TAUNTON SCHOOL

Year 12 Syllabus in a nutshell

A Level PHYSICS

Year 12 Syllabus in a nutshell – A Level Physics

AQA AS and A Level Scheme of Work

AS Teacher 1

Topic	Spec	Learning Objective
Use of SI units and their prefixes	3.1.1	• To recognise that a system of measurement depends on the selection of several base units • To recall the base units of the SI system • To name and use standard prefixes • To be able to convert between different units for the same quantity
Limitation of physical measurements	3.1.2	• To recognise the terms: precision, repeatability, reproducibility and accuracy • To be able to estimate absolute uncertainties and to calculate fractional and percentage uncertainties • To be able to combine absolute and percentage uncertainties • To be able to use error bars on graphs
Estimation of Physical Quantities	3.1.3	• To understand and to use orders of magnitude • To derive estimates using knowledge of physics
Constituents of the atom	3.2.1.1	• Simple model of the atom, including the proton, neutron and electron. Charge and mass of the proton, neutron and electron in SI units and relative units. • Specific charge of the proton and the electron, and of nuclei and ions. • Proton number Z, nucleon number A, nuclide notation. • Students should be familiar with the notation $^{A}_{Z}X$ • Meaning of isotopes and the use of isotopic data.
Stable and unstable nuclei	3.2.1.2	• The strong nuclear force: its role in keeping the nucleus stable; short-range attraction up to approximately 3 fm, very-short range repulsion closer than approximately 0.5 fm • Unstable nuclei; alpha and beta decay • Equations for alpha decay, β- decay including the need for the neutrino. • The existence of the neutrino was hypothesised to account for conservation of energy in beta decay
Particles, antiparticles and photons	3.2.1.3	• For every type of particle, there is a corresponding antiparticle • Knowledge of particle antiparticle pairs and a comparison of their properties • The photon model of electromagnetic radiation. • The energy of photons • The mechanisms of annihilation of matter and antimatter and pair production
Particle interactions	3.2.1.4	• The four fundamental interactions • The fundamental interactions in terms of exchange particles • The weak interaction • Diagrams to represent the fundamental interactions
Quarks and antiquarks	3.2.1.6	• Properties of quarks and antiquarks • Combinations of quarks and antiquarks required for baryons, antibaryons and mesons

Classification of particles	3.2.1.5	• Hadrons are subject to the strong interaction. • There are two classes of hadrons • Baryon number and its conservation • The proton as the only stable baryon • The pion as the exchange particle of the strong nuclear force • The decay of kaons into pions. Leptons are affected by the weak interaction. • Examples of leptons and their antiparticles • Lepton number and its conservation • The decay of muons into electrons • Strange particles and their production through the strong interaction and their decay through the weak interaction • Strangeness and its conservation in strong interactions • Strangeness does not have to be conserved in the weak interaction
Applications of conservation laws	3.2.1.7	• Change of quark nature in b- and b+ decay • Application of conservation laws for charge, baryon number, lepton number and strangeness for particle interactions • Conservation of energy and momentum in interactions
Collisions of electrons with atoms	3.2.2.2	• Ionisation and excitation • Application in the fluorescent tube • The electron volt
Energy levels and photo emission	3.2.2.3	• Line spectra as evidence of discrete energy levels • Calculation of the frequency of emitted photons
The photoelectric effect	3.2.2.1	• Description of the photoelectric effect • Explanation of threshold frequency in terms of photon model • Explanation of work function and stopping potential • The photoelectric equation
Wave-particle duality	3.2.2.4	• Electron diffraction as a demonstration that particles possess wave properties • The photoelectric effect as a demonstration that electromagnetic waves have a particulate nature • The de Broglie wavelength
Progressive waves	3.3.1.1	• Define the terms amplitude, frequency, period, wavelength, phase and phase difference • Use the equation c= fλ
Longitudinal and transverse waves	3.3.1.2	• The nature of longitudinal and transverse waves • Electromagnetic waves as examples of transverse waves • Speed of electromagnetic waves • Polarisation as a feature of transverse waves • Applications of polarisers
Refraction at a plane surface	3.3.2.3	• Define refractive index in terms of wave speed in different media • Snell's law of refection at a boundary: $n_1 \sin\theta_1 = n_2 \sin\theta_2$ • Total internal reflection $\sin\theta_c = \frac{n_1}{n_2}$ • Step index optic fibres including the function of the cladding • Material and modal dispersion and the consequences of pulse broadening and absorption

