Programme of study for Year 13 A-LEVEL Physics

Autumn (1st term)	Autumn (2nd term)	Spring (1st term)	Spring (2nd Term)	Summer (1st term)	Summer (2nd term)
Topics: Continued from end of Year 12: **Circular motion** **Thermal Physics** **Simple Harmonic motion** **Gases** Skills(students should be able to do): AO1: Demonstrate knowledge and understanding of conditions for SHM by investigating different examples of oscillations. AO3: Analyse and interpret data from to reach conclusions on the relationship between x, v and a in a system executing SHM. AO2: Apply knowledge and understanding of scientific ideas to derive the equations for the mass spring and pendulum systems. AO3: Analyse and interpret data from to reach conclusions on the relationship between variables in oscillating systems.	Topics: **Gravitational fields** **Electric fields** **Capacitors** **Magnetic Fields** **Electromagnetic induction** Skills(students should be able to do): AO1: Demonstrate knowledge and understanding of Newton's Law of gravitation. AO1: Demonstrate knowledge and understanding of the concept of gravitational fields. AO2: Apply knowledge and understanding of gravitational field strength to solve problems in different contexts. AO1: Demonstrate knowledge and understanding of the concept of gravitational potential when solving problems. AO1: Demonstrate knowledge and understanding of satellites and their orbits when	Topics: **Radioactivity** Skills(students should be able to do): AO1: Demonstrate knowledge and understanding of Rutherford Scattering experiment. AO3: Analyse and interpret data from Rutherford Scattering experiment to draw a conclusion. AO2: Apply knowledge and understanding of the properties of radiation in medicine and industry. AO3: Analyse, interpret and evaluate data from absorption and inverse-square law experiments to: •make judgements and reach conclusions •develop and refine practical design and procedures. AO2: Apply knowledge and understanding of radioactive decay to the storage of radioactive waste and radioactive dating. AO3: Analyse, interpret and evaluate data on	Topics: **Nuclear Physics** **Option topic – Turning Points** Skills(students should be able to do): AO1: Demonstrate knowledge and understanding of the size of the nucleus and evidence for this. AO2: Apply knowledge and understanding of Coulomb's Law and diffraction to calculate nuclear radii. AO1: Demonstrate knowledge and understanding of binding energy, fission and fusion. AO2: Apply knowledge and understanding to calculate the energy released in nuclear fission and fusion. AO1: Demonstrate knowledge and understanding of nuclear fission, fusion and the construction of a nuclear power station. AO1: Demonstrate knowledge and understanding of nuclear safety.	Topics: Revision for A-Level Physics exams.	Topics: Revision for A-Level Physics exams.

AO1: Demonstrate knowledge and understanding of resonance. AO3: Analyse and interpret data to reach conclusions on the relationship between variables in oscillating systems. AO1: Demonstrate knowledge and understanding of the Ideal Gas equation. AO3: Analyse and interpret data from gas law experiments to find a value for absolute zero and evaluate this value. AO1: Demonstrate knowledge and understanding of Brownian motion and the development of kinetic theory. AO2: Apply knowledge and understanding of mechanics to derive the kinetic theory equations.	relating observed orbits to uses. AO2: Apply knowledge and understanding of gravitational potential when explaining energy considerations in the orbit of satellites. AO2: Apply knowledge and understanding of electric fields and circular motion to describe and explain the trajectory of a charge particle in a uniform electric field. AO2: Apply knowledge and understanding of electric fields and circular motion to describe and explain the trajectory of a charge particle in a uniform electric field. AO2: Apply knowledge and understanding of capacitors to solve problems in a variety of contexts. AO1: Demonstrate knowledge and understanding of capacitor discharge by sketching graphs of Q, V and I against time. AO2: Apply knowledge and understanding to predict direction of motion of a spinning motor.	radioactive decay to make judgements and reach conclusions. AO1: Demonstrate knowledge and understanding of decay processes.	AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to make judgements and reach conclusions on the development of nuclear power. Skills(students should be able to do): AO1: Demonstrate knowledge and understanding of the cathode ray tube. AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, to make judgements and reach conclusions about the quantisation of charge in the Milikan oil drop experiment. AO1: Demonstrate knowledge and understanding of the evidence for the electromagnetic nature of light. AO1: Demonstrate knowledge and understanding of the TEM and STM AO1: Demonstrate knowledge and understanding of Einstein's two relativity postulates.		

