KS5 Curriculum Map – Physics:

Topic	Substantive Knowledge This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	Disciplinary Knowledge (Skills) This is the action taken within a particular topic in order to gain substantive knowledge.	Assessment Opportunities What assessments will be used to measure student progress?
Matter and radiation	• List the components of an atom • Describe what happens when an unstable nucleus emits an alpha particle or a beta minus particle • Recall what is meant by a photon. • Calculate the energy of a photon. • Define antimatter. • Describe what happens when a particle and its antiparticle meet. • Describe what is meant by an interaction. • Name different types of interaction.	• Explain why some nuclei are stable and others unstable. • Estimate how many photons a light source emits every second. • Discuss whether anti-atoms are possible. • Explain what makes charged particles attract or repel each other. • Construct or complete Simple diagrams to represent the above reactions or interactions in terms of incoming and outgoing particles and exchange particles.	• Multiple choice test • Controlled Homework • Mini Formative tests • Summative end of unit tests

Quarks and leptons	• State whether we can predict new particles. • Describe strange particles. • Recognise hadrons. • Recognise leptons. • Distinguish between different types of neutrinos. • Define strange particles. • Define quarks and explain how we know they exist. • State the conservation rules for particle interactions.	• Explain how we can find new particles. • Identify different classifications of particles. • Consider whether leptons are elementary. • Evaluate the importance of lepton numbers. • Explain the quark changes that happen in beta decay • Explain why it could be said that there are no antimesons. • Explain what is sometimes conserved. • Explain what is never conserved. • Use conservation rules to identify possible and impossible interactions.	• Multiple choice test • Controlled Homework • Mini Formative tests • Summative end of unit tests
Quantum phenomena	• Define a photon. • Discuss how the photon model was established. • Define a quantum. • Photoelectric equation: • $hf = \varphi + E_{Kmax}$. • Explain what is meant by ionisation of an atom. • Explain what is meant by excitation of an atom. • Explain what energy levels are.	• Explain the photoelectric effect. • Explain why Einstein's photon model was revolutionary. • Explain why an electron can't absorb several photons to escape from a metal. • E_{Kmax} is the maximum kinetic energy of the photoelectrons.	• Multiple choice test • Controlled Homework • Mini Formative tests • Summative end of unit tests

	• Explain what happens when atoms de-excite. • Define a line spectrum. • . • $h f = E_1 - E_2$ • Explain why we say photons have a dual nature. • Describe how we know that matter particles have a dual nature.	• Use the photoelectric experiment graph to determine and threshold frequency. • Explain how a fluorescent tube works. • Explain why atoms emit characteristic line spectra • Calculate the wavelength of light for a given electron transition. • Discuss why we can change the wavelength of a matter particle but not that of a photon. • Use the De Broglie equation to determine momentum of photons and velocity of electron waves.	
Waves	• Explain the differences between transverse and longitudinal waves. • Define a plane-polarised wave. • Explain what is meant by the amplitude of a wave. • Explain what is meant by the wavelength of a wave. • Calculate the frequency of a wave from its period. • Explain what we mean by diffraction. • Describe the necessary condition for the formation of a stationary wave. • Explain why nodes are formed in fixed positions.	• Describe a physics test that can distinguish transverse waves from longitudinal waves. • Explain what causes waves to refract when they pass across a boundary. • Demonstrate the direction light waves bend when they travel out of glass and into air • Explain what we mean by diffraction. • Deduce whether a stationary wave is formed by superposition.	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests • Summative end of unit tests

	• Describe the simplest possible stationary wave pattern that can be formed. • Compare the frequencies of higher harmonics with the first harmonic frequency. • $c = f\lambda$ and $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$	• Explain what condition must be satisfied at both ends of the string. • Describe how an oscilloscope can be used. • Interpret waveforms on an oscilloscope to give peak voltage and wavelength. • '4.7 Practical: Speed of sound'	
Optics	• Explain what we mean by rays. • State Snell's law. • Explain what happens to the speed of light waves when they enter a material such as water. • Relate refractive index to the speed of light waves. • State the conditions for total internal reflection. • . • $n_1 \sin \vartheta_1 = n_2 \sin \vartheta_2$. • Total internal reflection $\sin \vartheta_c = \frac{n_2}{n_1}$. • Path difference. Coherence. • Interference using a laser as a source of monochromatic light.	• Comment on whether refraction is different for a light ray travelling from a transparent substance into air. • Simple treatment of fibre optics including the function of the cladding. • Explain why a glass prism splits white light into the colours of a spectrum. • Relate the critical angle to refractive index. • Explain why diamonds sparkle • 5.3 Practical • Explain why slits, rather than two separate light sources, are used in Young's double slit experiment. • Describe the roles of diffraction and interference when producing Young's fringes.	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests • Summative end of unit tests

