright and dark fringes.

Physics

Physics

Module 5 - Newtonian World and Astrophysics

Definitions and Concepts

5.1: Thermal Physics

Absolute Temperature	A temperature value relative to absolute zero.
Absolute Zero	The lowest possible temperature of a system, where no heat remains and the particles in the system have no kinetic energy.
Avogadro Constant	The number of particles that make up one mole of any gas.
Boltzmann Constant	A constant relating the average kinetic energy of the particles in a gas, to the gas' temperature.
Boyle's Law	The pressure of an ideal gas is inversely proportional to its volume when held at constant temperature.
Brownian Motion	The random motion of particles.
Change of Phase	The transitions between solids, liquids and gases. During a change of phase, there is a change of internal energy but not temperature.
Equation of State of an Ideal Gas	An equation linking pressure, volume, number of moles, temperature and the ideal gas constant.
Gas	A phase of matter in which the particles are high energy and free to move. Gases will fill the space they are placed in.
Internal Energy	The sum of the randomly distributed kinetic and potential energies of the particles in a given system.
Kelvin	The unit of absolute temperature.
Liquid	A phase of matter in which the particles can slide over each other, but still have forces of attraction between each other.
Solid	A phase of matter in which the particles can only vibrate about fixed positions, due to strong intermolecular forces.
Specific Heat Capacity	The amount of energy required to increase the temperature of 1kg of a substance by 1 Kelvin.
Specific Latent Heat:	The amount of energy required to change the state of 1kg of a substance without a change of temperature.
Thermal Equilibrium	A stable state in which there is no thermal heat transfer between two regions.

5.2: Circular Motion

Angular Velocity	An object's rate of change of angular position.
Centripetal Acceleration	The acceleration of an object moving in circular motion. Any object in circular motion must have an acceleration since the direction of the object, and therefore the velocity of the object, is constantly changing.
Centripetal Force	The resultant force responsible for an object moving in circular motion. Centripetal forces always act towards the centre of the object's rotation.
Frequency	The inverse of time period. The number of rotations per unit time.
Period	The time taken for one whole rotation.
Radian	unit of angle, where 2π equal to one complete angular rotation.

5.3: Oscillations

Angular Frequency	A measure of an object's angular displacement per unit time.
Critical Damping	The form of damping that reduces the displacement of an oscillating object to its equilibrium position in the quickest time possible and without further oscillation.
Damping	The dissipation of energy from an oscillating system. The consequence is that the amplitude of oscillation will decrease. Damping occurs when a force opposes the system's motion.
Forced Oscillations	Repeated up and down oscillations, at the frequency of a driver. The amplitude of oscillation is small at high frequencies and large at low frequencies.
Free Oscillations	Oscillations that are not caused by a driver. An object will naturally oscillate at its natural frequency.
Isochronous Oscillator	An oscillator whose frequency is independent to amplitude.
Natural Frequency	The frequency that a system naturally oscillates at when there is no driving force.

Physics

Module 5 - Newtonian World and Astrophysics

Definitions and Concepts

5.3: Oscillations continued

Overdamping	A type of damping where the system is damped more than required to stop the oscillations. It takes longer for the system to return to equilibrium than for critical damping.
Resonance	Resonance occurs when the frequency of oscillations is equal to the natural frequency of the oscillating system. The rate of energy transfer is at a maximum during resonance.
Simple Harmonic Motion	Motion where the acceleration of an object is directly proportional, and in the opposite direction, to its displacement.
Underdamping	A type of damping where energy is gradually removed from the system and the amplitude of oscillations slowly decreases.

5.4: Gravitational Fields

Escape Velocity	The minimum velocity required by an object to be able to escape a gravitational field of a mass when projected vertically from its surface.
Field Lines	A line representing the path that a mass would take when placed within the field.
Geostationary Satellite	A satellite that orbits above the equator with a 24 hour period, so it will always remain above the same position on the Earth. They orbit approximately 36,000km above the surface of the Earth.
Gravitational Field Strength	The force per unit mass exerted on a small test mass placed within the field.
Gravitational Field	A region surrounding a mass in which any other object with mass will experience an attractive force.
Gravitational Potential Energy	The component of an object's energy due to its position in a gravitational field.
Gravitational Potential	The work done per unit mass required to move a small test mass from infinity to that point.
Kepler's First Law	All planets travel in elliptical orbits, centred around the sun.
Kepler's Second Law	All planets sweep out the same area in a given period of time.
Kepler's Third Law	The square of a planet's period is directly proportional to the cube of its mean distance to the sun.
Newton's Law of Gravitation	The force between two masses is proportional to the product of the masses involved and inversely proportional to the square of the separation of the masses.