	AO1: Demonstrate knowledge and understanding of forces on charged particles in magnetic fields. AO2: Apply knowledge and understanding to explain machines that use magnetic forces to guide the motion of charged particles. AO1: Demonstrate knowledge and understanding of magnetic flux. AO1: Demonstrate knowledge and understanding of how changing flux linkage produces an emf. AO2: Apply knowledge and understanding of scientific ideas to explain electromagnetic braking. AO1: Demonstrate knowledge and understanding of rms and peak values. AO3: Analyse and interpret data from oscilloscope display to find rms and peak values. AO1: Demonstrate knowledge and understanding of construction and operation of a transformer.		AO2: Apply knowledge and understanding of length contraction / time dilation to explain the observed properties of muons.		

	AO3: Analyse, interpret and evaluate data from building transformer practical.				
Key Learning Outcomes (students should know): Recall the condition for SHM : $a \propto -x$ Solve problems using the equations of SHM : $x = A\cos(\omega t)$ and $v = \pm\omega\sqrt{A^2 - x^2}$ $v_{max} = \omega A$ $a_{max} = \omega^2 A$ Recognise and use the concept of the gradient of the x – t graph leading to the v – t graph, and the gradient of the v - t graph leading to the a – t for SHM. Given appropriate structure and support students should be able to derive the equations for mass-spring and simple pendulum. Use the mass-spring and pendulum equations to solve SHM problems. Recognise other harmonic oscillators and apply knowledge and understanding of mass-	Key Learning Outcomes (students should know): Understand that gravity is a force that acts between all matter, is always attractive and is a vector quantity. Calculate the force between masses using Newton's Law of gravitation. Understand and describe the concept of a force field. Sketch gravitational fields around objects and near the surface of the Earth. Recall the definition of gravitational field strength and use the gravitational field strength equations, $g = F/m$ $g = GM/r^2$ Define gravitational potential. Recall and understand zero value at infinity. Understand and apply the concept of potential	Key Learning Outcomes (students should know): Describe the results of the Rutherford scattering experiment and explain how they lead to the nuclear model of the atom. Understand that the model of the atom has changed over time. Recall the properties of α, β and γ radiation. Describe a simple absorption experiment that could be used to identify the different types of radiation including correction for background radiation. Apply knowledge and understanding of properties of radiation and inverse square law to explain safe handling of radioactive sources and applications in industry and medicine. To include evaluation of the balance	Key Learning Outcomes (students should know): Recognise situations in which electromagnetic induction will occur. Recall Faraday's and Lenz's Laws. Calculate the emf induced by electromagnetic induction in scenarios such as a straight conductor moving in a magnetic field or a coil rotating in a magnetic field. Know the meaning of the terms root mean square and peak-to-peak value. Use the equations $I_{rms} = I_0/\sqrt{2}$ $V_{rms} = V_0/\sqrt{2}$ to calculate root mean square values or peak values. Use of an oscilloscope to display dc and ac voltage signals and find rms and peak values.	Key Learning Outcomes (students should know):	Key Learning Outcomes (students should know):

spring and pendulum to solve problems in different contexts. Describe the energy changes that take place in SHM and sketch graphs of variation of Ek, Ep and total energy with displacement and time. Describe the effects of damping on oscillations including sketching appropriate graphs of damped systems. Recognise free and forced vibrations and describe the difference between them. Sketch a typical frequency response curve for a forced vibration to show the sharpness of response and the effect of damping. Recall the gas laws that give the relationships between p, V and T and the mass of a gas. Express these in words, algebraically and graphically. Understand the concept of absolute zero of temperature and how the gas laws lead to the existence of this temperature. Derive the equation Work done = p Δ V	difference including through calculations. Draw equipotential surfaces on field line diagrams and understand and apply the concept that potential difference along an equipotential line is zero. Use the equations. ΔW = mΔV V = – GM/r g = – ΔV/Δr to solve problems. Understand the significance of the negative sign. Sketch and interpret graphs to show the variation of g and V with r. Recall and use the relationship V = – GM/r and the concept that ΔV is found from area under graph of g against r. Students can derive; T2 ∝ r3 Describe the energy considerations for an orbiting satellite and provided with structure solve problems. Describe the meaning of the term escape velocity and given appropriate data calculate escape velocities. Describe Synchronous orbits and the use of	of risks and benefits of applications. Use the inverse square law to calculate distances and intensities. Describe an experiment to confirm the inverse square law including correction for background radiation. Recognise and understand the random nature of radioactive decay. Use the equations $\frac{\Delta N}{\Delta t} = -\lambda N$ $N = N_o e^{-\lambda t}$ $A = \lambda N$ $T_{1/2} = \frac{\ln 2}{\lambda}$ $A = A_o e^{-\lambda t}$ to solve radioactive decay problems in a variety of contexts. Determination of half-life from graphical data. Apply knowledge and understanding of half-life to explain considerations such as the safe storage of radioactive waste and radioactive dating of rocks. Sketch the graph of N against Z for stable nuclei. Identify and explain regions of the graph that	Use the transformer and efficiency equations to solve problems related to structure and operation of transformers. Explain how Eddy currents form in transformers and how this leads to inefficiency. Describe the role of transformers in the transmission of power. Use electrical power equations to calculate power losses in transmission lines. Describe the production of cathode rays in a discharge tube. Describe the principle of thermionic emission. Understand that the energy of an electron accelerated through an electric field depends on the potential difference. Calculate the work done on an accelerated electron using: 1/2mv2 = eV Describe how the specific charge of an electron can be found. Recall and understand the significance of Thomson's determination of e/m for an electron.		

