Beths Grammar School KS5 Physics Curriculum Map

Term **OCR A Level Physics A**	**INTENT**	**IMPLEMENTATION**	**IMPACT**
	Substantive Knowledge This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	**Disciplinary Knowledge (Skills)** This is the action taken within a particular topic in order to gain substantive knowledge.	**Assessment opportunities** What assessments will be used to measure student progress? Evidence of how well students have learned the intended content.
Autumn Term **1A** **Year 12**	**<u>Intent</u>** Why is this taught now? **Module 1: Development of practical skills a in physics.** From their work in KS4 physics, students will have basic knowledge in identifying variables., plotting analysing graphs, using basic equipment, presenting table, and identifying anomalies in experimental measurements. This module will build on skills already acquired and prepare them for the A Level in physics course. Students will learn planning and experimental design, implementation, analysing data, significant figures, plotting and interpreting graphs and evaluating experiments.	Demonstrate and apply their knowledge and understanding of: • experimental design, to solve problems, set in a practical context. • identification of variables that must be controlled where appropriate. • evaluation that an experimental method is appropriate to meet the expected outcomes. • how to use a wide range of practical apparatus and techniques correctly • appropriate units for measurements • presenting observations and data in an appropriate format • the conventions used for labelling table columns. • processing, analysing, and interpreting qualitative and quantitative experimental results. • the identification of anomalies in experimental measurements • use of appropriate mathematical skills for analysis of quantitative data. • appropriate use of significant figures	Classwork and homework tasks. In class teacher assessment through Q & A Knowledge recall activity. Teacher assessment during lesson. Practice exam-styled questions. Use online physics self-assessment website (Isaac Physics, Seneca) All students will sit a similar standard formal module test approximately three weeks before the first Y12 report. This could be in term 1B.

	Module 2.1 Physical quantities, units, and measurements. **Intent** Why is this taught now? Students need to have the basic knowledge in physics to access the wider course. Students will be dealing with physical quantities, their unit, and taking measurements throughout the course. Physical quantities and units, estimating physical quantities, systematic and random errors, precision and accuracy, absolute and percentage uncertainties, graphical treatment of errors and uncertainties.	• plotting and interpreting graphs with suitable graphs from experimental results • selecting and labelling of axes with appropriate scales, quantities and units • measuring of gradients and intercepts. • how to evaluate results and draw conclusions • the limitations of experimental procedures • precision and accuracy of measurements and data, including margins of error, percentage errors and uncertainties in apparatus. • the refining of experimental design by suggesting improvements to the procedures and apparatus. Demonstrate and apply their knowledge and understanding of: • physical quantities have a numerical value and a unit • Système International (SI) base quantities and their units • derived units of SI base units • prefixes and their symbols to indicate decimal submultiples or multiples of units. • checking the homogeneity of physical equations using SI base units. • making estimates of physical quantities • systematic errors and random errors in measurement. • the terms accuracy and precision.	

		• absolute and percentage uncertainties when data are combined by addition, subtraction, multiplication, division and raising to powers. • graphical treatment of errors and uncertainties; line of best fit; worst acceptable line; absolute and percentage uncertainties; percentage difference.	
	Module 2.2 Physical quantities, units, and measurements. **<u>Intent</u>** Why is this taught now? Students need to have the basic knowledge in physics to access the wider course. Students will be dealing with physical quantities, their unit, and taking measurements throughout the course. Scalar and vector quantities, Scalar and vector calculations, resolving vectors.	Demonstrate and apply their knowledge and understanding of: • scalar and vector quantities. • vector addition and subtraction. • vector triangles to determine the resultant of any two coplanar vectors. • resolving a vector into two perpendicular components: $F_x = F_{cos}\vartheta$ and $F_y = F_{sin}\vartheta$.	
	Module 3.1 Motion **<u>Intent</u>** Why is this taught now? Motion is a fundamental concept in physics and provides the foundation for understanding more complex topics in the subject. By studying motion, students learn about the basic principles of mechanics, such as velocity, acceleration, and force, which are essential for understanding how objects move and interact with each other. Additionally, it allows students to develop important skills in problem-solving, critical thinking, and data	Demonstrate and apply their knowledge and understanding of: • displacement, instantaneous speed, average speed, velocity, and acceleration. • graphical representations of displacement, speed, velocity, and acceleration • velocity as the gradient of displacement–time graphs • acceleration as the gradient of velocity–time graphs; displacement as area under graph.	