5.5: Astrophysics and Cosmology

Absorption Line Spectrum	A spectrum consisting of dark lines at specific frequencies that have been absorbed by the gases present. Elements can only absorb certain energies, and therefore frequencies, of photons.
Astronomical Unit	The mean distance of the earth to the sun.
Big Bang Theory	The theory that the universe originated as a small, dense and hot region that expanded and cooled forming the structures in the universe we see today.
Black Hole	A law stating that the power output (luminosity) of a star is directly proportional to its surface area and its absolute temperature to the 4th power.
Chandrasekhar Limit	The maximum mass that a white dwarf star can have whilst remaining stable.
Comets	Concentrated clusters of ice and dust that travel through space. When near the sun, they begin to melt and so leave a trail as they move.
Continuous Spectrum	A spectrum that covers a full range of frequencies without any gaps. The electromagnetic spectrum is an example of a continuous spectrum.
Cosmological Principle	A principle stating that the universe is isotropic (same in all directions to all observers) and homogenous (matter is distributed evenly).
Dark Energy	An energy that is responsible for the acceleration in the expansion of the universe which cannot be explained by any observable energy.

Definitions and Concepts

5.5: Astrophysics and Cosmology continued

Doppler Effect	The apparent change in the wavelength of a wave as the source moves relative to an observer. For a source moving away the wavelength increases, for a source moving towards the observer the wavelength decreases.
Electron Degeneracy Pressure	The outwards force, resisting the inwards force of gravity, produced as a result of multiple electrons not being able to exist in identical states in an energy level.
Emission Line Spectrum	A series of bright lines at specific frequencies that have been emitted by the gases present. Elements can only release photons of certain energies, and therefore frequencies.
Galaxies	Collections of billions of stars, planets, gases and dust, held together by gravitational attraction.
Hertzsprung-Russell Diagram	A visual representation of the lifecycle of a star. It is a plot of luminosity against temperature.
Hubble's Law	The speed of a galaxy moving away from ours is proportional to its distance away from us. The constant of proportionality is Hubble's constant.
Light-Year	The distance travelled through space by a photon in a year.
Nebula	A cloud of dust and gas in space.
Neutron Star	An incredibly dense star that is formed when the core of a large star collapses. Protons and electrons are forced together under gravity to form neutrons.
Parsec	The distance at which the angle of parallax is 1 arcsecond.
Planet	A body that orbits around a star, in our case, the Sun.
Planetary Satellites	Bodies that orbit a planet. The gravitational force of the planet's mass provides the centripetal force of rotation.
Red-Giant	A stage in the life cycle of a star less than 3 solar masses, in which the hydrogen has run out and the temperature of the star increases. Helium nuclei fuse to form heavier elements.
Solar Systems	A collection of planets that orbit a common star.
Stefan's Law	A law stating that the power output (luminosity) of a star is directly proportional to its surface area and its absolute temperature to the 4th power.
Stellar Parallax	The change in position of an object depending on the viewing angle. It can be used to estimate the distance of a star, based on how much it moves relative to the background of stars in the time it takes for the earth to move half an orbit.
Supernova	When a star greater than 1.4 solar masses dies, the core collapses rapidly inward and becomes rigid. The outer layers then fall inward and rebound off of the core in a shockwave, causing heavy elements to be fused and distributed into space in an explosion.
Universe	The name given to all space and matter.
White Dwarf	A dense star, similar mass to the sun, similar size to the earth. A final stage of a low mass star's life with low luminosity.
Wien's Displacement Law	A law stating that the peak wavelength of emitted radiation is inversely proportional to its absolute temperature.

Module 6 - Particles and Medical Physics

Physics

Definitions and Concepts

6.1: Capacitors

Capacitance	The charge stored per unit pd in a capacitor.
Capacitor	An electrical component that stores charge. A parallel-plate capacitor is made of two parallel conducting plates with an insulator between them (dielectric).
Capacitors in Parallel	When capacitors are connected in parallel, their individual capacitances are summed to give the total capacitance.
Capacitors in Series	When capacitors are connected in series, the total capacitance is equal to the inverse of the sum of the inverses of the individual capacitances.
Energy Stored by a Capacitor	Equal to half the product of the charge stored and the capacitance. This can be found from the area under a charge-voltage graph.
Farad	The unit of capacitance.
Time Constant	The product of the circuit resistance and capacitance. It is the time taken for the voltage to discharge to 1/e (or 36.8%) of its initial charge.
Parallel Plate Capacitor	A capacitor made up of two parallel conducting plates with an insulator between them (dielectric).
Permittivity	A property of an electric field. It relates electric flux density and the electric field strength.

