Long-term planning

GCSE Physics - Year 10 & Year 11

Year 10 GCSE Physics	Autumn term 1	Autumn term 2	Spring term 1	Spring term 2	Summer term 1	Summer term 2
	Students will know that					
Static electricity and electrical circuits **Electricity in the home** **Molecules and matter** **Radioactivity** **Forces and motion**	Atoms consist of protons neutrons and electrons and be able to state their respective charges. When insulators are rubbed together electrons are transferred from one to another, leaving the insulators with equal and opposite charges. Charged objects exert a force on each other due to an electric field. An electric field around a charged object. Like charges repel and like charges attract. Electric current is a flow of electrons. Electrons flow in a closed circuit due to a force from the interaction with an electric field. $\frac{Charge\ (C)}{Time\ (s)} = Current\ (A)$ Symbols can be used to represent components in circuits. Potential difference (V), current (A) and Resistance (Ω) are related by the following equation: Potential difference = current x resistance.	Current and potential difference behave differently in series and parallel circuits. Resistors in series affect the total resistance of the circuit differently to those in parallel. The differences between alternating and direct current. Alternating current is used throughout mains circuits in the UK. DC current only comes from batteries. The national grid is the UK distribution network with a series of transformers and cables. Step up transformers are used to increase potential difference and decrease current. Step down transformers are used to decrease potential difference and increase current. The national grid is an efficient way to transfer energy. Plugs and sockets contain 3 wires. We use a variety of safety features in our electrical circuits at home. Short circuits can be dangerous. The Earth wire prevents harm from short circuits.	Density = mass/volume. Matter exists in three states. Particles are arranged differently in solids liquids and gases. The kinetic energy of particles depends on their temperature. When substances change state (melt, freeze, boil, evaporate, condense or sublimate), mass is conserved. Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up a system. Forces of attraction between particles are different in different states of matter. Energy needed to change the state of 1kg of matter from solid to liquid is called the specific latent heat of fusion. Energy needed to change the state of 1kg of matter from solid to liquid is called the specific latent heat of vaporisation. Gas exerts a pressure on a surface.	Atoms consist of protons, electrons and neutrons and know their locations in the atom. The model of the atom has changed over time. Atoms are very small. Atoms that have lost or gained electrons become ions. Isotopes are atoms of the same element with different number of neutrons. Mass number represents the number of neutrons and protons in the nucleus. The atomic number represents the number of protons in the nucleus. Radioactive decay is a random process. Alpha, Beta and Gamma radiation are ionising. Ionising radiation can be dangerous to living things. Neutron radiation is non ionising. The activity of a radioactive sample can be measured by a Geiger counter. Activity of a substance is the number of unstable nuclei that decay per second. The half-life is the time taken for a radioactive sample to	Vector quantities have direction and magnitude, and can be represented by a scale arrow but scalar only have magnitude. Forces are interactions between objects. Forces can be contact or non-contact. Newton's third law applies to all force interactions between objects. Multiple forces can be replaced with one single resultant force. Newton's first law states if the resultant force on an object is zero then there is no change to its velocity. Multiple forces can be represented on free body force diagrams. Levers can be used to provide greater turning force (moment/torque) around a pivot. Moment = Force x distance. Levers and gears are known as force multipliers. The centre of mass of an object is the point at which its mass can be thought of being concentrated. Vector diagrams can be used to resolve two forces into one resultant force.	Speed is a scalar, and velocity is a vector quantity. Speed = distance/time Velocity = displacement/time Displacement/distance-time graphs can be used to track an objects movement. Acceleration = change in velocity/time taken. Speed/velocity-time graphs can be used to track an objects movement. The following are average speeds: walking- 1.5 m/s running- 3 m/s cycling- 6 m/s. Sound in air 330m/s Inertial mass = Force/acceleration. Mass of an object refers to the amount of matter it contains. Weight of an object is the force acting on a mass due to gravity. Terminal velocity is the velocity a falling object reaches when there is no resultant force acting upon it.