	analysis. These skills are crucial for success in physics and other STEM subjects. Definition of kinematics, Graphs of motion, constant acceleration equations, free fall and projectile motion, measurement of g, car stopping distances **Module 4.1 Electricity: charge and current** **<u>Intent</u>** Why is this taught now? Charge and current are an essential part of the physics curriculum. Understanding charge and current is fundamental to understanding the principles of electricity, magnetism, and	• the equations of motion for constant acceleration in a straight line, including motion of bodies falling in a uniform gravitational field without air resistance • $v = u + at$ • $s = \frac{1}{2}(u + v)t$ • $s = ut + \frac{1}{2}at^2$ • $v^2 = u^2 + 2as$. • the equations of motion for constant acceleration in a straight line, including the motion of bodies falling in a uniform gravitational field without air resistance • the acceleration *g* of free fall • independence of the vertical and horizontal motion of a projectile • two-dimensional motion of a projectile with constant velocity in one direction and constant acceleration in a perpendicular direction. • techniques and procedures used to investigate the motion of objects. • techniques and procedures used to determine the acceleration of free fall using a trap door and electromagnet arrangement or light gates and a timer. • reaction time and thinking distance. • braking distance and stopping distance for a vehicle Demonstrate and apply their knowledge and understanding of: • circuit symbols	

	electromagnetism, which are important topics in physics and other science subjects. Additionally, studying charge and current helps students develop critical thinking skills, problem-solving abilities, and a deeper understanding of the physical world around them. Electric circuit and components, electric current and charge, electron drift velocity	• circuit diagrams using these symbols • conventional current and electron flow. • electric current as rate of flow of charge; $I = \frac{\Delta Q}{\Delta T}$ • the coulomb as the unit of charge • the elementary charge *e* equals 1.6×10^{-17} C • net charge on a particle or an object is quantised and a multiple of *e* • current as the movement of electrons in metals and movement of ions in electrolytes • Kirchhoff's first law; conservation of charge. • mean drift velocity of charge carriers • $I = Anev$; where *n* is the number density of charge carriers • distinction between conductors, semiconductors, and insulators in terms of *n*.	
Autumn Term 1B Year 12	**Module 3.2 Forces in action** **<u>Intent</u>** Why is this taught now? Studying forces after motion in A-level physics is important because it helps students understand the relationship between motion and the forces acting on an object. By studying forces after motion, students can learn how different forces, such as friction, gravity, and air resistance, affect the motion of an object. This knowledge is essential for understanding concepts such as Newton's laws of motion and how forces can cause changes in an object's velocity or acceleration. Additionally, studying	Demonstrate and apply your knowledge and understanding of: • the equation net force = mass × acceleration, $F = ma$ • the newton as the unit of force • weight of an object, $w = mg$. • the terms tension, normal contact force, upthrust and friction • free-body diagrams. • drag as the frictional force experienced by an object travelling through a fluid.	Classwork and homework tasks. In class teacher assessment through Q & A Knowledge recall activity. Teacher assessment during lesson. Practice exam-styled questions. Use online physics self-assessment website (Isaac Physics, Seneca)

