Curriculum Map: Year 12 Subject: A-level Physics Exam Board: AQA

Topic	Key Knowledge *What will all students KNOW by the end of the topic?*	Key Skills *What key skills will be learnt/developed by the end of the topic? What will all students be able to DO by the end of the topic?*	Assessment Opportunities *What are the key pieces of assessment? How will students be assessed?*
Further Mechanics	• Mathematical study of mass-spring systems and simple pendulum • Variation of kinetic energy, gravitational potential energy and total energy with both displacement and time. • Effects of damping on oscillations. • Qualitative treatment of free and forced vibrations. • Resonance and the effects of damping on the sharpness of resonance. • Examples of resonance in mechanical systems and situations involving stationary waves.	• Appreciation that the v – t graph is derived from the gradient of the x – t graph and that the a – t graph is derived from the gradient of the v – t graph. From completing Required Practical 7 • How to reduce uncertainties • Using a fiducial point to reduce parallax error • How to increase accuracy with small measurements	Past ISA Questions Questioning in class AFL in class PPQ Targeted Worksheets
Gravitational and Electric Fields	• Concept of a force field as a region in which a body experiences a non-contact force. • Students should recognise that a force field can be represented as a vector, the direction of which must be determined by inspection. • Gravity as a universal attractive force acting between all matter. • Newton's law of universal gravitation • Representation of a gravitational field by gravitational field lines. • Gravitational potential as force per unit mass • Magnitude of g in a radial field • Definition of gravitational potential, including zero value at infinity. • Use of gravitational potential difference. • Work done in moving a mass m within a gravitational field • Equipotential surfaces • Gravitational potential in a radial field • Graphical representations of variations of gravitational field strength and gravitational potential with distance from the centre of mass of a body • Orbital period and speed related to radius of circular orbit •	• Interpret g-r and V-r graphs • Use of log scales when plotting data • Working with inter-related quantities such as field strength and potential • Interpretation of area under graphs and gradient of graphs using unit analysis • Use of infinity as a zero reference point	Questioning in class AFL in class PPQ Targeted Worksheets inc PhysSheets

	Derivation of Kepler's Law • Energy considerations for an orbiting satellite. • Escape velocity. • Synchronous orbits. • Use of satellites in low orbits and geostationary orbits • Force between point charges in a vacuum: • Permittivity of free space • Appreciation that air can be treated as a vacuum when calculating force between charges & that for a charged sphere, charge may be considered to be at the centre. • Comparison of magnitude of gravitational and electrostatic forces between subatomic particles. • Representation of electric fields by electric field lines. • Electric field strength. In uniform & radial fields • Trajectory of moving charged particle entering a uniform electric field initially at right angles. • Definition of absolute electric potential, including zero value at infinity • Use of electric potential difference. • Work done in moving charge a charge through a potential difference • Equipotential surfaces & no work done moving charge along an equipotential surface. • Electric potential in a radial field • Graphical representations of variations of electric field strength and electric potential with distance from a point charge; use of these graphs • Relationship of electric field strength and electric potential		
Thermal	• Internal energy is the sum of the randomly distributed kinetic energies and potential energies of the particles in a body. • The internal energy of a system is increased when energy is transferred to it by heating or when work is done on it (• Qualitative treatment of the first law of thermodynamics. • During a change of state the potential energies of the particle ensemble are changing but not the kinetic energies. • Calculations involving specific heat capacity and specific latent heat. • Gas laws as experimental relationships between pressure, volume, temperature and the mass of the gas.	From completing Required Practical 8 • Safely using practical equipment • Identifying hazards • Derivation of pV = ⅓Nm (crms) 2 • Use of this equation	

	• Concept of absolute zero of temperature. • Ideal gas equation • Work done on a gas = pΔV • Avogadro constant, molar gas constant & the Boltzmann constant • Use of molar mass and molecular mass. • Brownian motion as evidence for existence of atoms. • Explanation of relationships between pressure, volume & temperature in terms of a simple molecular model. • The gas laws are empirical in nature whereas the kinetic theory model arises from theory. • Assumptions leading to pV = ⅓Nm (crms) 2 • For an ideal gas internal energy is kinetic energy of the atoms. • Use of the equation for average molecular kinetic energy • Appreciation of how knowledge and understanding of the behaviour of a gas has changed over time.		
Nuclear	• Qualitative study of Rutherford scattering. • Appreciation of how knowledge and understanding of the structure of the nucleus has changed over time • Properties and experimental identification of alpha, beta and gamma radiation using simple absorption experiments and the relative hazards of exposure to humans. • Applications of alpha, beta and gamma radiation including thickness measurements of aluminium foil paper and steel. • Inverse-square law for gamma radiation and its application to safe handling of radioactive sources. • Background radiation; examples of its origins and experimental elimination from calculations. • Appreciation of balance between risk and benefits in the uses of radiation in medicine • Random nature of radioactive decay; constant decay probability of a given nucleus; • Use of activity • Modelling with constant decay probability.	From completing Required Practical 12 • Work in a safe way with radioactive materials • Complete a risk assessment for working with radioactive materials • How to cite a reference • Use of background count rate • Reducing uncertainty in measurement of radioactive decay by counting over a longer time period • Compare a relationship to the equation for a straight line graph and use to demonstrate a mathematical relationship (in this case the inverse square law) • Use of molar mass or the Avogadro constant. • Use of log graphs • Use of nuclear energy level diagrams. • Conversion of units; 1 u = 931.5 MeV. • Converting degrees to acr seconds • Converting degrees to radians and vice versa	Questioning in class AFL in class PPQ Targeted Worksheets inc PhysSheets