	• Fringe spacing • $w = \frac{\lambda D}{s}$ • State the general condition for the formation of a bright fringe. • Describe the Young's double slit experiment. • Describe which factors could be (i) increased or (ii) decreased, to increase the fringe spacing. • Identify coherent sources. • Derivation of • $d \sin \vartheta = n \lambda$. • Applications of diffraction gratings.	• Practical – finding the wavelength by double slit diffraction. • Explain why diffraction of light is important in the design of optical instruments. • Compare the single slit diffraction pattern with the pattern of Young's fringes. • Describe and explain the effect of the single slit pattern on the brightness of Young's fringes. • Explain why a diffraction grating diffracts • monochromatic light in certain directions only.	
Forces in equilibrium	• Define a vector quantity. • Describe how we represent vectors. • Demonstrate when two (or more) forces have no overall effect on a point object. • Explain the parallelogram of forces.	• Explain how we add and resolve vectors • Explain why we have to consider the direction in which a force acts. • Explain how the turning effect of a given force can be increased. • Assess when a tilted object will topple over.	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests

	• Resolution of vectors into two components at right angles to each other. Examples include components of forces along and perpendicular to an inclined plane. • Describe the conditions under which a force produces a turning effect. • Explain what is required to balance a force that produces a turning effect. • Explain why the centre of mass is an important idea. • Describe the support force on a pivoted body. • When a body in equilibrium is supported at two places, state how much force is exerted on each support. • Explain what is meant by a couple. • Explain the difference between stable and unstable equilibrium. • Explain what condition must apply to the forces on an object in equilibrium. • Explain what condition must apply to the turning effects of the forces. • State the important principles that always apply to a body in equilibrium.	• Explain why a vehicle is more stable when its centre of mass is lower. • Numerous calculations and problems are used here to develop and assess students' technique and understanding. • Describe how we can apply these conditions to deduce the forces acting on a body in equilibrium, create equations describing the relationships between the forces acting on static bodies and solve these for unknown forces and distances where needed.	• Summative end of unit tests

On the move	• • Displacement, speed, velocity, acceleration. • Explain why uniform acceleration is a special case. • Explain why acceleration is considered a vector • $v = \frac{\Delta s}{\Delta t}$ • $a = \frac{\Delta v}{\Delta t}$ • Calculations include average and instantaneous speeds and velocities. • Equations for uniform acceleration: • Acceleration due to gravity, *g*. • Distinguish between *u* and *v*. • Calculate the displacement of an object moving with uniform acceleration. • Define 'free fall'. • Explain how the velocity of a freely falling object changes as it falls. • Distinguish between a distance–time graph and a displacement–time graph. • Describe what the gradient of a velocity–time graph represents. • Describe what the area under a velocity–time graph represents. • Explain how we use signs to work out if an object is moving forwards or backwards.	• Explain what else we need to know to calculate the acceleration of an object if we know its displacement in a given time. • Discuss if objects of different masses or sizes all fall with the same acceleration. • Calculate the motion of an object with constant acceleration if its velocity reverses. • Deduce whether the overall motion should be broken down into stages. • Application of the Suvat equations to a large number of typical situations. • Numerous calculations and problems are used here to develop and assess students' technique and understanding. • Practical to determine g by measuring the motion of a free-falling object. • Describe what would happen to the motion of a projectile if we could switch gravity off. • Describe where we meet projectile motion. • Explain the path of a projectile. With no drag • Describe how projectile motion is affected by the air it passes through.	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests • Summative end of unit tests