6.2: Electric Fields

Coulomb's Law	The size of the force that acts between two point charges is proportional to the product of their charges and inversely proportional to the square of their separation. It is attractive for opposite charges and repulsive for like charges.
Electric Field Strength	The force per unit positive charge exerted on a charged object placed at that point in the field. This is a vector acting in the same direction as the force on a positive charge.
Electric Field	A region surrounding a charged object which causes a force to be exerted on any charged object placed within the field.
Electric Potential Energy	The work done on a positive charge in bringing it from infinity to that point in the field. It is proportional to the product of the two charges and inversely proportional to their separation.
Electric Potential	The work done per unit charge on a positive test charge in bringing it from infinity to that point in the field.
Field Lines	Lines that demonstrate the direction in which a positive charge would feel if placed at that point in the field.

6.3: Electromagnetism

Faraday's Law	The magnitude of the induced EMF is directly proportional to the rate of change of magnetic flux linkage.
Field Lines	Lines that show the direction in which a magnetic North monopole would experience a force if placed at that point in a field. Magnetic field lines point from North to South.
Fleming's Left-Hand Rule	The relative direction of motion, field direction and current direction in the motor effect can be represented by the thumb, first finger and second finger of the left hand respectively. For the motion of a charged particle in a magnetic field, its direction replaces the current direction.
Force on a Charge Particle	A charged particle moving through a magnetic field will experience force equal to the product of the charge, its velocity and the magnetic flux density.
Force on a Current-Carrying Conductor	A current-carrying conductor will experience a force when placed in a magnetic field. The direction of the force can be determined using Fleming's left-hand rule.
Lenz's Law	The direction of an induced current is such that it opposes the current that created it.
Magnetic Field	A region of space in which magnetic materials and moving electric charges feel a force.
Magnetic Flux Density	The force per unit current per unit length on a current-carrying wire placed at 90° to the field lines. Sometimes also referred to as the magnetic field strength.
Magnetic Flux Linkage	The magnetic flux multiplied by the number of turns, N, of the coil.

Module 6 - Particles and Medical Physics

Physics

Definitions and Concepts

6.3: Electromagnetism continued

Magnetic Flux	A value which describes the magnetic field or field lines passing through an area. It is the product of magnetic flux density and the perpendicular area it passes through.
Tesla	The unit of magnetic flux density.
Transformer	A device used to increase or decrease the voltage with two sets of coils with different numbers of turns wrapped around a magnetic core. The transformer is step-up if the number of coils on the secondary coil is greater than the number on the primary coil. The transformer is step-down if the number of coils on the secondary coil is fewer than the number on the primary coil.
Velocity Selector	A combination of a magnetic field and an electric field, which results in charges passing through and leaving with a specific velocity.
Weber	The unit of magnetic flux.