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	There is various components that act as resistors and some of these are affected by outside factors.	All electrical appliances are sold with an efficiency rating. Efficiency = output power/input power x 100%. Power = current x potential difference.	Temperature of a gas can affects its pressure. Random movement of gas particles is called Brownian motion. How gas pressure can affect its volume and vice versa. Pressure x volume of a gas is always constant (Boyle's law). Work done increasing the pressure on a gas can increase temperature. The unit of pressure is Pascals.	decrease its mass/count rate by half. Radiation emitted from unstable nuclei is used in nuclear medicine. Ionising radiation from substances in the environment is called background radiation. Background radiation poses very little health risk to humans. Nuclear medicine uses ionising radiation in different ways. Irradiation is the exposure to radiation whereas contamination is when radioactive substances are in/on the object. Nuclear fission is the splitting of one large nucleus into two daughter nuclei. Nuclear fusion is the fusing of two lighter nuclei into one heavier one. Nuclear fission is used to generate electricity. Nuclear fusion happens in stars. Using Ionising radiation and radiation in the environment can be dangerous.	A single force can be resolved into two component forces at right angles to each other using vector diagrams.	
	Students will know how to					
	Explain how two insulators become charged. **WS 1.2**	Calculate the total resistance in series and parallel circuits. **MS 1c, 3b, 3c, 3d**	Apply and rearrange **MS 1a, b, c, 3b, c**	Compare historical models of the atom. **WS 3.8, WS 1.1, WS 1.2**	Apply Newton's third law to a variety of situations. **WS 1.2**	Carry out an experiment to calculate average speed. **MS 1a, c, 2f**

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	Explain the interaction of charged particles. **WS 1.2** Apply and rearrange Charge = current x time **MS 3b, c** $[\ Q\ = I\ t\ ]$ Construct and interpret circuit diagrams. **WS 1.2** Construct basic electrical circuits. **AT6, 7** Apply and rearrange **MS 3b, c** potential difference = current x voltage. $[\ V\ = I\ R\ ]$ **(Required practical 4)** Construct circuits in order to collect data that allows the relationship between current and potential difference to be plotted. **AT6, AT7, Multiple WS and MS.** **(Required practical 3)** Construct circuits in order to collect data that allows the relationship between resistance and wire length to be plotted. Plot graphs showing the resistance characteristics for a range of electrical components. **AT1, AT6, AT7, Multiple WS and MS.**	Explain the design and use of DC series circuits for measurement and testing purposes. **WS 1.4** Label the parts and wires of a plug and physically wire it. **WS 1.5, WS2.4** Apply and rearrange **MS 3b, c, WS 1.4, W S4.5.** Power = energy/time Power = current x potential difference Power = current^2 x resistance Charge = current x time Energy = potential difference x charge Energy = current x time x potential difference. Compare energy efficiency ratings. **WS 3.5**	$density = \frac{mass}{volume}$ $[\ \rho = \frac{m}{V}\ ]$ **(Required practical 5)** Use appropriate apparatus to make and record the measurements needed to determine the densities of regular and irregular solid objects and liquids. **AT 1, Multiple WS and MS.** Compare and contrast the kinetic theory of different states of matter. **WS 1.2** Use and interpret a temperature time graph to find the melting/boiling point of a substance. **WS 3.2** Explain changes of state referencing forces of attraction and kinetic theory.**WS 4.1** Explain gas pressure using kinetic theory. **WS1.2, WS4.1** Apply and rearrange **MS 1a, 3b, c, d** Energy for a change in state = mass x specific latent heat $[\ E\ = m\ L\ ]$ Conduct experiments to measure the specific latent heat of fusion/vaporisation. **MS 4a, AT5** See random movement of gas molecules. **WS1.2**	Compare the scale of atomic structure. **MS 1b, WS 4.4** Compare alpha, beta, neutron and gamma radiation and the effect they have on the emitting nucleus. Also, their ionising and penetration properties and their suitability for certain uses. **WS 1.4, WS 1.5** Balance nuclear equations. **WS 1.2, 4.1, MS 1b, c, 3c** Use graphs to calculate half-life. Calculate activity using half-life. **MS 4a, WS 3.5, Ms 1b** Convert from sieverts to milli-sieverts. **WS 4.4** Explain and compare hazards from a range of situations involving radioactive decay. **WS 1.5, WS 1.6**	How to construct free body force diagrams. **WS 1.2** Apply and rearrange **MS 3c** moment = force x distance from the pivot $[\ M\ =\ F\ d\ ]$ and apply them to equilibrium situations. **MS 3c** Represent vector quantities on a scale diagram. **MS 4a, 5a, b**	Apply and rearrange. **MS 3b, c** Distance travelled = speed x time $[\ s\ = v\ t\ ]$ Plot and analyse displacement/distance-time graphs. **MS 4a, b, c, d, f** Apply and rearrange. **MS 1d, 3b, 3c** Acceleration = change in velocity / time $[\ a\ = \frac{\Delta v}{t}\ ]$ Plot and analyse speed/velocity-time graphs. **MS 4a, b, c, d, f, WS 3.3** Apply and rearrange. **MS 3b, 3c** $[\ v^2\ -\ u^2\ = 2\ a\ s\ ]$ Apply and rearrange. **MS 3a, b, c, WS 4.2** Force = mass x acceleration $F\ = m\ a$ Apply and rearrange **MS 3b,c** Weight = mass x gravity $[\ W\ = m\ g\ ]$ **(Required practical 7)** Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force.

