Scheme of Work
AQA A-level Physics Year 2 of A-level

This course covers the requirements of the second year of AQA AS and A-level Physics specification. These schemes of work are designed to accompany the use of Collins' AQA A-level Physics Year 2 Student Book.

We have assumed that 120 one-hour lessons are taught during the year, 95 of which will cover the Specification's Core units. Each lesson is matched to the Specification content. It is suggested in which lessons the six Required Practicals may be carried out.

Outline schemes have been provided for each of the five Option units, allowing 25 lessons for each.

The schemes of work suggested are of course flexible, and editable, to correspond with your timetabling and to enable you to plan your own route through the course. Time is allowed in the schemes for consolidation and exam questions practice at the end of each topic. This should help enable students to draw together all their knowledge from earlier in the course.

Scheme of Work

AQA A-level Physics Year 2 of A-level: CORE (95 hours)

One-hour lessons	Specification Content	Required Practicals
CHAPTER 1 CIRCULAR MOTION (5 hours)		
1 Going round in circles	3.6.1.1 Motion in a circular path at constant speed implies there is an acceleration and requires a centripetal force Magnitude of angular speed $\omega = v/r = 2\pi f$ Radian measure of angle Direction of angular velocity will not be considered	
2 Going round a bend	3.6.1.1 Centripetal acceleration $a = v^2/r = \omega^2 r$ The derivation of the centripetal acceleration formula will not be examined. Centripetal force $F = mv^2/r = m\omega^2 r$	
3 Banking at the velodrome		
4 Staying in the loop		
5 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 2 OSCILLATIONS (11 hours)		
1 Introducing simple harmonic motion (SHM)	3.6.1.2 Analysis of characteristics of simple harmonic motion (SHM) $x = A \cos \omega t$ Graphical representation linking the variation of x with time.	
2 Velocity and acceleration in SHM	3.6.1.2 Graphical representations linking the variations of v and a with time. 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.	
3 SHM equations	Condition for SHM: $a \propto -x$ Defining equation: $a = -\omega^2 x$ $v = \pm\omega\sqrt{A^2 - x^2}$ Maximum speed = ωA Maximum acceleration = $\omega^2 A$	
4 The physics of an oscillating mass–spring system	3.6.1.3 Study of mass–spring system:	

One-hour lessons	Specification Content	Required Practicals
5 Timing oscillations of a mass–spring system	$T = 2\pi\sqrt{\frac{m}{k}}$	Required Practical 7 Part 1: Investigation into simple harmonic motion using a mass–spring system
6 The physics of an oscillating simple pendulum	3.6.1.3 Study of simple pendulum: $T = 2\pi\sqrt{\frac{l}{g}}$	
7 Timing oscillations of a simple pendulum		Required Practical 7 Part 2: Investigation into simple harmonic motion using a simple pendulum
8 Using logarithms to analyse the pendulum data		
9 Oscillation energy and damping	3.6.1.3 Variation of E_k, E_p, and total energy with both displacement and time Effects of damping on oscillations	
10 Forced vibrations and resonance	3.6.1.4 Qualitative treatment of free and forced vibrations Resonance and the effects of damping on the sharpness of resonance Examples of these effects in mechanical systems and situations involving stationary waves	
11 Applying knowledge and skills	3.6.1.4 Examples of these effects in mechanical systems and situations involving stationary waves Questions may involve other harmonic oscillators (e.g. liquid in U-tube) but full information will be provided in questions where necessary *(Consolidation and exam questions practice)*	
CHAPTER 3 THERMAL PHYSICS (14 hours)		
1 Changing internal energy	3.6.2.1 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 (and vice versa), e.g. a qualitative treatment of the first law of thermodynamics For a change of temperature: $Q = mc\,\Delta\theta$ where c is specific heat capacity	
2 Measuring specific heat capacity using electrical heating	3.6.2.1 Calculations involving transfer of energy For a change of temperature: $Q = mc\,\Delta\theta$ where c is specific heat capacity	
3 Alternative methods for measuring specific heat capacity		
4 Energy transfer by fluid flow	3.6.2.1 Calculations involving transfer of energy Calculations including continuous flow	
5 Changing state	3.6.2.1 Appreciation that during a change of state the potential energies of the particle ensemble are	