Newton’s laws of motion	• Describe what effect a resultant force produces. • Describe what would happen to a body that was already in motion if there was no resultant force acting on it. • . • Apply *F* = *m a* when the forces on an object are in opposite directions. • Describe any situations in which *F* = *m a* cannot be applied. • Explain what we mean by a drag force. • Explain what determines the terminal speed of a falling object or a vehicle. • Distinguish between braking distance and stopping distance. • Describe how road conditions affect these distances. • Explain what should be increased to give a smaller deceleration from a given speed. • State which design features attempt to achieve this in a modern vehicle.	• Explain how weight is different from mass • Explain why you experience less support as an ascending lift stops. • Explain why the speed of an object moving through a viscous fluid reaches a maximum when a driving force is still acting.	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests • Summative end of unit tests

Force and momentum	• *momentum* = *mass* × *velocity*.
	• Force as the rate of change of momentum,
	  • $F = \frac{\Delta(mv)}{\Delta t}$.
	• Impulse = change in momentum.
	  • $F \Delta t = \Delta(m v)$, where F is constant.
	• Significance of the area under a force–time graph.
	• Quantitative questions may be set on forces that vary with time. Impact forces are related to contact times (e.g., kicking a football, crumple zones, packaging).
	• Conservation of linear momentum
	• Distinguish between an elastic collision and an inelastic collision.
	• Describe what is conserved in a perfectly elastic collision.
	• Discuss whether any real collisions are ever perfectly elastic.
	• State what can always be said about the total momentum of a system that has exploded.
	• Describe the consequences when, after the explosion, only two bodies move apart.
		• Describe what happens to the momentum of a ball when It bounces off a wall.
		• Principle applied quantitatively to problems in one dimension.
		• Elastic and inelastic collisions; explosions.
		• Appreciation of momentum conservation issues in the context of ethical transport design.
		• 9.3 Practical: Testing conservation of momentum'
		• Analysis of force-time graphs.
		• Describe the energy changes that take place in an explosion.
		• Use conservation of momentum in calculations about collisions and explosions.
			• Multiple choice test
			• Controlled Homework
			• Required practical assessments
			• Mini Formative tests
			• Summative end of unit tests

Work, energy and power	• Define energy and describe how we measure it. • . • Define work (in the scientific sense). • W = F s cos θ. • Principle of conservation of energy. • ΔEp = m g Δh • and • Ek = ½ m v^2 • rate of doing work = rate of energy transfer, P = F v. • Significance of the area under a force–displacement graph. • $efficiency = \frac{useful\ output\ power}{output\ power}$. • Efficiency can be expressed as a percentage.	• Discuss whether energy ever disappears • Quantitative questions may be set on variable forces • Quantitative and qualitative application of energy conservation to examples involving gravitational potential energy, kinetic energy, and work done against resistive forces. • 10.2 Practical: Investigating the gravitational potential energy of a table tennis ball' • Exercises to identify and calculate the power of energy transfers and the efficiency of machines and processes.	• Multiple choice test • Controlled Homework • Mini Formative tests • Summative end of unit tests

Materials	• Density, $\rho = \frac{m}{V}$. • Hooke's law, elastic limit, • $F = k\,\Delta L$, • k as stiffness and spring constant. • Spring energy transformed to kinetic and gravitational potential energy. • Tensile strain and tensile stress. • Elastic strain energy, breaking stress, *energy stored* = $\frac{1}{2} F\,\Delta L$ = *area under force–extension graph*. • Description of plastic behaviour, fracture, and brittle behaviour linked to force–extension graphs. • Quantitative and qualitative application of energy conservation to examples involving elastic strain energy and energy to deform. • Appreciation of energy conservation issues in the context of ethical transport design. • *Young modulus* = $\frac{\text{tensile stress}}{\text{tensile strain}} = \frac{F\,L}{A\,\Delta L}$ • Use of stress–strain graphs to find the Young modulus. • (One simple method of measurement is required.) • 'both involves aspects of:	• Measure the density of an object. • Discuss whether there is any limit to the linear graph of force against extension for a spring. • Define the spring constant and state its unit of measurement. • If the extension of a spring is doubled, calculate how much more energy it stores. • 11.2 Practical: Investigating springs • Make calculations of the effective spring constant of a 'network' of linked springs. • Interpretation of stress–strain curves • 11.3 Practical: Determining the Young modulus' and 11.4 Practical: Deforming strawberry laces'	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests • Summative end of unit tests

Electric current	• Electric current as the rate of flow of charge; potential difference as work done per unit charge.
	  • $I = \frac{\Delta Q}{\Delta t}$
	• Energy and power equations:
	  • $E = I\,V\,t$
		• Calculate the charge flow in a circuit.
		