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			Apply Boyle's law. **M 3b, c**			**AT 1, 2 and 3. Multiple WS and MS.**
	Vocabulary and the concepts they link to					
	Proton Neutron Electron Charge Insulator Repel Attract Interaction Field Current Resistor Ammeter Voltmeter Cell Battery Diode Thermistor Series Parallel	Live wire Neutral wire Earth wire National grid Alternating current Direct current Fuse Power Efficiency Appliance	Density Mass Volume Meniscus Kinetic theory Melt Freeze Condense Vaporise Sublimate Pressure Fusion Exert Pascals	Nucleus Plum pudding Proton Electron Neutron Subatomic Unstable Ionising Radioactive Activity Decay Half-life Contamination Irradiation Fission Fusion	Vector Scalar Resultant Resolve Newton Moment Equilibrium Torque Gears	Acceleration Velocity Displacement
	Assessment					
	Energy recap assessment End of unit test: Electricity Key piece six-mark exam question	End of unit test: Electricity Key piece six-mark exam question	End of unit test: Molecules and matter Key piece six-mark exam question	End of unit test: Radioactivity Key piece six-mark exam question Paper 1 mock	End of unit test: Forces Key piece six-mark exam question	End of unit test: Motion Key piece six-mark exam question
	Diversity & development of cultural capital					
	Electrician and electrical engineering links (college and apprenticeship).	Choosing and purchasing electrical appliances. Readings on energy bills.	Story of the word Eureka and Archimedes. Why things float and sink!	Development of the Universe after the Big Bang. Cancer development.	Gearboxes in cars and bicycle gears. Levers in everyday life.	Tachograph in vehicles. Average speeds of athletes.

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	Lighting in homes and Christmas lights.	Purchasing a home (energy surveys).	Air pressure (balloons, tyres, airplane cabins). Diesel engines. Why bike pumps heat up.	Cancer scans. Cancer treatment. Non-renewable energy. Radon gas survey when buying a house. Blue John mines and their radon gas detectors.	See-saw in the park. Approach vectors and navigation of aircraft and boats.	Students own running speeds.
	Cross-curricular opportunities and enrichment					
	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures, interpreting and drawing graphs). Electronics (circuit diagrams and components).	IDP household bills.	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures, standard form and volumes of regular shapes). Chemistry (Solids, liquids and gases, bonding and Brownian motion)	Maths (graph skills). Chemistry (atomic structure), Biology (cancer development, cancer treatment and scans) Geography (Non-renewable energy resources, environmental disasters and pollution). History (Second world war and the cold war)	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures, standard form and symmetry)	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures, interpreting and drawing graphs).