One-hour lessons	Specification Content	Required Practicals
	changing but not the kinetic energies Calculations involving transfer of energy For a change of state $Q = ml$ where l is the specific latent heat	
6 Boyle's law	3.6.2.2 Gas laws as experimental relationships between p, V, T and the mass of the gas	Required practical 8 Part 1: Investigation of Boyle's (constant temperature) law for a gas
7 Charles' law	3.6.2.2 Gas laws as experimental relationships between p, V, T and the mass of the gas Concept of absolute zero of temperature	Required practical 8 Part 2: Investigation of Charles's (constant pressure) law for a gas
8 The pressure law	3.6.2.2 Gas laws as experimental relationships between p, V, T and the mass of the gas	
9 The ideal gas equation	3.6.2.2 Ideal gas equation: $pV = nRT$ for n moles and $pV = NkT$ for N molecules Avogadro constant N_A, molar gas constant R, Boltzmann constant k Molar mass and molecular mass Work done = $p\,\Delta V$	
10 The development of atomic and kinetic theory	3.6.2.3 Brownian motion as evidence for existence of atoms Appreciation of how knowledge and understanding of the behaviour of a gas has changed over time	
11 Using kinetic theory to explain the gas laws	3.6.2.3 Explanation of relationships between p, V and T in terms of a simple molecular model Students should understand that the gas laws are empirical in nature whereas the kinetic theory model arises from theory	
12 Molecular kinetic energy	3.6.2.3 Appreciation that for an ideal gas internal energy is kinetic energy of the atoms	
13 The kinetic theory equation	3.6.2.3 Assumptions leading to $pV = \frac{1}{3}Nm(c_{\mathrm{rms}})^2$ including derivation of the equation and calculations A simple algebraic approach involving conservation of momentum is required Use of average molecular kinetic energy = $\frac{1}{2}m(c_{\mathrm{rms}})^2 = \frac{3kT}{2} = \frac{3RT}{2N_A}$	
14 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 4 GRAVITATIONAL FIELDS (8 hours)		
1 Newton's law of gravity	3.7.2.1 Gravity as a universal attractive force acting between all matter	

One-hour lessons	Specification Content	Required Practicals
	Magnitude of force between point masses: $F = \frac{Gm_1m_2}{r^2}$ where *G* is the gravitational constant	
2 Gravitational field strength	3.7.1 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 Force fields arise from the interaction of mass 3.7.2.2 Representation of a gravitational field by gravitational field lines g as force per unit mass as defined by $g = F/m$ Magnitude of g in a radial field given by $g = GM/r^2$	
3 Gravitational potential	3.7.2.3 Understanding of definition of gravitational potential, including zero value at infinity Understanding of gravitational potential difference Work done in moving mass m given by $\Delta W = m\,\Delta V$ Equipotential surfaces Idea that no work is done when moving along an equipotential surface V in a radial field given by $V = -GM/r$ Significance of the negative sign	
4 Graphical representations of potential	3.7.2.3 Graphical representations of variations of g and V with r V related to g by: $g = -\Delta V/\Delta r$ ΔV from area under graph of g against r	
5 Orbits of planets and moons	3.7.2.4 Derivation of $T^2 \propto r^3$	
6 Looking at satellites	3.7.2.4 Orbital period and speed related to radius of circular orbit Synchronous orbits Use of satellites in low orbits and geostationary orbits, to include plane and radius of geostationary orbit	
7 Satellite energy	3.7.2.4 Energy considerations for an orbiting satellite Total energy of an orbiting satellite Escape velocity	
8 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 5 ELECTRIC FIELDS (8 hours)		
1 Measuring static electricity	3.7.3.1 Force between point charges in a vacuum: $F = \frac{Q_1Q_2}{4\pi\varepsilon_0 r^2}$	