Understand and use the terms: Avogadro constant, molar mass, molecular mass. Use the gas law equations Work done = p Δ V to solve problems on the behaviour of gases. Describe Brownian motion and understand how it provides evidence for the existence of atoms. Explain relationships between p, V and T in terms of a simple molecular model. Understand that the gas laws are empirical in nature whereas the kinetic theory model arises from theory. Know the assumptions of the kinetic theory and the derivation of $pV = \frac{1}{3} N m (c_{rms})^2$ Use the equations of the kinetic theory to solve problems. Describe how knowledge and understanding of gaseous behaviour has changed over time.	satellites in low orbits and geostationary orbits, including plane and radius of geostationary orbit. Be able to predict the direction of a force on a current carrying wire. Use the equation F=BIl to calculate the force on a current carrying wire or magnetic flux density. Describe an investigation to investigate the relationship between magnetic flux density, current and length of a wire. Apply the equation F = BQv to problems where a charge particle is moving in a magnetic field. Explain how the force on the charged particle leads to circular motion in devices such as the cyclotron. Be able to define flux and flux linkage. Use the relationships φ = BA and Nφ = BANcosθ to calculate flux linkage in common contexts such as a conductor dropped in a uniform magnetic field or a rectangular coil in an electric motor.	correspond to possible decay modes, Generate and/or complete simple decay equations. Describe the existence of nuclear excited states and applications.	Compare the specific charge of an electron and a hydrogen ion. Understand and explain the conditions for holding a charged oil droplet stationary in an electric field. Understand and explain the procedure and measurements needed to find the electronic charge including use of the relationships: QV / d = mg F = 6πηrυ Describe and explain the significance of Milikan's results – quantisation of electric charge. Describe and understand the key features of Newton's corpuscular theory including explanation of reflection and refraction. Comparison of Huygen's wave theory. Describe and appreciate the reasons why Newton's theory was preferred. Describe the nature of electromagnetic waves. Appreciation that ε0 relates to the electric field strength due to a charged object in free space and μo relates to the magnetic flux density due to a		

	Understand and describe how closest approach and electron diffraction give an estimate size for nuclear radius. Use the Coulomb Law to carry out closest approach calculations. Use the equation R = R0A1/3 to relate the radius of different nuclei to nucleon number. Given appropriate data calculate nuclear densities. Recall the order of magnitude radius for the nucleus. Understand that E = mc2 applies to all energy changes. Define and understand the term binding energy. Calculate mass difference / binding energy using appropriate units including fission and fusion reactions. Describe fission and fusion processes including how knowledge of these processes informs energy supply choices. Sketch the graph of average binding energy per nucleon against nucleon number and explain regions where fission and fusion will release energy.		current-carrying wire in free space. Describe and understand Hertz's experiment to show the existence of and then measure the speed of electromagnetic waves. Understand the significance of this result. Describe Fizeau's determination of the speed of light and the implication of the result. Describe the ultraviolet catastrophe in terms of black body radiation. Recall that Planck's interpretation using quanta solved the ultraviolet catastrophe. Understand and describe Einstein's explanation of photoelectricity and it significance in demonstrating particle properties of electromagnetic radiation. Recall de Broglie's hypothesis p = h / λ Describe electron diffraction as evidence of the wave-like nature of the electron. Explain, qualitatively, the changes in diffraction pattern observed when changing the speed of the electrons. Solve problems using the equations:		