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Year 11 GCSE Physics Themes	Autumn term 1	Autumn term 2	Spring term 1	Spring term 2	Summer term 1	Summer term 2
Forces and motion **Wave properties** **Electromagnetic waves** **Light** **Electromagnetism** **Space**	**Students will know that**					
	Vector quantities have direction and magnitude, and can be represented by a scale arrow but scalar only have magnitude. Forces are interactions between objects. Forces can be contact or non-contact. Newton's third law applies to all force interactions between objects. Multiple forces can be replaced with one single resultant force. Newton's first law states if the resultant force on an object is zero then there is no change to its velocity. Multiple forces can be represented on free body force diagrams. Levers can be used to provide greater turning force (moment/torque) around a pivot. Moment = Force x distance. Levers and gears are known as force multipliers.	Speed is a scalar, and velocity is a vector quantity. Speed = distance/time Velocity = displacement/time Displacement/distance-time graphs can be used to track an objects movement. Acceleration = change in velocity/time taken. Speed/velocity-time graphs can be used to track an objects movement. Newton's second law states that force = mass x acceleration. Inertial mass = Force/acceleration. Mass of an object refers to the amount of matter it contains. Weight of an object is the force acting on a mass due to gravity. Terminal velocity is the velocity a falling object reaches when there is no resultant force acting upon it. Braking distance + thinking distance = stopping distance. Typical human reaction time is 0.2-0.9s. Large decelerations can be dangerous. Momentum = mass x velocity. Momentum is conserved in collisions (closed system).	Pressure is measured in pascals. Pressure = force/area. Pressure in a column of liquid depends on depth. The atmosphere exerts pressure on surfaces which is dependent on altitude. Objects in a fluid will be subject to a force called upthrust. The density of the object and the upthrust it is subject to in a fluid are the deciding factors of whether it floats or sinks. Waves are a transfer of energy, not matter. Waves are longitudinal or transverse. All waves have specific parts and properties. Period = 1/frequency. Wave speed = frequency x wavelength. Refraction occurs as waves enter new mediums. Reflection occurs as waves meet the boundary of a new medium. Human hearing range is 20-20K Hz.	Electromagnetic waves are transverse waves that all travel at the speed of light in a vacuum. Electromagnetic waves have different properties, uses and dangers dependent on their frequency and wavelength. Different electromagnetic waves are produced in a variety of ways. Some electromagnetic radiation is ionising. Visible light can be reflected at surfaces following the law of reflection. Smooth and bumpy surfaces produce different reflected images. Refraction causes light to disperse through a prism shaped object. Different colours of light combine with different effects. The colour of objects depends on the light they absorb/reflect. Lenses use refraction to focus an image. Lenses can be used to correct eye defects. Magnets can attract or repel each other.	The Solar system consists of planets and other bodies that were formed from a supernova. Gravity acts as centripetal force to keep bodies in orbit. Earths satellites orbits are different depending on their designated purpose. Red-shift is when light from distant galaxies has had its wavelength stretched. Red-shift provides evidence for the expansion of the Universe and therefore the Big Bang theory. Red-shift allows to calculate age and distance of distant galaxies. Cosmic microwave background radiation can be explained by the Big Bang. The Big Bang theory has more credible evidence than other theories. Stars of different sizes have different life-cycles. A bodies orbit will depend on its speed. An orbiting body's velocity is constantly changing.	GCSE PREPERATION AND EXAMS