One-hour lessons	Specification Content	Required Practicals
	Permittivity of free space, ε_0 Appreciation that air can be treated as a vacuum when calculating force between charges	
2 Applying Coulomb's law	3.7.3.1 Force between point charges in a vacuum: $F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$ For a charged sphere, charge may be considered to be at the centre Comparison of magnitude of gravitational and electrostatic forces between subatomic particles	
3 A radial electric field	3.7.3.2 Representation of electric fields by electric field lines Electric field strength E as force per unit charge defined by $E = F/Q$ Magnitude of E in a radial field given by $E = \frac{Q}{4\pi\varepsilon_0 r^2}$	
4 A uniform electric field	3.7.3.2 Magnitude of E in a uniform field given by $E = V/d$ Derivation from work done moving charge between plates: $Fd = Q\,\Delta V$	
5 Deflection of charged particles	3.7.3.2 Trajectory of moving charged particle entering a uniform electric field initially at right angles	
6 Electric potential	3.7.3.3 Understanding of definition of absolute electric potential, including zero value at infinity, and of electric potential difference Work done in moving charge Q given by $\Delta W = Q\,\Delta V$ Magnitude of V in a radial field given by $V = \frac{Q}{4\pi\varepsilon_0 r}$ Graphical representations of variations of E and V with r V related to E by $E = \Delta V/\Delta r$ ΔV from the area under graph of E against r Equipotential surfaces No work done moving charge along an equipotential surface	
7 Comparing *E* and *g* fields	3.7.1 Force fields arise from the interaction of mass, of static charge, and between moving charges Similarities and differences between gravitational and electrostatic forces: Similarities: both have inverse-square force laws that have many characteristics in common, e.g. use of field lines, use of potential concept, equipotential surfaces, etc. Differences: masses always attract, but charges may attract or repel	
8 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 6 CAPACITANCE (10 hours)		
1 Introducing the capacitor	3.7.4.1 Definition of capacitance: $C = Q/V$	

One-hour lessons	Specification Content	Required Practicals
2 The action of a dielectric	3.7.4.2 Dielectric action in a capacitor: $C = \frac{A\varepsilon_0\varepsilon_r}{d}$ Relative permittivity and dielectric constant Students should be able to describe the action of a simple polar molecule that rotates in the presence of an electric field	
3 Energy stored in a capacitor	3.7.4.3 Interpretation of the area under a graph of charge against pd $E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$	
4 Analysis of a charging capacitor		
5 Measuring the variation of capacitor charging current	3.7.4.4 Graphical representation of charging of capacitors through resistors Graphs of I against time for charging Interpretation of gradients and areas under graphs where appropriate Time constant *RC* Calculation of time constants including their determination from graphical data Time to halve, $T_{½}$ = 0.69*RC*	Required practical 9 Part 1: Investigation of the charge of capacitors. Analysis techniques should include log-linear plotting leading to a determination of the time constant *RC*
6 Considering the pd and charge of a charging capacitor	3.7.4.4 Corresponding graphs for *Q* and *V* against time for charging Interpretation of gradients and areas under graphs where appropriate Calculation of time constants including their determination from graphical data Quantitative treatment of capacitor charge: $Q = Q_0\left(1 - e^{-\frac{t}{RC}}\right)$	
7 Analysis of a discharging capacitor		
8 Measuring the variation of capacitor discharging current	3.7.4.4 Graphical representation of discharging of capacitors through resistors Corresponding graphs for *Q, V* and I against time for discharging Interpretation of gradients and areas under graphs where appropriate Quantitative treatment of capacitor discharge: $Q = Q_0 e^{-\frac{t}{RC}}$ Use of the corresponding equations for *V* and I	Required practical 9 Part 2: Investigation of the discharge of capacitors. Analysis techniques should include log-linear plotting leading to a determination of the time constant *RC*
9 Continuing the analysis of a discharging capacitor		
10 Applying knowledge and skills	*(Consolidation and exam questions practice)*	