	forces after motion can help students develop problem-solving skills and critical thinking abilities, as they learn to examine and predict the effects of various forces the motion of an object.	• factors affecting drag for an object travelling through air. • motion of objects falling in a uniform gravitational field in the presence of drag. • terminal velocity • techniques and procedures used to determine the terminal velocity of objects in fluids. • equilibrium of an object under the action of forces • condition for equilibrium of three coplanar forces. • moment of force • the principle of moments • equilibrium of an object under the action of forces and torques. • the centre of mass of an object • the centre of gravity of an object • simple experiments to determine the centre of gravity of an object. • density; $\rho = \frac{m}{v}$ • upthrust on an object in a fluid, Archimedes principle. • pressure; $P = \frac{F}{A}$ for solids, liquids, and gases • $p = hpg$; upthrust on an object in a fluid; Archimedes' principle.	A formal module test will be sat by all students approximately three weeks before the first Y12 report.
	Force and the newton, dynamics, drag and terminal velocity, equilibrium, turning forces, centre of mass, density, pressure. **Module 4.2 Energy, power, and resistance** **Intent** Why is this taught now?	Demonstrate and apply their knowledge and understanding of:	

	Energy, power, and electromotive force (emf) are typically taught after charge and current (4.1) in a physics course because they build upon the foundational concepts of charge and current. Understanding charge and current is essential for grasping more advanced topics such as energy, power, and emf. Potential difference and e.m.f, resistance and Ohm's law, resistance of circuit components, resistivity, the effect of temperature on resistivity, electrical power, cost of electricity.	• potential difference, p.d.; the unit *volt* • electromotive force, e.m.f. of a source, such as a cell or power supply • distinction between e.m.f and p.d. in terms of energy transfer • energy transfer; $W = VQ$; $W = EQ$ • energy transfer $e = \frac{1}{2}mv^2$ for electrons and other charged particles. • resistance; $R = \frac{V}{I}$; the unit Ω • Ohm's law. • I–V characteristics of a resistor, filament lamp, diode and light-emitting diode (LED) • light-dependent resistor (LDR); variation of resistance with light intensity • techniques and procedures used to investigate the electrical characteristics for a range of ohmic and non-ohmic components. • resistivity of a material; the equation $R = \frac{\rho l}{A}$ • techniques and procedures used to determine the resistivity of a metal. • variation of the resistivity of metals and semiconductors with temperature • negative temperature coefficient (NTC) thermistor; variation of resistance with temperature. • the equations $P = VI$, $P = I^2R$ and $P = \frac{V^2}{R}$	

		• Energy transfer; $W = \frac{V}{t}$. • the kilowatt-hour (kWh) as a unit of energy • calculating the cost of energy.	
Spring Term 2A **Year 12**	**Module 3.3 Work, energy and power** **<u>Intent</u>** Why is this taught now? Work, energy, and build upon the concepts and principles of forces in action. Understanding forces is essential for grasping the concepts of work, energy, and power since these concepts are closely related to the application of forces. Teaching these concepts after forces enables students to understand how forces are related to the work done, the energy transferred, and the power generated in various systems. Work and the joule, the conservation of energy, potential and kinetic energy, power and the watts and efficiency	Demonstrate and apply their knowledge and understanding of: • the unit joule • transfer of energy is equal to work done • $W = Fd\cos\theta$ for work done by a force. • energy in different forms; transfer and conservation • the principle of conservation of energy. • gravitational potential energy of an object in a uniform gravitational field; $E_P = mgh$ • kinetic energy; $E_K = \frac{1}{2}mv^2$ • the exchange between gravitational potential energy and kinetic energy. • power; the unit watt • $P = Fv$. • efficiency of a mechanical system • efficiency = $\frac{\text{useful output energy}}{\text{total input energy}} \times 100\%$.	Classwork and homework tasks. In class teacher assessment through Q & A Knowledge recall activity. Teacher assessment during lesson. Practice exam-styled questions. Use online physics self-assessment website (Isaac Physics, Seneca)