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	The centre of mass of an object is the point at which its mass can be thought of being concentrated. Vector diagrams can be used to resolve two forces into one resultant force. A single force can be resolved into two component forces at right angles to each other using vector diagrams.	The rate of change of momentum during collisions is equal to the force on the objects. Safety features that increase the time momentum changes over reduce impact forces. Elastic materials return to their original shape after the forces are removed. Force applied = spring constant x extension	Infrasound is below 20Hz and ultrasound is above 20kHz. Ultrasound is used in medical scanning and echo sounding. We can track seismic waves through the Earth to identify its internal structure.	Magnets can attract magnetic materials. Magnets are surround by a magnetic field. Magnetic fields can be induced in magnetic materials. Electric currents produce magnetic fields. A solenoid is a coil of wire with a current passing through it. A current carrying wire in an magnetic field is subject to a force. A moving magnetic field inside a wire or a wire moving inside a magnetic field induces a current. A current flowing through a wire in a magnetic field is subjected to a force which can produce movement. Transformers can be used to change the size of an alternating potential difference.		
	Students will know how to					
	Apply Newton's third law to a variety of situations. **WS 1.2** How to construct free body force diagrams. **WS 1.2** Apply and rearrange **MS 3c**	Carry out an experiment to calculate average speed. **MS 1a, c, 2f** Apply and rearrange. **MS 3b, c** Distance travelled = speed x time $[\ s = v\,t\ ]$ Plot and analyse displacement/distance-time graphs. **MS 4a, b, c, d, f**	Apply and rearrange. **MS 3b, c, WS 4.3, 4.4, 4.5, 4.6** Pressure = force normal to a surface / area of that surface $\left[p = \frac{F}{A}\right]$	Use diagrams to show the transmission of waves between mediums, **WS 1.2** **(Required practical 10)** **I**nvestigate how the amount of infrared radiation absorbed or radiated by a	Use evidence to evaluate theories of the Universe. **WS 1.1, 1.2, 1.3**	

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	moment = force x distance from the pivot $[M = F d]$ and apply them to equilibrium situations. **MS 3c** Represent vector quantities on a scale diagram. **MS 4a, 5a, b**	Apply and rearrange. **MS 1d, 3b, 3c** Acceleration = change in velocity / time $\left[a = \frac{\Delta v}{t} \right]$ Plot and analyse speed/velocity-time graphs. **MS 4a, b, c, d, f, WS 3.3** Apply and rearrange. **MS 3b, 3c** $[v^2 - u^2 = 2 a s]$ Apply and rearrange. **MS 3a, b, c, WS 4.2** Force = mass x acceleration $F = m a$ Apply and rearrange **MS 3b,c** Weight = mass x gravity $[W = m g]$ **(Required practical 7)** Investigate the effect of varying the force on the acceleration of an object of constant mass, and the effect of varying the mass of an object on the acceleration produced by a constant force. **AT 1, 2 and 3. Multiple WS and MS.** Explain the factors that affect braking and thinking distance. **WS 1.5, 2.2, MS 1a, c, AT 1** Estimate the braking force of a vehicle.**MS 1d** Measure human reaction time. **MS 3.5, 3.7** Apply and rearrange. **WS 1.2**	Apply and rearrange. **MS 3b, 3 c, WS 4.3, 4.4, 4.5, 4.6** Pressure = height of fluid x density of fluid x gravitational field strength $[p = h \rho g]$ Explain why atmospheric pressure changes with altitude. **WS 1.2** Explain why objects in fluid experience upthrust due to pressure difference. **MS 1c, 3c** Calculate if objects will float or sink in a fluid. **MS 1c, 3c** Compare transverse and longitudinal waves. **WS 1.2** Describe wave motion. **MS 1c, 3b, c** Measure the speed of sound in air. **AT1, WS 2.3, 2.4, 2.6, 2.7, 3.1, 3.5** Measure the speed of water waves. **AT1, AT4, WS 2.3, 2.4, 2.6, 2.7, 3.1, 3.5** Apply and rearrange. **MS 1c, 3b, c** Period = 1/frequency $\left[T = \frac{1}{f} \right]$	surface depends on the nature of that surface. **AT 1, 4, Multiple WS and MS.** Compare converging and diverging lenses and the images produced**. MS 5a, 5c, WS 1.2** Calculate magnification and investigate magnification by a range of lenses. **MS 3b, c, AT 4, 8** Plot a magnetic field. **WS 2.2** Explain the strength of magnetic fields in various situations. **WS 2.2** Apply and rearrange. **MS 3b, c** Force = magnetic field strength x current x length of wire $[F = B I l]$ Explain how an AC and a DC generator work. **WS 1.4** Apply and rearrange. **MS 3b, c** $\left[\frac{v_p}{v_s} = \frac{n_p}{n_s} \right]$ For transformers. Apply and rearrange. **MS 3b, c** $V_s \times I_s = V_p \times I_p$ Calculate values of current and potential difference in the national grid and explain		