One-hour lessons	Specification Content	Required Practicals
CHAPTER 7 MAGNETIC FIELDS (7 hours)		
1 Investigating the effect of a magnetic field on a wire part 1	3.7.5.1 Force on a current-carrying wire in a magnetic field Fleming's left hand rule	Required practical 10 Part 1: Investigate how the force on a wire varies with magnetic flux density and current using a top pan balance.
2 Investigating the force on a wire part 2		Required practical 10 Part 2: Investigate how the force on a wire varies with magnetic flux density and length of wire using a top pan balance.
3 Magnetic flux density	3.7.5.1 Force on a current-carrying wire in a magnetic field: $F = BIl$ when field is perpendicular to current Magnetic flux density B and definition of the tesla	
4 Magnetic force on a moving charged particle	3.7.5.2 Force on charged particles moving in a magnetic field: $F = BQv$ when the field is perpendicular to velocity Direction of force on positive and negative charged particles	
5 Applications of the force on moving charged particles	3.7.5.2 Circular path of particles; application in devices such as the cyclotron	
6 Magnetic flux and flux linkage	3.7.5.3 Magnetic flux defined by $\Phi = BA$ where B is normal to A. Flux linkage as $N\Phi$ where N is the number of turns cutting the flux Flux and flux linkage passing through a rectangular coil rotated in a magnetic field: flux linkage $N\Phi = BAN \cos\theta$	
7 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 8 ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT (10 hours)		
1 Faraday's law	3.7.5.4 Simple experimental phenomena Faraday's law Magnitude of induced emf = rate of change of flux linkage $\varepsilon = N \Delta\Phi/\Delta t$ Applications such as a straight conductor moving in a magnetic field	
2 Investigating induced emf		Required practical 11: Investigate, using a search coil and oscilloscope, the effect on magnetic flux linkage of varying the angle

One-hour lessons	Specification Content	Required Practicals
		between search coil and magnetic field direction
3 Lenz's law	3.7.5.4 Simple experimental phenomena Lenz's law	
4 The ac generator	3.7.5.4 emf induced in a coil rotating uniformly in a magnetic field: $\varepsilon = BAN\omega \sin \omega t$	
5 Alternating pd and current	3.7.5.5 Sinusoidal voltages and currents only; root mean square, peak and peak-to-peak values for sinusoidal waveforms only $I_{rms} = \frac{I_0}{\sqrt{2}}$ $V_{rms} = \frac{V_0}{\sqrt{2}}$ Application to the calculation of mains electricity peak and peak-to-peak voltage values	
6 Analysing ac and dc waveforms	Use of an oscilloscope as a dc and ac voltmeter, to measure time intervals and frequencies, and to display ac waveforms No details of the structure of the instrument are required but familiarity with the operation of the controls is expected	
7 Transforming voltages	3.7.5.6. The transformer equation: $\frac{N_s}{N_p} = \frac{V_s}{V_p}$	
8 Transformer efficiency	3.7.5.6 Transformer efficiency $= \frac{I_s V_s}{I_p V_p}$ Production of eddy currents Causes of inefficiencies in a transformer	
9 The National Grid	3.7.5.6 Transmission of electrical power at high voltage including calculations of power loss in transmission lines	
10 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 9 RADIOACTIVITY (10 hours)		
1 Atomic structure and alpha particle scattering	3.8.1.1 Qualitative study of Rutherford scattering Appreciation of how knowledge and understanding of the structure of the nucleus has changed over time. 3.8.1.5 Estimate of radius from closest approach of alpha particles Students will need to be familiar with the Coulomb equation for the closest approach estimate	