		• Calculate electrical power.
		
		• Explain how energy transfers take place in electrical devices
			• Multiple choice test
			
			• Controlled Homework
			
			• Required practical assessments
			
			• Mini Formative tests

	• $P = IV$ • $V = \frac{W}{Q}$ • Resistance defined as • $R = \frac{V}{I}$. • Ohm’s law as a special case where $I \propto V$ under constant physical conditions*3.5.1.3* • Resistivity, $\rho = \frac{RA}{L}$. • Superconductivity • Applications of superconductors • Current–voltage characteristics for an ohmic conductor, semiconductor diode, and filament lamp.	• Describe what causes electrical resistance. • Discuss when Ohm’s law can be used. • Explain what a superconductor is. • Make calculations relating power current pd time resistance and energy. • 12 Support: Electricity • 12.3 Support: Resistance and resistivity • 12.3 Practical: Investigating resistivity • 12.4 Practical: *I–V* characteristics • 12.4 Practical: Characteristics of light-emitting diodes • 12.4 Practical: Investigating the characteristics of a thermistor • 13 Revision podcast: Electric current	• Summative end of unit tests

DC circuits	• Energy and power equations: • $P = I^2 R = \frac{V^2}{R}$. • •State the rules for series and parallel circuits. • and the principles behind these rules. • •Calculate resistances in series and in parallel. • •Define resistance heating. • The relationships between currents, voltages, and resistances in series and	• 13.4 Practical: Conservation of energy in a circuit • Describe how we use the rules in circuits. • Calculate the current and pds for each component in a circuit. • 13.2 Practical: Investigating resistors • 13 Support: Direct current circuits	

	parallel circuits, including cells in series and identical cells in parallel. Conservation of charge and conservation of energy in dc circuits. • $\varepsilon = \frac{E}{Q}$, $\varepsilon = I(R + r)$. • Terminal pd; emf.	• Explain why the pd of a battery (or cell) in use is less than its emf. • Measure the internal resistance of a battery. • Describe how much power is wasted in a battery. • 13.3 Practical: Internal resistance and electromotive force • 13.3 Calculation sheet: Emf and pd • 13 Support: Cells, electromotive force, and internal resistance • 13.4 Practical: Investigating cell combinations • Calculate currents in circuits with: • resistors in series and parallel • more than one cell • diodes in the circuit. • Describe a potential divider.	• Multiple choice test • Controlled Homework • Required practical assessments • Mini Formative tests • Summative end of unit tests

		• Explain how we can supply a variable pd from a battery. • Explain how we can design sensor circuits. • 13 Stretch and challenge teacher sheet: Direct current circuits • 13.5 Calculation sheet: Potential dividers • 13.5 Practical: Application of potential dividers and sensor circuits	
Motion in a Circle	• Uniform Circular motion • Magnitude of angular speed • Radian measure of angle • Motion in a circular path at constant speed implies there is an acceleration and requires a centripetal force • Centripetal acceleration • Centripetal force	• Recognise uniform motion in a circle • Describing what you need to measure to find the speed of an object moving in uniform circular motion • Defining angular displacement and angular speed Explain why velocity is not constant when an object is travelling uniformly in a circle • Determining the direction of the acceleration • Calculating the centripetal force • Describing scenarios where centripetal acceleration is experienced	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests
Applications of Simple Harmonic Motion	• Analysis of characteristics of simple harmonic motion (SHM). • Condition for SHM: $a \propto -x$ • Defining equation: $a = -\omega 2x$ • Graphical representations linking the variations of x, 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 Relevant formula	• Describing the phase difference between two oscillators that are out of step. • Stating the two fundamental conditions about acceleration that apply to simple harmonic motion • Describing how displacement, velocity, and acceleration vary with time • Calculating the velocity for a given displacement. Stating the circumstances in which resonance occurs	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests

	• Energy and simple harmonic motion • Effects of damping on oscillations. • Qualitative treatment of free and forced vibrations. • Resonance and the effects of damping on the sharpness of resonance.	• Distinguishing between free vibrations and forced vibrations • Explaining why a resonant system reaches a maximum amplitude of vibration	
Gravitational fields	• Gravity as a universal attractive force acting between all matter. • Magnitude of force between point masses: Newton's Formula • Representation of a gravitational field by gravitational field lines. • Escape velocity. • Use of satellites in low orbits and geostationary orbits, to include plane and radius of geostationary orbit. • Orbital period and speed related to radius of circular orbit; derivation of T2 ∝ r3 • Energy considerations for an orbiting satellite. • Total energy of an orbiting satellite.	• Describing how gravitational attraction varies with distance • Explaining what is meant by an inverse-square law • Discussing whether spherical objects, for example planets, can be treated as point masses • Describing the shape of a graph of g against r for points outside the surface of a planet • Comparing this graph with the graph of V against r • Explaining the significance of the gradient of the V-r graph • State the condition needed for a satellite to be in a stable orbit • Describing what happens to the speed of a satellite if it moves closer to the Earth • Discussing why a geostationary satellite must be in an orbit above the equator.	• Multiple choice test • Mini Formative tests • Controlled questions • Summative end of unit tests
Electric fields	• Representation of electric fields by electric field lines • Electric field strength as force per unit charge with a knowledge of associated formulae • 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 Δ W = Q Δ Equipotential surfaces. • No work done moving charge along an equipotential surface. • Coulomb's law	• Describing what the direction of an electric field line shows concerning a test charge • Illustrating the strength of an electric field by using field lines. • Explaining why potential is defined in terms of the work done per unit + charge • Calculating the electric potential difference between two points • Describing how to find the change in electric potential energy from pd • Explaining why potential (and pd) is measured in V. • Calculations using Coulomb's formulae	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests

	• Similarities and differences between gravitational and electrostatic forces:	• Stating the similarities and the principal differences between electric and gravitational fields	
Capacitors	• Definition of capacitance • Interpretation of the area under a graph of charge against pd • Time constants including their determination from graphical data. • Quantitative treatment of capacitor • Dielectric action in a capacitor • Relative permittivity and dielectric constant.	• Relating the potential difference (pd) across the plates of a capacitor to the charge on its plate • Discussing what capacitors are used for. • Describing the form of energy that is stored by a capacitor • Calculation of time constants including their determination from graphical data. • Defining the time constant of a capacitor-resistor circuit. • Defining relative permittivity and dielectric constant • Describing the action of a simple polar molecule rotating in an electric field	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests
Magnetic fields	• The factors that the magnitude of the force on a current-carrying wire depends on. • What happens to charged particles in a magnetic field • What happens to the direction of the magnetic force when electrons are deflected by a magnetic field? • Why the moving charges move in a path that is circular • The factors that affect the radius of the circular path.	• Calculations for various scenarios for charges moving in electric and magnetic fields • Describing what happens to the direction of the magnetic force when electrons are deflected by a magnetic field • Explaining why the moving charges move in a path that is circular • Stating the factors that affect the radius of the circular path	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests

Electromagnetic induction	• The laws of electromagnetic induction • Principles of the alternating current generator • Alternating current and power both numerical and qualitative analysis • Elements and function of Transformers	• Stating the factors that would cause the induced emf to be greater • Calculations using Faraday's law • Using Lenz's law to explain induction phenomena • Explaining what is meant by the rms value of an alternating current • Calculating the power supplied by an alternating current. • the energy changes that take place in a transformer • Discussing how the efficiency of transformers is improved by better design.	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests
Thermal Physics	• Internal energy is the sum of the randomly distributed kinetic energies and potential energies of the particles in a body and a varies with work done • Concept of absolute zero of temperature. • Specific Heat capacity and Specific latent Heat	• Defining internal energy • Stating the lowest temperature that is possible • Complete calculations using appropriate thermal equations for latent heat and specific heat capacity. • and stating the experimental gas laws	• Multiple choice test • Required practical assessments • Controlled questions • Mini Formative tests • Summative end of unit tests
Gases	• Gas laws as experimental relationships between p, V, T and the mass of the gas. • Ideal gas equation its' derivation and application • Molar mass and molecular mass • Avogadro constant N_A, molar gas constant R, Boltzmann constant k	• Calculating the increase of the pressure of a gas when it is heated or compressed • Calculating the work done in an isobaric process. • Calculating the increase of the pressure of a gas when it is heated or compressed • Derive the ideal gas equation • Stating what is meant by an isothermal change. • Calculating the work done in an isobaric process • Use data to calculate the value of absolute zero	• Multiple choice test • Required practical assessments • Controlled questions • Mini Formative tests • Summative end of unit tests