Interference	3.3.2.1	• Path difference and coherence • Demonstrate interference and diffraction using a laser as a source of monochromatic light • The Young's double split experiment. The equation for fringe space. • Fringe spacing: $w = \frac{\lambda D}{s}$ • Production of interference • The interference pattern produced by white light • Interference patterns produced by sound and electromagnetic waves • Appreciation of how knowledge and understanding of the nature of electromagnetic radiation has changed over time
Diffraction	3.3.2.2	• The appearance of the diffraction pattern from a single slit using monochromatic and white light • A qualitative treatment of the variation of the width of the central diffraction maximum and slit width • Using a plane diffraction grating with light at normal incidence • The derivation of the grating equation: $dsin\theta = n\lambda$ • Applications of the diffraction grating
Principle of superposition of waves and formation of stationary waves	3.3.1.3	• Stationary waves on strings • The meaning of nodes and antinodes in relation to standing waves • The equation for the frequency of the first harmonic for first harmonic • The formation of a stationary wave by two waves of the same frequency travelling in opposite directions • Graphical explanation for the formation of stationary waves • Examples of stationary waves including those formed on strings and those produced using sound waves or microwaves

AS Teacher 2

Topic	**Spec**	**Learning Objective**
Scholars and vectors	3.4.1.1	• The nature of scalar and vector quantities • Addition of vectors by calculation or scale drawing • Addition of vectors by calculation or scale drawing • The conditions for equilibrium for two or three coplanar forces acting at a point
Moments	3.4.1.2	• Definition of the moment of a force about a point • A couple as a pair of equal and opposite coplanar forces. The equation for the moment of a couple • The principle of moments • The centre of mass and its position in a uniform regular solid

Motion along a straight line	3.4.1.3	• Definitions of displacement, speed, velocity, acceleration • Representation by graphical methods of uniform and non-uniform acceleration • Significance of areas of velocity – time and acceleration – time graphs and gradients of displacement – time and velocity – time graphs • The equations for uniform acceleration $v = u + at$ $s = \left(\frac{u+v}{t}\right)t$ $s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ • The acceleration due to gravity, g
Projectile motion	3.4.1.4	• The factors affecting the maximum speed of a vehicle • Independent effect of motion in horizontal and vertical directions of a uniform gravitational field • A qualitative treatment of friction • Qualitative treatments of lift and drag forces • A qualitative treatment of the effects of air resistance on the trajectory of a projectile
Newton's laws of motion	3.4.1.5	• Knowledge and application of the three laws of motion • Use of the equation; F=ma
Work, energy and power	3.4.1.7	• The relationship between energy transferred and work done W=Fscosθ • Rate of doing work is equal to the rate of energy transfer $P = \frac{\Delta W}{\Delta t} = Fv$ • The significance of the area under a force displacement graph • Efficiency as the ratio of useful output power to input power
Conservation of energy	3.4.1.8	• The principle of conservation of energy • Kinetic energy and gravitational potential energy • Quantitative and qualitative applications of energy conservation
Momentum	3.4.1.6	• Define momentum • The conservation of linear momentum in one dimension • Force as rate of change of momentum • Define impulse and its relationship to the area under a force time graph • The relationship between impact forces and contact time • Distinguish between elastic and inelastic collisions • Apply the conservation of momentum to explosions
Bulk of properties of solids	3.4.2.1	• The definition of density • Hooke's law and the elastic limit • The force extension equation: $F = k\Delta l$ • Definitions of tensile stress and tensile strain • The meaning of breaking stress • Elastic strain energy $energy\ stored = \frac{1}{2}F\Delta l$ • Description of plastic behaviour, fracture and brittle behaviour related to force – extension graphs

		• Application of energy conservation to examples involving elastic strain energy and energy to deform • The transformation of spring energy to kinetic and gravitational potential energy • Appreciation of energy conservation issues in the context of ethical transport design • Interpretation of stress – strain curves
The Young modulus	3.4.2.2	• The definition of the Young modulus • Experiment to determine the Young modulus using a stress-strain graph
Basics of electricity	3.5.1.1	• Electric current is the rate of flow of charge • Potential difference is the work done per unit charge • The definition of resistance
Current voltage characteristics	3.5.1.2	• The current – voltage characteristics for an ohmic conductor, a semiconductor diode and a filament lamp • Ohm's law as a special case where current is directly proportional to voltage under constant physical conditions
Resistivity	3.5.1.3	• Description of the qualitative effect of temperature on the resistance of metal conductors • The effect of temperature on a negative temperature coefficient thermistor • Application of thermistors in temperature sensors • Resistivity, $\rho = \frac{RA}{L}$ • Experiment to determine the resistivity of a wire • Superconductivity as a property of certain materials which have zero resistivity at or below the critical temperature • Applications of superconductors
Circuits	3.5.1.4	• Cells in series and identical cells in parallel • The relationship between currents, voltages and resistances in series and parallel circuits • The conservation of charge and energy in dc circuits • Combining resistors in series and in parallel • The energy and power equations: • E=VIt $P = VI = I^2R = \frac{V^2}{R}$
Potential divider	3.5.1.5	• The potential divider used to supply constant or variable potential difference from a power supply • The use of variable resistors, light dependent resistors and thermistors in potential divider circuits
Electromotive force and internal resistance	3.5.1.6	• The definition of emf • Circuit equation when cells have appreciable internal resistance $\epsilon = I(R + r)$ • Terminal pd