	Module 4.3 Electrical circuits **<u>Intent</u>** Why is this taught now? This topic is taught after energy, power and resistance because they provide the foundation for understanding the behaviour of electrical circuits. It also helps students apply their knowledge in practical situations such as analysing and designing circuits for specific purposes. Kirchhoff's first and second law, series circuits, parallel circuits, the potential divider, internal resistance, circuit analysis 1 and circuits analysis 2	• Demonstrate and apply their knowledge and understanding of: • Kirchhoff's second law; the conservation of energy applied to electrical circuits • Kirchhoff's first and second laws. • applying Ohm's law to solve a range of series circuit problems • total resistance of two or more resistors in series; $R = R_1 + R_2 + R_3$ • analysing of circuits and series components. • total resistance of two or more resistors in parallel: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ • analysis of circuits with components, including both series and parallel. • potential divider circuits with components • potential divider equations, e.g. $V_{out} = \frac{R_2}{R_1} + R_2 \times V_n$ and $\frac{V_1}{V_2} = \frac{R_1}{R_2}$ • potential divider circuits with variable components, e.g. LDR and thermistors • techniques and procedures used to investigate potential divider circuits, which may include a sensor such as a thermistor or LDR. • source of electromotive force, e.m.f.; internal resistance • terminal potential difference, p.d.; 'lost volts'	

		• the equations E $= I(R + r)$ and E $= V + Ir$ denoted • techniques and procedures used to determine the internal resistance of a chemical cell or other source of e.m.f. • analysis of circuits with components, including both series and parallel. • analysis of circuits with more than one source of e.m.f.	
Spring Term 2B **Year 12**	**Module 3.5 Newton's laws of motion** **Intent** Why is this taught now? Students will apply the knowledge gained in Module 3.5 (work, energy and power) to understand how forces influence the motion of objects. By building on the concepts of work, energy, and power, students can more easily grasp the principles of Newton's laws and apply them to solve problems in mechanics. Newton's three laws of motion, momentum, momentum, force and impulse, elastic and inelastic collisions	Demonstrate and apply their knowledge and understanding of: • Newton's three laws of motion • apply the second law using the formula $F = ma$ • explain how the three laws apply to a range of problems involving motion. • linear momentum; $p = mv$ • vector nature of momentum • the principle of conservation of momentum • collisions and interactions of bodies in one dimension. • impulse of a force, impulse = $F\Delta t$ • net force = rate of change of momentum; $F = \frac{\Delta p}{\Delta t}$ • impulse is equal to the area under a force–time graph • collisions and interactions of bodies in one dimension and two dimensions • perfectly elastic and inelastic collision	Classwork and homework tasks. In class teacher assessment through Q & A Knowledge recall activity. Teacher assessment during lesson. Practice exam-styled questions. Use online physics self-assessment website (Isaac Physics, Seneca) A formal trial exam will be sat by all students approximately three weeks before the second Y12 report. This would be in term 3A. Students will be examined on all module covered.
	Module 4.4 Waves **Intent**	Demonstrate and apply their knowledge and understanding of: • progressive waves; longitudinal and transverse waves.	

	Why is this taught now? Waves is taught in year 1 because it is essential for understanding more advanced topics like quantum physics and electromagnetism. Also, waves are a key aspect of the A Level Physics curriculum and are often included in exams and assessments. By studying waves in Year 1, students can build a solid foundation of knowledge and skills that will be important for their future studies in physics and related fields. Wave motion, wave terminology, wave speed and wave equation, common properties, electromagnetic waves, polarisation, refraction of light, total internal reflection, interference, the Young double-slit experiment, the diffraction grating, stationary waves and stationary wave experiments and stationary longitudinal waves.	• displacement, amplitude, wavelength, period, phase difference, and frequency of a waves • the equation $f = \frac{1}{T}$ • graphical representations of transverse and longitudinal waves • techniques and procedures used to use an oscilloscope to determine frequency. • the wave equation $v= f$⍰ • intensity of a progressive wave; $I = \frac{P}{A}$ • intensity α (amplitude)^2. • reflection, refraction and diffraction of all waves • techniques and procedures used to demonstrate wave effects using a ripple tank. • electromagnetic spectrum; properties of electromagnetic waves • orders of magnitude of wavelength of the principal radiations from radio waves to gamma rays. • polarisation of all waves • plane polarised waves; polarisation of electromagnetic waves • techniques and procedures used to observe polarising effects using microwaves and light. • refraction of light • refractive index; $n = \frac{c}{v}$ • $n \sin \vartheta$ = constant at a boundary, where ϑ is the angle to the normal	