	Describe the process of induced fission, chain reactions and the meaning of critical mass. Describe and explain the functions of the moderator (including use of a model of elastic collisions), control rods and coolant and the choice of material used for each. Describe the safety considerations in nuclear power stations including the handling and storage of radioactive waste. Describe and evaluate the arguments for and against nuclear power. Define capacitance. Use the equations, $C = A\varepsilon_0\varepsilon_r/d$, $E = \frac{1}{2} QV = \frac{1}{2} CV^2$ $= \frac{1}{2} Q^2 / C$ to solve problems. Understand and use the terms relative permittivity and dielectric constant. Describe the action of a simple polar molecule that rotates in the presence of an electric field. Find and interpret the area under a graph of charge against PD Sketch graphs of Q, V and I against time to show charging and discharging		$p = h / \lambda$; $\lambda = h / \sqrt{2meV}$ including estimating the voltage needed to produce wavelengths of the order of the size of an atom. Understand the principle of the Michelson–Morley experiment as an interferometer. Describe and explain the experiment as a means of detecting absolute motion. Describe and explain the significance of failure to detect absolute motion. Understand and use the terms proper time and time dilation. Use the equation $t = t_o \sqrt{(1 - v^2 / c^2)}$ to solve problems. Understand and use the term length contraction. Use the equation $l = l_o \sqrt{(1 - v^2 / c^2)}$ to solve problems. Describe and interpret the results of Bertozzi's experiment. Understand and use the concept of the equivalence of mass and energy including sketching graphs of the variation of mass and kinetic energy with speed and calculations using		

	of capacitors through different resistances. Find and interpret the area and gradient of graphs representing the discharge of capacitors. Recall the use the concept of Time Constant RC. Solve problems including the use of the equations : $T_{½} = 0.69RC$, $Q = Q_0 e^{-t/RC}$ $Q = Q_{max} (1-e^{-t/RC})$ Understand the meaning of ε_0 and that air can approximately be treated as a vacuum. Use electric field lines to sketch electric field patterns. Define electric field strength. Use the equations $F = \frac{1}{4\pi\varepsilon_0} \frac{Q_1 Q_2}{r^2}$ $E = \frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2}$ $E = F / Q$ and $E = V / d$ to solve electric field problems. Derive $Fd = Q\Delta V$ Sketch and describe the trajectory of a moving charged particle entering a uniform electric field initially at right angle.		$E = mc^2$; $E = m_o c^2 / \sqrt{(1 - v^2 / c^2)}$		

	Define absolute electric potential and explain the significance of the zero value at infinity. Understand and use the concept of potential difference. Sketch and use equipotential diagrams. Recognise and use the idea that no work is done by a moving charge on an equipotential surface. Use the equation $V = 1/(4\pi\varepsilon_0)\ Q/r$ Sketch and use graphs showing the variations of E and V with r. Recognise and use the relationships $E = \Delta V / \Delta r$ and ΔV is the area under graph of E against r.				
End of Autumn 1st term assessment: FURTHER MECHANICS AND THERMAL PHYSICS module graded test	End of Autumn 2nd term assessment: FIELDS module graded test	Y13 Mock exams to cover all A-Level Physics topics covered so far: Measurements and their errors. Matter and radiation Quarks and leptons Electromagnetic radiation and quantum phenomenon Newton's laws of motion Forces in equilibrium On the move Force and Momentum Waves Work, energy and power Optics Materials Electric current		End of year assessment (external exams) to cover: All A-Level Physics topics: Measurements and their errors. Matter and radiation Quarks and leptons Electromagnetic radiation and quantum phenomenon Newton's laws of motion Forces in equilibrium On the move Force and Momentum Waves Work, energy and power Optics Materials Electric current	