	• Half-life including determining of half-life from graphical decay data including decay curves and log graphs. • Application of half life e.g. relevance to storage of radioactive waste, radioactive dating etc. • Graph of neutron number (N) against atomic number (Z) for stable nuclei. • Possible decay modes of unstable nuclei including α, β+, β− and electron capture. • Changes in N and Z caused by radioactive decay and representation in simple decay equations. • Existence of nuclear excited states; γ ray emission and its application e.g. use of technetium-99m in medical diagnosis. • Estimate of radius from closest approach of alpha particles and determination of radius from electron diffraction. • Knowledge of typical values for nuclear radius. • Dependence of radius on nucleon number • R = R0A1/3 derived from experimental data and its interpretation evidence for constant density of nuclear material. • Calculation of nuclear density. • Graph of intensity against angle for electron diffraction by a nucleus. • Appreciation that E = mc2 applies to all energy changes • Simple calculations involving mass difference and binding energy. • Use of the atomic mass unit, u. • Fission and fusion processes. • Simple calculations from nuclear masses of energy released in fission and fusion reactions. • Graph of average binding energy per nucleon against nucleon number & interpretation of regions where nuclei will release energy when undergoing fission/fusion. • Appreciation that knowledge of the physics of nuclear energy allows society to use science to inform decision making. • Fission induced by thermal neutrons and the; possibility of a chain reaction; critical mass. • The functions of the moderator, control rods, and coolant in a thermal nuclear reactor. • Simple mechanical		

	model of moderation by elastic collisions. • Factors affecting the choice of materials for the moderator, control rods and coolant. Examples of materials used for these functions. • Fuel used, remote handling of fuel, shielding and emergency shut-down. • Production, remote handling and storage of radioactive waste materials. • Appreciation of balance between risk and benefits in the development of nuclear power		
Capacitors	• Definition of capacitance: • Dielectric action in a capacitor including the action of a simple polar molecule that rotates in the presence of an electric field. • Relative permittivity and dielectric constant. • Graphical representation of charging and discharging of capacitors through resistors. Corresponding graphs for Q, V and I against time for charging and discharging. • Time constant RC. • Calculation of time constants including their determination from graphical data. • Half life of a capacitor • Quantitative treatment of capacitor charging and discharging for charge, potential difference and current	From completing Required Practical 9 • Work in a safe way with capacitors • Complete a risk assessment for working with capacitors • How to cite a reference • Use of a log-linear graph to demonstrate a mathematical relationship (in this case exponential decay) • Use of log-linear graph and of linear decay curve to determine time constant • Use of data logging equipment as a time-saving method to determine time constant • Interpretation of gradients and areas under graphs where appropriate.	Questioning in class AFL in class PPQ Targeted Worksheets inc PhysSheets
Magnetic Fields	• Force on a current-carrying wire in a magnetic field when field is perpendicular to current. • Fleming's left hand rule. • Magnetic flux density and definition of the tesla. • Force on charged particles moving in a magnetic field when the field is perpendicular to velocity. • Direction of force on positive and negative charged particles causing a circular path; application in devices such as the cyclotron. • Magnetic flux and magnetic flux linkage • Flux and flux linkage passing through a rectangular coil rotated in a magnetic field	From completing Required Practical 10 • Use of set square to reducing uncertainty in measurement of length or wire and to ensure magnetic field is perpendicular to the current. • Plotting a straight line graph and sing the gradient to determine a value for the magnetic field strength From completing Required Practical 11 • How to control difficult to control variables (such as the position of the search coil in the magnetic	Questioning in class AFL in class PPQ Targeted Worksheets inc PhysSheets

	• Magnetic induction in simple experimental phenomena. • Faraday's and Lenz's laws. • Magnitude of induced emf = rate of change of flux linkage • Applications such as a straight conductor moving in a magnetic field. • Equation for the emf induced in a coil rotating uniformly in a magnetic field • Sinusoidal voltages and currents; root mean square, peak and peak-to-peak values and application to mains electricity • Use of an oscilloscope as a dc and ac voltmeter, to measure time intervals and frequencies, and to display ac waveforms. • The transformer equation: Ns Np = Vs Vp • Transformer efficiency • Production of eddy currents. • Causes of inefficiencies in a transformer. • Transmission of electrical power at high voltage including calculations of power loss in transmission lines.		
Further Mechanics			Targeted Worksheets inc PhysSheets Questioning in class AFL in class PPQ
Option			