One-hour lessons	Specification Content	Required Practicals
2 Alpha and beta radiation	3.8.1.2 Their (alpha and beta) properties and experimental identification using simple absorption experiments; applications, e.g. to relative hazards of exposure to humans Applications also include thickness measurements of aluminium foil, paper and steel	
3 Gamma radiation	3.8.1.2 (Gamma) properties and experimental identification using simple absorption experiments; applications, e.g. to relative hazards of exposure to humans Inverse-square law for γ radiation: $I = k/x^2$ Applications, e.g. to safe handling of radioactive sources	
4 Investigating the inverse-square law for gamma radiation	3.8.1.2 Experimental verification of inverse-square law	Required practical 12: Investigation of the inverse-square law for gamma radiation.
5 The risks and benefits of ionising radiation	3.8.1.2 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	
6 The random nature of radioactive decay	3.8.1.3 Random nature of radioactive decay; constant decay probability of a given nucleus: $\frac{\Delta N}{\Delta t} = -\lambda N$ Modelling with constant decay probability	
7 Exponential decay analysis	3.8.1.3 $N = N_0 e^{-\lambda t}$ Use of activity, $A = \lambda N$ Questions may be set which require students to use $A = A_0 e^{-\lambda t}$ Questions may also involve use of molar mass or the Avogadro constant Determination of half-life from graphical decay data including decay curves and log graphs	
8 Analysis of decay data using logarithms	3.8.1.3 Half-life equation: $T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$ Determination of half-life from graphical decay data including log graphs	
9 The implications and applications of radioactive decay	3.8.1.3 Applications, e.g. relevance to storage of radioactive waste, radioactive dating, etc.	
10 Applying knowledge and skills	*(Consolidation and exam questions practice)*	
CHAPTER 10 NUCLEAR ENERGY (12 hours)		
1 Stable and unstable isotopes	3.8.1.4 Graph of *N* against *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	
2 Nuclear excited states	3.8.1.4 Questions may use nuclear energy level diagrams Existence of nuclear excited states; γ ray emission	

One-hour lessons	Specification Content	Required Practicals
3 Use of technetium-99m	3.8.1.4 γ ray emission; application, e.g. use of technetium-99m as a γ source in medical diagnosis	
4 Using electron diffraction to measure nuclear radii	3.8.1.5 Determination of radius from electron diffraction Knowledge of typical values for nuclear radius Dependence of radius on nucleon number: $R = R_0 A^{1/3}$ derived from experimental data Students should be familiar with the graph of intensity against angle for electron diffraction by a nucleus	
5 Nuclear density and binding energy	3.8.1.5 Dependence of radius on nucleon number: $R = R_0 A^{1/3}$ Interpretation of equation as evidence for constant density of nuclear material Calculation of nuclear density 3.8.1.6 Appreciation that $E = mc^2$ applies to all energy changes Simple calculations involving mass difference and binding energy Atomic mass unit, u Conversion of units; 1 u = 931.5 MeV	
6 The significance of binding energy per nucleon	3.8.1.6 Graph of average binding energy per nucleon against nucleon number Students may be expected to identify, on the plot, the regions where nuclei will release energy when undergoing fission/fusion	
7 Fission	3.8.1.6 Fission processes Simple calculations from nuclear masses of energy released in fission reactions	
8 Fusion	3.8.1.6 Fusion processes Simple calculations from nuclear masses of energy released in fusion reactions	
9 The nuclear fission reactor	3.8.1.7 Fission induced by thermal neutrons; possibility of a chain reaction; critical mass The functions of the moderator, control rods, and coolant in a thermal nuclear reactor Details of particular reactors are not required Students should have studied a simple mechanical model of moderation by elastic collisions	
10 Nuclear power	3.8.1.7 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, emergency shut-down Production, remote handling, and storage of radioactive waste materials	
11 Discussing the benefits and risks of nuclear power	3.1.8.6 Appreciation of balance between risk and benefits in the development of nuclear power	
12 Applying knowledge and skills	*(Consolidation and exam questions practice)*	