		DC circuits Simple Harmonic motion Gases Radioactivity Nuclear Physics Capacitors Electric fields Gravitational fields Magnetic Fields Electromagnetic induction		DC circuits Simple Harmonic motion Gases Radioactivity Nuclear Physics Capacitors Electric fields Gravitational fields Magnetic Fields Electromagnetic induction Optional topic – Turning Points	
Building understanding: Rationale / breakdown for your sequence of lessons: Simple harmonic motion (SHM) prior knowledge: Uniform linear motion and motion graphs. F = ma Simple harmonic systems prior knowledge: Uniform linear. Newton's Laws. F = ma. Small angle approximation. The definition of centre of mass and stability in general is assumed as are the general properties of a simple pendulum. At A-level there is analysis of the simple pendulum time period equation. Forced vibrations and resonance prior knowledge: Simple Harmonic motion. There is no quantitative work at GCSE of kinetic theory, just an	**Building understanding: Rationale / breakdown for your sequence of lessons:** Newton's law of gravity prior knowledge: Basic forces including gravity. Vectors. Gravitational field strength prior knowledge: Contact and non-contact forces. Magnetic field diagrams. Gravitational potential prior knowledge: Work. Potential difference. Gravitational potential energy (GPE = mgh). Orbits of planets and satellites prior knowledge: Circular motion. Centripetal force. Gravitational forces and potential. Coulomb's law and Electric field strength prior knowledge: Non-contact forces. Concept of	**Building understanding: Rationale / breakdown for your sequence of lessons:** Rutherford scattering prior knowledge: Nuclear model of the atom. Properties of alpha radiation. Coulomb's Law. Momentum. α, β and γ radiation prior knowledge: Nuclear model of the atom. Nature of α, Β and γ radiation. Sources of background radiation. Radioactive decay prior knowledge: Simple understanding of probability. Random nature of radioactive decay. Activity and the Becquerel. Logarithms. A general appreciation of radioactive substances, the three types of radiation and their properties, safety, hazards, background and	**Building understanding: Rationale / breakdown for your sequence of lessons:** Nuclear radius prior knowledge: Nuclear model of the atom. Properties of alpha radiation. Coulomb's Law. Momentum. Wave particle duality - Electron Diffraction. Knowledge of the fissile substances used in thermal reactors and that the process involves the nucleus and neutrons is common to both GCSE and A-level, as is the fact that fusion involves nuclei 'joining' at high temperatures. Mass and energy prior knowledge: Atomic mass units and atomic notation. The electron volt and the mega electron volt. Nuclear equations.	**Building understanding: Rationale / breakdown for your sequence of lessons:**	**Building understanding: Rationale / breakdown for your sequence of lessons:**

appreciation of the basic model of constantly moving atoms, molecules and particles, as well as the different energy states of solid, liquid and gases. Ideal gases prior knowledge: States of matter. Basic kinetic theory. Work = force x distance. Atomic notation. Molecular kinetic theory model prior knowledge: Newton's Laws of motion. Momentum. Ideal Gas laws. The kinetic theory at A-level is described by assumptions and mathematical interpretation linking micro and macro to generate, for gases, PV = nRT(as well as pV = NkT) , moles, work done, Avogadro constant, NA, Boltzmann's constant kand absolute temperature, (T). Link between (KE)av and T is also covered at A-level.	a force field. Use of field lines to represent a force field. Work. Circular motion and centripetal Capacitance, Parallel plate capacitor and Energy stored by a capacitor prior knowledge: dc circuits, charge and potential difference, uniform electric field. Magnetic flux density prior knowledge: Construction of DC circuits, basic magnetism and electromagnetism. Moving charges in a magnetic field prior knowledge: Circular motion and centripetal forces. Magnetic flux and flux linkage prior knowledge: Basic magnetism and electromagnetism.# Electromagnetic induction prior knowledge: The relative motion of a conductor in a magnetic field induces an electric current. Alternating currents prior knowledge: The difference between ac and dc signals. An understanding of how current-carrying	half life is assumed at A-level. At GCSE (higher), only the nuclear equation for α–decay is required. At A-level, the equation for β–decay (including the neutrino) is also required. Nuclear instability prior knowledge: Atomic notation. Nature of α, B and γ radiation. A-level requires more detail about the reasons for instability, including the N against Z curve, and the forces involved in decay such as the strong nuclear force and short range attractive. The experimental investigation of evidence for α, β and γ is required at A-level, along with the inverse square law for γ. Count rate (elimination of background), mathematical definition of half-life and manipulation of exponential decay equations are all required at A-level, along with knowledge of natural logs.	At A-level, the concepts of binding energy and use of E = mc2 for calculations of mass difference and energy are required. Induced fission prior knowledge: Atomic Structure. Nuclear equations. Elastic collisions. Safety aspects prior knowledge: Nuclear Power stations. Nature of Radiation. An understanding of critical mass, moderator, control rods and coolant in a thermal reactor is necessary. Cathode rays, Thermionic emission of electrons and Specific charge of the electron prior knowledge: Electric and Magnetic fields and electric potential. Electron energy levels. Principle of Milikan's determination of the electronic charge, e prior knowledge: Electric fields. Newton's corpuscular theory of light, Significance of Young's double slits experiment and Electromagnetic waves prior knowledge: Diffraction. Superposition. Interference. Electric fields		