6.4: Nuclear and Particle Physics

Activity	The rate of decay of the radioactive nuclei in a given isotope. It is proportional to the total number of nuclei in the sample and is measured in Becquerels.
Alpha Particles	A type of particle consisting of two protons and two neutrons. Alpha particles are emitted in alpha decay and are strongly ionising, but weakly penetrating.
Alpha-Scattering	An experiment that involved firing alpha particles at a thin gold foil and detecting their subsequent motion. It provided evidence for the currently accepted model of the atom.
Annihilation	The process of a particle and its antiparticle colliding and being converted into energy. The energy is released in two photons to conserve momentum.
Antiparticles	All particles have a corresponding antiparticle with the same mass but opposite charge and conservation numbers.
Beta Particles	An electron or positron. Beta particles are emitted during beta decay and have medium ionising and penetrating capabilities.
Beta-Minus Decay	The process of a proton inside a nucleus turning into a neutron, and emitting a beta-minus particle (an electron) and a neutrino.
Beta-Plus Decay	The process of a neutron inside a nucleus turning into a protron, and emitting a beta-plus particle (a positron) and a neutrino.
Binding Energy	The amount of energy required to split a nucleus into all its separate constituent nucleons. It is equivalent to the mass defect.
Chain Reaction	The process of the neutrons released by a fission reaction inducing further fissile nuclei to undergo fission.
Control Rods	Rods found in nuclear reactors to absorb neutrons and control the rate of reaction. They can be raised or lowered depending on the rate required.
Decay Constant	The probability of decay in a unit time.
Einstein's Mass-Energy Equivalence	Mass and energy are equivalent, with the energy equivalent of a given mass being equal to the product of the mass and the speed of light squared.
Electron	A negatively charged fundamental particle that is found in energy levels surrounding a nucleus.
Gamma Rays	A type of radiation emitted in gamma decay. Gamma rays are weakly ionising but very strongly penetrating.
Hadrons	A class of subatomic particle that experiences the strong nuclear interaction.
Half-Life	The average time it takes for the number of radioactive nuclei in a sample of an isotope to halve.
Isotopes	A form of an element with the same number of protons but different numbers of neutrons.
Leptons	A group of elementary subatomic particles, consisting of electrons, muons and neutrinos.
Mass Defect	The difference in mass between a nucleus and the sum of the masses of its constituent nucleons.
Moderator	A material in nuclear reactors that absorbs energy from fast moving neutrons, to slow them down to speeds that can be absorbed by fissile neutrons to induce fission.

Physics

Module 6 - Particles and Medical Physics

Definitions and Concepts

6.4: Nuclear and Particle Physics continued

Neutron	A neutrally charged nucleon, found in the nucleus of an atom. Neutrons are a form of hadron.
Nuclear Fission	The splitting a nucleus, to form two smaller daughter nuclei, neutrons and energy.
Nuclear Fusion	The joining of two smaller nuclei to form a larger nucleus and to release energy.
Nucleon Number	The sum of the number of protons and neutrons in a given nucleus.
Positron	A positively charged particle that is the antiparticle of an electron.
Proton Number	The number of protons present in the nucleus of a given element.
Proton	A positively charged nucleon, found in the nucleus of an atom. Protons are a form of hadron.
Quarks	Fundamental particle that interacts with other quarks via the strong interaction. They change flavour via the weak interaction and annihilate with antiquarks to form photons via the electromagnetic interaction.
Radioactive Dating	The use of radioactive isotopes with known half-lives to date objects. The isotope that is usually used is Carbon-14.
Random Nature of Decay	Radioactive decay is random - you cannot predict when a nucleus will decay or which nucleus will decay next.
Strong Nuclear Force	A force that acts between nucleons in a nucleus to keep it stable. It is attractive at distances of up to 3fm and repulsive at separations less than 0.5fm.

6.5: Medical Imaging

A-Scan	A method of scanning tissue that involves placing an ultrasound emitting transducer on the surface of the body, and then measuring reflections of emitted pulses. A-Scans are used to measure the foetal head size during pregnancy.
Acoustic Impedance	The product of the speed of sound through a given medium, and the density of the medium.
Anode	A positively charged electrode.
Attenuation of X-Rays	The reduction of X-ray intensity as they pass through matter.
B-Scan	A method of scanning tissue, used for more complex structures than A-scans. Instead of the echo signals controlling the y-gain (as in A-scans), they control the brightness of the oscilloscope spot. B-scans are used to determine the placenta's position during pregnancy.
Cathode	A negatively charged electrode.
Compton Effect	The decrease in a photon's energy when it is scattered by a charged particle. This results in a decrease in the photon's frequency and therefore an increase in its wavelength.
Computerised Axial Tomography Scanning	A scanning method that produces a cross section of the body by rotating a monochromatic x-ray beam around it, in combination with a series of detectors. Whilst it produces higher resolution images that ultrasound and is non-invasive, it is highly ionising and costly.
Contrast Media	A contrast medium is a substance that ensures that there is a significant difference between the density of the area being scanned and the rest of the body. Barium is often chosen due to its high proton number. It is consumed by the patient.
Gamma Camera	A type of detector used in PET scanners, consisting of photomultiplier tubes that convert gamma photons into electrical pulses.
Medical Tracers	Gamma emitters that have suitably short half-lives to be ingested into the body, and be detected externally for the duration of a medical process.
Pair Production	The production of a particle and antiparticle pair from a sufficiently high energy photon.
Photoelectric Effect	The emission of electrons from a metal surface when light above a certain frequency is shone on it.
Piezoelectric Effect	An effect shown by crystals like quartz. When a potential difference is applied, the crystal will mechanically deform. Likewise, when the crystal is deformed, a potential difference is produced.
Positron Emission Tomography Scans	A scanning technique that produces cross-sectional and 3D images. It involves a radionuclide being injected into the body, which then releases gamma photons that are detected by the scanning machine.
Simple Scatter	The process of low energy photons scattering off a particle without a change of momentum.
Ultrasound	Sound waves with a frequency higher than the upper-frequency audible to the human ear (20kHz).
X-Ray Tube	An evacuated tube which converts electrical signals into X-rays.