		• techniques and procedures used to investigate refraction of light using ray boxes, including transparent rectangular and semi-circular blocks. • total internal reflection for light • critical angle; sin C = $\frac{1}{n}$ • techniques and procedures used to investigate total internal reflection of light. • the principle of superposition of waves • graphical methods to illustrate the principle of superposition • two-source interference with sound and microwaves • interference, coherence, path difference and phase difference • constructive interference and destructive interference in terms of path difference and phase • difference. • Young double-slit experiment using visible light • use the equation ⍰ = $\frac{aX}{D}$ • techniques and procedures used to determine the wavelength of light using a double slit. • techniques and procedures used to determine the wavelength of light using a diffraction grating. • how stationary waves are formed • graphical representations of stationary wave similarities, and differences between stationary and progressive waves • nodes and antinodes	

		• the idea that the separation between adjacent nodes (or antinodes) is equal to $\frac{\lambda}{2}$, where λ is the wavelength of the progressive wave. • stationary (standing) waves using microwaves and stretched strings • standing wave patterns for a stretched string • fundamental mode of vibration (1st harmonic); harmonics. • stationary (standing) waves using air columns • stationary wave patterns for air columns in closed and open tubes • techniques and procedures used to determine the speed of sound in air, by formation of stationary waves in a resonance tube.	
Summer Term **3A** **Year 12**	**Module 3.4 Materials** **Intent** Why is this taught now? This topic follow newton's law (3.5). Student's knowledge in forces help them understand the properties of materials such elasticity and strength. For example, students can use their knowledge of Newton's laws to understand how forces are transmitted through a material and how they deform under stress. Deformation of materials, Hooke's law, the Young modulus, categorisation of materials	Demonstrate and apply their knowledge and understanding of • elastic and plastic deformations of materials • tensile and compressive deformation; extension and compression • force–extension (or compression) graphs for springs and wires • techniques and procedures used to investigate force–extension characteristics. • Hooke's law and the force constant K of spring or wire; $F = kx$ • force–extension (or compression) graph; work done is area under graph • elastic-potential energy: $E = \frac{1}{2}Fx$;	Classwork and homework tasks. In class teacher assessment through Q & A Knowledge recall activity. Teacher assessment during lesson. Practice exam-styled questions. Use online physics self-assessment website (Isaac Physics, Seneca) A formal trial exam will be sat by all students approximately three weeks before the second Y12 report. students

	Module 4.5 Quantum physics **Intent** Why is this taught now? Students’ knowledge in waves will serve as a foundation for understanding concepts in quantum physics. Quantum physics builds on concepts that are covered in waves. For example, waves are essential in understanding concept like wave-particle duality. The photon, the electronvolt, the photoelectric effect 1&2, wave-particle duality	• the terms stress σ, strain ε and ultimate tensile strength • Young modulus = $\frac{\text{tensile stress}}{\text{tensile strain}}$, $E = \frac{\sigma}{\varepsilon}$ • to determine the Young modulus for metal techniques and procedures. • stress–strain graphs for typical ductile, brittle and polymeric materials Demonstrate and apply their knowledge and understanding of: • the particulate nature (photon model) of electromagnetic radiation • the photon as a quantum of energy of electromagnetic radiation • energy of a photon; $E = hf$ and $E = \frac{hc}{\lambda}$ • using LEDs and the equation $Ev = \frac{hc}{\lambda}$ to estimate the value of Planck constant h • determine the Planck constant using different coloured LEDs. • the electronvolt (eV) as a unit of energy. • photoelectric effect, including a simple experiment to demonstrate this effect • demonstration of the photoelectric effect using, e.g. gold-leaf electroscope and zinc plate • a one-to-one interaction between a photon and a surface electron • work function; threshold frequency • Einstein’s photoelectric equation $hf = \varphi + KE_{\text{max}}$.	will be examined on all module covered.