	conductors react in magnetic fields is included for both specifications. In particular, Fleming's left hand rule is required for currents and fields at 90°. A-level considers the concept of B (flux density) and moving charges with equations for F used to explain how a current balance works and the circular motion of particles, eg in a cyclotron. The operation of a transformer prior knowledge: Electrical power = VI. Structure of a transformer: primary coil, secondary coil, laminated iron core. Use of transformers in the National Grid. The concept of electrical induction, including simple experiments, is expected at both GCSE and A-level, as is the structure of a transformer, its turns ratio and power ratio for an ideal transformer. A-level requires an understanding of Lenz's and Faraday's laws for induction, flux and flux linkage (topic 7.4.4), leading to an appreciation of energy losses in a transformer – Eddy		and Magnetic fields. Basic properties of electromagnetic waves. The discovery of photoelectricity prior knowledge: Electromagnetic waves. Photons. Photoelectric effect. Wave particle duality. Wave-particle duality and Electron microscopes prior knowledge: Momentum. Interference. Diffraction. The Michelson-Morley experiment and Einstein's theory of special relativity prior knowledge: Interference.		

	currents/laminations. Calculations are included at A-level on transformers with efficiency below 100%. Knowledge of National Grid and use of transformers is assumed at A-level and the transmission of energy by power lines is common to both GCSE and A-level. A-level develops an equation for generating of an AC voltage (rotating coil), includes the transformer and deals quantitatively with power loss in transmission lines. Both GCSE and A-level have definitions of efficiency and assumed principles of conservation of energy. At A-level the use of efficiency is restricted to transformers.				
Home – Learning: Past exam questions	Home – Learning: Past exam questions	Home – Learning: Past exam questions	Home – Learning: Past exam questions	Home – Learning: Past exam questions	Home – Learning: Past exam questions
Reading / literacy: Discuss the energy changes that occur during SHM using simulations. Students write a short essay on the development of the gas	Reading / literacy: Discuss similarities of the equations for electric and gravitational fields.	Reading / literacy: Students consider parallels between the mathematics of radioactive decay, capacitor discharge and damped harmonic motion.	Reading / literacy: Extended writing on Nuclear Power stations, fission and fusion. In triads, one student prepares a short argument for nuclear power, another against and the	Reading / literacy:	Reading / literacy:

laws from an experimental and theoretical perspective.			third evaluates the two arguments. A discussion of Millikan's data selection and the following controversy. Discussion of the twin paradox. Investigate the motion of a pendulum damped by electromagnetic braking or other Eddy current brake.		
Numeracy: MS3.9: Apply the concepts underlying calculus by finding the velocity/acceleration from x –t / v – t graphs of SHM. MS 4.6 / AT b, c Students should recognise the use of the small-angle approximation in the derivation of the time period for examples of approximate SHM. MS3.12: Sketch the relationship modelled by y = k/x, when dealing with an ideal gas.	Numeracy: MS1.4: Make order of magnitude calculations for gravitational forces between objects. MS3.8, 3.9: Students use graphical representations to investigate relationships between v, r and g. MS3.8: Δ V from the area under graph of E against r and be able to calculate it or estimate it by graphical methods as appropriate. MS4.2: Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects.	Numeracy: MS1.3: Understand simple probability in radioactive decay. MS2.1: Understand and use the symbols: ∝, Δ. MS3.1: Translate information between graphical, numerical and algebraic forms when dealing with radioactive decay.	Numeracy: MS1.4: Make order of magnitude calculations in determining nuclear densities. MS0.1: Recognise and make use of appropriate units (eV, MeV and J) in binding energy calculations. MS3.1: Translate information between graphical and numerical form with binding energy graph. MS2.1: Understand and use the symbols: =, <, <<, >>, >, ∝, ≈, Δ MS3.5: Calculate rate of change from a graph showing a linear relationship.	Numeracy:	Numeracy:

Enrichment / opportunities to develop cultural capital (including careers, WRL and SMSC):
Attend lectures at London Universities and Institutions to enrich learning about a wide variety of Science, technology and engineering topics of which Physics makes a major contribution. Attend workshops and holiday schools run by universities to help prepare for university studies.