SPaG

Grammar: Write in Sentences

A sentence is a group of words that make sense. Sentences start with a capital letter and end with a full stop, question mark or exclamation mark. All sentences contain clauses. You should try to use a range of sentences when writing. There are three main types of sentences.

Simple sentence: A sentence containing one main clause with a **subject** and a **verb**.
He reads.
Literacy is important.

Compound sentence: Two simple sentences joined with a conjunction. Both of these simple sentences would make sense on their own. Varying conjunctions makes your writing more interesting.
He read his book because **it was written** by his favourite author.
Literacy is important so **students had** an assembly about reading.

Complex sentence: A longer sentence containing a main clause and one or more subordinate clause(s) used to add more detail. The main clause makes sense on its own. However, a subordinate clause would not make sense on its own, it needs the main clause to make sense. The subordinate clause is separated by a comma (s) and/or conjunction. The clause can go at the beginning, middle or end of the sentence.
He read his book even though it was late.
Even though it was late, he read his book.
He read his book, even though it was late, because it was written by his favourite author.

How can you develop your sentences?
1. Start sentences in different ways. For example, you can start sentences with adjectives, adverbs or verbs.
Adjective: Funny books are my favourite!
Adverb: Regularly reading helps me develop a reading habit.
Verb: Looking at the front cover is a good way to choose a reading book.
2. Use a range of **punctuation**.
3. **Nominalisation**
Nominalisation is the noun form of verbs; verbs become concepts rather than actions. Nominalisation is often used in academic writing. For example:
It is important to read because it helps you in lots of ways.
Becomes: Reading is beneficial in many ways.
Germany invaded Poland in 1939. This was the immediate cause of the Second World War breaking out. Becomes: Germany's invasion of Poland in 1939 was the immediate cause of the outbreak of the Second World War.

Connectives and Conjunctions	
Cause And Effect	Because So Consequently Therefore Thus
Addition	And Also In addition Further (more)
Comparing	Whereas However Similarly Yet As with/ equally/Likewise
Sequencing	Firstly Initially Then Subsequently Finally After
Emphasis	Importantly Significantly In particular Indeed
Subordinate	Who, despite, until, if, while, as, although, even though, that, which

Literacy Knowledge Organiser

SPaG: Spelling and Punctuation

Punctuation

Use a range of punctuation accurately when you are writing.

. Full stop Marks the end of a sentence.

, Comma Separates the items on a list or the clauses in a sentence.

' Apostrophe Shows possession (belonging) or omission (letters tak en away).

" " Quotation marks Indicate a quotation or speech.

' ' Inverted commas Indicate a title.

? Question mark Used at the end of a sentence that asks a question.

! Exclamation mark Used at the end of a sentence to show surprise or shock.

: Colon Used to introduce a list or an explanation/ elaboration/ answer to what preceded. A capital letter is only needed after a colon if you are writing a proper noun (name of person or place) or two or more sentences.

; Semi-colon Joins two closely related clauses that could stand alone as sentences. Also used to separate items on a complicated list. A capital letter is not needed after a semi-colon unless you are writing a proper noun (name of person or place).

Brackets Used to add extra information which is not essential in the sentence.

Spelling

Use the following strategies to help you spell tricky words.

1. Break it into sounds (d-i-a-r-y)
2. Break it into syllables (re-mem-ber)
3. Break it into affixes (dis + satisfy)
4. Use a mnemonic (necessary – one collar, two sleeves)
5. Refer to word in the same family (muscle – muscular)
6. Say it as it sounds – spell speak (Wed-nes day)
7. Words within words (Parliament – I AM parliament)
8. Refer to etymology (bi + cycle = two + wheels)
9. Use analogy (bright, light, night, etc)
10. Use a key word to remember a spelling rule (horrible/drinkable for -ible & -able / advice/advise for -ice & -ise)
11. Apply spelling rules (writing, written)
12. Learn by sight (look-cover-say-write check)