		• the idea that the maximum kinetic energy of the photoelectrons is independent of the intensity of the incident radiation • the idea that rate of emission of photoelectrons above the threshold frequency is directly proportional to the intensity of the incident radiation. • electron diffraction, including experimental evidence of this effect • diffraction of electrons travelling through a thin slice of polycrystalline graphite by the atoms of graphite and the spacing between the atoms • the de Broglie equation $\lambda = \frac{h}{p}$.	
Summer Term 3B Year 12	**Module 5.1 Circular motion** **Intent** Why is this taught now? Circular motion builds on the fundamental concepts of forces and motion. Understanding forces and motion is essential for understanding how objects move in circular paths and how centripetal forces are required to keep objects moving in a circular motion. Kinematics of circular motion, centripetal force	Demonstrate and apply their knowledge and understanding of: • the radian as a measure of angle • period and frequency of an object in circular motion • angular velocity ω, $\omega = \frac{2\pi}{T}$ or $\omega = 2\pi f$ • constant speed in a circle: $v = \omega r$ • centripetal acceleration: $a = \frac{v^2}{r}$; $a = \omega^2 r$ • a constant net force, which when perpendicular to the velocity of an object causes it to travel in a circular path r • centripetal force: $F = mv^2/r$; $F = m\omega^2 r$ • techniques and procedures used to investigate circular motion using a whirling bung	Classwork and homework tasks. In class teacher assessment through Q & A Knowledge recall activity. Teacher assessment during lesson. Practice exam-styled questions. Use online physics self-assessment website (Isaac Physics, Seneca)

	Module 6.1 Capacitors **Intent** Why is this taught now? Students can apply the knowledge gained in electric circuit to understand capacitors work and they are used in various applications. Capacitors are often used in combination with other components in more complex circuits, so it is important for students to have solid understanding of electric circuits before moving to the study of capacitors Capacitors, capacitors in series and parallel, energy stored in a capacitor, charging and discharging capacitors, graphical and spreadsheet method.	Demonstrate and apply their knowledge and understanding of: ● capacitance; $C = \frac{Q}{V}$; the unit farad (F) ● charging and discharging of a capacitor or capacitor plates with reference to the flow of electrons. ● total capacitance of two or more capacitors in series; $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$ ● total capacitance of two or more capacitors in parallel; $C = C_1 + C_2 + \ldots$ ● techniques and procedures used to investigate capacitors in both series and parallel combinations using ammeters and voltmeters ● analysis of circuits containing capacitors, including resistors (continued in Topic 6.1.4). ● p.d.–charge graph for a capacitor; energy stored is area under graph ● energy stored by capacitor; $W = \frac{1}{2}QV$, $W = \frac{1}{2}\frac{Q^2}{C}$ and $W = \frac{1}{2}V^2C$ ● uses of capacitors as storage of energy. ● charging and discharging a capacitor through a resistor ● analysis of circuits containing capacitors, including resistors (continued from Topic 6.1.2) ● techniques and procedures to investigate the charge and the discharge of a capacitor using both meters and dataloggers ● the time constant of a capacitor–resistor circuit; $\tau = CR$	

		● equations of the form $x = x_0 e^{-t/CR}$ and $x = x_0 (1 - e^{-t/CR})$ for capacitor–resistor circuits ● exponential decay graphs; constant-ratio property of such a graph (continued in Topic 6.1.5). ● graphical methods and spreadsheet modelling of the equation $\frac{\Delta Q}{\Delta} = -\frac{Q}{CR}$ for a discharging capacitor ● exponential decay graphs; constant-ratio property of such a graph (continued from Topic 6.1.4).	