Year 13

Knowledge	**Skills**
<u>Scientific Working</u> Know and understand the distinction between base and derived quantities and their SI units Understand the limitations of physical measurement and apply these imitations to practical situations Understand applications and implications of science and evaluate their associated benefits and risks Understand the role of the scientific community in validating new knowledge and ensuring integrity Understand the ways in which society uses science to inform decision making.	<u>Scientific Working</u> Be able to estimate values for physical quantities and use their estimate to solve problems Demonstrate knowledge of practical skills and techniques for both familiar and unfamiliar experiments Be able to communicate information and ideas in appropriate ways using appropriate terminology

Further Mechanics	Further Mechanics
Know the physical quantities derived from the slopes and areas of displacement-time, velocity-time and acceleration-time graphs, including cases of non-uniform acceleration and understand how to use the quantities Understand scalar and vector quantities and know examples of each type of quantity and recognise vector notation Understand how to make use of the independence of vertical and horizontal motion of a projectile moving freely under gravity Be able to use the equation $\Sigma F = ma$ Know and understand Newton's third law of motion and know the properties of pairs of forces in an interaction between two bodies Understand that momentum is defined as $p = mv$. Relate this to Newton's laws of motion and understand how to apply this to problems in one dimension Know the principle of conservation of linear momentum Know, and understand how to apply, the principle of conservation of energy including use of work done, gravitational potential energy and kinetic energy	Be able to draw and interpret displacement-time, velocity-time and acceleration-time graphs Be able to draw and interpret free-body force diagrams to represent forces on a particle or on an extended but rigid body Be able to use the equations for uniformly accelerated motion in one dimension Be able to resolve a vector into two components at right angles to each other by drawing and by calculation Use $\Sigma F = ma$ equation in situations where m is constant (Newton's second law of motion), including Newton's first law of motion where $a = 0$, objects at rest or travelling at constant velocity Be able to find the resultant of two coplanar vectors at any angle to each other by drawing, and at right angles to each other by calculation Be able to use the equations for gravitational field strength weight Be able to use the equation for the moment of a force Be able to use the concept of centre of gravity of an extended body and apply the principle of moments to an extended body in equilibrium Be able to use the equation for work Be able to use the equation for the kinetic energy of a body

Electric and Magnetic Fields + Gravitational Fields	Electric and Magnetic Fields + Gravitational Fields
Understand that electric current is the rate of flow of charged particles	Be able to use the equation for the difference in gravitational potential energy near the Earth's surface
Understand how to use the equation for energy charge and potential difference	Be able to use the equation for resistivity
Understand that resistance is defined by $R = V/I$ and that Ohm's law is a special case when $I \propto V$ for constant temperature	Be able to use the equations relating power, time and energy transferred or work done
Understand how the distribution of current in a circuit is a consequence of charge conservation	Be able to use the equations for efficiency
Understand how the distribution of potential differences in a circuit is a consequence of energy conservation	Be able to derive the equations for combining resistances in series and parallel using the principles of charge and energy conservation, and be able to use these equations
Be able to use the equations $P = VI$, $W = VIt$ and be able to derive and use related equations	Understand how to sketch, recognise and interpret current-potential difference graphs for components, including ohmic conductors, filament bulbs, thermistors and diodes
Understand how the potential along a uniform current-carrying wire varies with the distance along it	Be able to use $I = nqvA$ to explain the large range of resistivities of different Materials
Understand the principles of a potential divider circuit and understand how to calculate potential differences and resistances in such a circuit	Be able to analyse potential divider circuits where one resistance is variable including thermistors and light dependent resistors (LDRs)
Know the definition of *electromotive force (e.m.f.)* and understand what is meant by *internal resistance* and know how to distinguish between e.m.f. and *terminal potential difference*	
Understand how changes of resistance with temperature may be modelled in terms of lattice vibrations and number of conduction electrons.	Apply this model to metallic conductors and negative temperature coefficient thermistors
Understand how changes of resistance with illumination may be modelled in terms of the number of conduction electrons.	Apply this model to LDRs

Thermodynamics Define the concept of absolute zero. Explain kinetic energy of molecules in terms of absolute zero. Define internal energy qualitatively and quantitatively. Describe phase changes in terms of specific heat capacity and specific latent heat. Describe a black body radiator.	Thermodynamics Calibrate a thermistor to act as a thermostat. Use associated equations theoretically and practically. Investigate specific latent heat practically.

Nuclear and Particle Physics and Nuclear Radiation	Nuclear and Particle Physics and Nuclear Radiation
Explain mass and atomic number.	Explain the evidence given by large angle alpha particle scattering for the nuclear atom
Explain thermionic emission in terms of electrons and the acceleration of electrons by electric and magnetic fields.	
Describe the roles of electric and magnetic fields in particle accelerators and particle detectors.	Use and derive the equation for a charged particle in a magnetic field.
Understand the significance of using high energies to investigate nucleus structure including fundamental particles.	Apply principles to the Large Hadron Collider.
Understand creation and annihilation of matter and anti-matter particles.	Quantify using appropriate equations.
Define baryons, mesons and photons.	Apply laws of conservation of charge, baryon number and lepton number to determine whether particle interaction is possible.

<u>Space</u> Define black body radiator in astronomy	<u>Space</u> Interpret radiation curves for a black body radiator
Use Stefan-Boltzmann and Wien's laws and equations.	
Sketch Hertzspring-Russell diagrams relating stellar luminosity to surface temperature.	Relate the diagrams to the life cycle of stars.
Understand astronomical distances.	Be able to use trigonometric parallax, the equation for the intensity of a star and standard candles.
Define the Doppler effect and Hubble's law.	Apply these to red shift of light and cosmological distances.
Understand the scientific debate about the age of the universe.	Explain this in terms of the Hubble constant and dark matter.

<u>Oscillations</u> Describe simple harmonic motion Apply conservation of energy to undamped oscillating systems. Explain free and forced oscillations, resonance, and damping.	<u>Oscillations</u> Interpret a distance time graph for a simple harmonic oscillator and use the equations for this and a simple pendulum. Explain the uses and implications of damping.