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		MS 3b, c Momentum = mass x velocity $p = m v$ Apply the rate of change of momentum to collisions. **AT 1, 2, 3** Apply and rearrange. **MS 3b, c, 4a** Force = spring constant x extension. $[F = k e]$ Plot and analyse Force-extension graphs. **WS 3.5**	Apply and rearrange. **MS 1c, 3b, 3c** Velocity = frequency x wavelength $[v = f \lambda]$ **(Required practical 8)** 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. **AT 4, Multiple WS and MS.** Construct ray diagrams to show waves at material interfaces. **MS 5a, 5c WS 1.2** **(Required practical 8)** Investigate the reflection of light by different types of surface and the refraction of light by different substances. **AT 1, 4, Multiple WS and MS.** Explain how ultrasound is used in scanning and sounding.	their advantages, **MS 1c, 3b, c**		

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			WS 1.4 Explain the journey of seismic waves though the Earth. **WS 1.1**			
	Vocabulary and the concepts they link to					
	Vector Scalar Resultant Resolve Newton Moment Equilibrium Torque Gears	Acceleration Velocity Displacement Momentum Rate Impact Collision	Pressure Pascal Sharp Column Atmosphere Upthrust Density Transverse Longitudinal Frequency Amplitude Frequency Period Ultrasound Infrasound Echo Seismic	Electromagnetic Radio wave Microwave Infrared Ultraviolet X-ray Gamma Ionising Diffuse Specular Real Virtual Convex Concave Medium Converging Diverging North South Pole Flux Induce Transformer	Supernova Black hole Neutron star Protostar Nebula Orbit Centripetal Asteroid Comet Red-shift Spectral	
	Assessment					
	Key piece six-mark exam question	End of unit test: Forces and motion Key piece six-mark exam question	Paper 1 mock End of unit test: Forces and pressure Key piece six-mark exam question	End of unit test: Electromagnetism End of unit test: Waves Key piece six-mark exam question	Paper 2 mock Key piece six-mark exam question	

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	Diversity & development of cultural capital					
	Gearboxes in cars and bicycle gears. Levers in everyday life. See-saw in the park. Approach vectors and navigation of aircraft and boats.	Tachograph in vehicles. Average speeds of athletes. Students own running speeds. Highway code. Driving theory test. Speed limits. Driving laws (drinking and phones). Bicycle helmets, boxing gloves, crash mats and everyday protective equipment.	Bed of nails. Why football boots hurt if you step on someone's foot. Airplane journeys. How knives work. Floating and sinking objects. Fireworks and thunder and lightning time delay. How we hear. Foetal scanning. Car reverse sensors. Animal echo location.	How food cooks in microwaves. How heat signature cameras work. UV protection in sun creams. Skin cancer. Medical physics techniques in hospitals. Why rainbows form. Eye defects and correction. Magilev trains. School door release system. Electric motors in cars.	Space in the news. Astronomy and the night sky. Theories of the Universe. Future of the Universe.	
	Cross-curricular opportunities and enrichment					
	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures, standard form and symmetry)	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures, interpreting and drawing graphs).	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures)	Maths (Rearrangement of equations, units and prefixes, decimal places and significant figures)		