Radioactivity	• Rutherford's experiment • Properties of alpha, beta & gamma • Dangers of radioactive decay • Radioactive decay • Usages of Radioactive isotopes • Nuclear decay modes • Nuclear radii and how to determine them	• Describing how the nucleus was discovered • Describing the properties of alpha, beta, and gamma radiation and their comparable dangers • Describing how the intensity of gamma radiation changes as it spreads out • Explaining how to represent the change in a nucleus when it emits alpha, beta, or gamma radiation. • Complete calculations using Nuclear Formulae • Describing how to do radioactive dating and complete appropriate calculations • Describe methods for ascertaining nuclear radii and completing calculations	• Multiple choice test • Required practical assessments • Mini Formative tests • Summative end of unit tests
Nuclear Energy	• Energy and mass • Binding Energy • Fission and Fusion • Thermal nuclear reactors	• Describing what happens to the mass of an object when it gains or loses energy • Calculating the energy released in a nuclear reaction. • Calculating how much energy is released in a fission or fusion reaction • Explaining how nuclear reactor works • Describing a thermal nuclear reactor • Explaining how a nuclear reactor is controlled.	• Multiple choice test • Controlled questions • Mini Formative tests • Summative end of unit tests
Special Relativity	• Absolute motion and the ether • The Michelson–Morley experiment • Einstein's postulates • Time dilation • Length contraction • Relativistic mass: Mass and energy • Bertozzi's experiment	• Explaining what is meant by absolute motion and relative motion • Describing the experimental evidence that all motion is relative • Stating the assumptions made by Einstein in his theory of special relativity • Explaining what is meant by length contraction, time dilation, and relativistic mass and completing relativistic calculations	• Multiple choice test • Controlled questions • Mini Formative tests • Summative end of unit tests

Wave–particle duality	• Newton’s corpuscular theory of light • The significance of Young’s double slits experiment • Maxwell’s theory of electromagnetic waves • Hertz’s discovery of radio waves • How to demonstrate the transverse nature of radio waves • Fizeau’s determination of the speed of light The development of the photon theory of light Einstein’s explanation of photoelectric emission • Stopping potential and threshold frequency • Wave–particle duality Electron microscopes	• Describing Newton’s corpuscular theory of light • Explaining what Young’s double slits experiment tells you about the nature of light • Explain what Maxwell proved about the speed of electromagnetic waves • Describe how radio waves were first produced and detected • Describe how the speed of electromagnetic waves was first measured accurately • Explaining what the ultraviolet catastrophe is and • describing the significance of Einstein’s explanation of photoelectricity • Explaining the diffraction of matter	• Multiple choice test • Controlled questions • Mini Formative tests • Summative end of unit tests
The discovery of the electron	• Thermionic emission of electrons • The principle of thermionic emission • Deflection of an electron beam • Using a uniform electric field • Using a uniform magnetic field • Balanced fields • Use of electric and magnetic fields • to determine specific charge • The determination of the charge of the electron, • e, by Millikan’s method	• Explaining what cathode rays are and how they were discovered • Describing how a beam of electrons is produced in a vacuum tube • Explaining how electron beams can be controlled and deflected • Describing what happens to the deflection of an electron beam if the speed of the electrons is increase • Complete calculations for specific charge and charge • Explaining why Millikan’s determination of e was important	• Multiple choice test • Controlled questions • Mini Formative tests • Summative end of unit tests