Year 12 Physics Learning Journey

YEAR GROUP: 12 **SUBJECT: Physics**

When?	Knowledge	Understanding	Assessment
Topic 4 Waves	**Topic 4 waves** **Be able to:** • **Define a plane-polarised wave** • **Explain the amplitude of a wave** • **Calculate the frequency of a wave from its period** • **Explain what causes a wave to refract as it passes along a boundary** • **Explain diffraction** • **Explain what features of two waves must combine in order to produce reinforcement/ cancellation** • **Describe if a stationary wave is formed by superposition** • **Explain why nodes formed in fixed positions** • **Describe the simplest possible stationary wave pattern that can be formed** • **Describe how an oscilloscope can be used.**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **Topic 4 waves** • Students can investigate the factors that determine the speed of a water wave. • Students can investigate the factors that determine the frequency of stationary wave patterns of a stretched string. **Topic 12 Electric Current** • Students can construct circuits from the range of components.	**Topic 4 Waves Test** **Topic 12 Electric Current Test**
Topic 12 Electric Current	**Topic 12 Electric Current** **Be able to:** • **Stare what electric current is.** • **Calculate the charge flow in a circuit** • **Define potential difference**		

	• **Calculate electrical power** • **State and explain the causes of electrical resistance.** • **Describe when we can use Ohm's law.** • **Describe a superconductor.** • **Describe how the current through a filament lamb vary with pd.** • **State the characteristics of a diode.** • **Describe what we can use a thermistor for.**		
Topic 5 Optics	**<u>Topic 5 Optics</u>** **Be able to:** • **What is Snell's law?** • **How is the refractive index related to the speed of light?** • **Explain why does a glass prism split light into the colours of the prism?** • **What are the conditions for total internal reflection?** • **How is the critical angle related to the refractive index?** • **Condition for the formation of a bright fringe** • **Describe factors should be increased/decreased to increase the fringe spacing** • **Define coherent sources** • **Explain the importance of diffraction of light in the design of optical instruments** • **Compare the single slit**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Topic 5 Optics</u>** • Investigation of two-source interference with sound, light and microwave radiation. • Students are expected to understand the principles and consequences of pulse broadening and absorption. **<u>Topic 13 Direct current circuits</u>** • Investigation of the variation of resistance of a thermistor with temperature. • Students can construct circuits with various component configurations and measure currents and potential differences. • Students can investigate the behaviour of a potential divider circuit. • Students should design and construct potential divider circuits to achieve various outcomes.	**Topic 5 Optics Test** **Topic 13 Direct current circuits Test**

Topic 13 - Direct Current Circuits	**pattern on the brightness of Young's fringes** • **Explain why does the diffraction grating diffract monochromatic light in certain directions only** **<u>Topic 13 Direct current circuits</u>** **Be able to:** • **State the rules and principals for series and parallel circuits.** • **Calculate resistance in series or in parallel.** • **Explanation of what resistance heating is.** • **Calculate the current and pd for each component in a circuit.** • **Explain why the pd of a cell/battery in use is less than its emf.** • **Measure the internal resistance of a battery.** • **Calculate how much power is wasted in a battery.** • **Calculate currents in circuits.** • **State what is a potential divider.** • **Describe how we can supply a variable pd from a battery.** • **Explain how we can design sensor circuits.**		
Topic 1 – Matter	**<u>Topic 1 Matter and Radiation</u>**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical	

and Radiation	**Be able to:** • **Describe what is inside an atom** • **State what keeps protons and neutrons in a nucleus together** • **Describe what happens when unstable nuclei emits alpha/beta minus particle** • **Calculate the energy of a photon** • **Define what antimatter is** • **Discuss the possibility of anti-atoms** • **Describe what is meant by an interaction** • **Describe what an exchange particle is**	endorsement qualification. **<u>Topic 1 Matter and Radiation</u>** • Demonstration of the range of alpha particles using a cloud chamber, spark counter or Geiger counter. • Use of prefixes for small and large distance measurements. • Students could determine the frequency and wavelength of the two gamma photons produced when a 'slow' electron and a 'slow' positron annihilate each other. • Students must show appreciation that particle physics relies on the collaborative efforts of large teams of scientists and engineers to validate new knowledge	Topic 1 Matter and radiation Test Topic 6 Forces in Equilibrium Test
Topic 6 – Forces in Equilibrium	**<u>Topic 6 Forces in Equilibrium</u>** **Be able to:** • **State what is a vector quantity** • **Represent vectors** • **Explain why we consider the direction in which a force acts** • **State under what conditions does a force produce a turning effect** • **Describe how the turning effect of a given force can be increased** • **State what can we say about the support force on a pivoted body** • **Describe what is meant by a couple** • **State what is stable/unstable**	**<u>Topic 6 Forces in Equilibrium</u>** • Conditions for equilibrium for two or three coplanar forces acting at a point. Appreciation of the meaning of equilibrium in the context of an object at rest or moving with constant velocity • Investigation of the conditions for equilibrium for three coplanar forces acting at a point using a force board	

	equilibrium • **Describe when is a tilted object going to topple** • **State what conditions must apply to the forces on an object in equilibrium** • **State what conditions must apply to the turning effects of the forces** • **Explain what are the important principles that always apply to a body in equilibrium**		
Topic 2 – Quarks and leptons **Topic 7 – On the Move**	**<u>Topic 2 Quarks and leptons</u>** **Be able to:** • **Explain how we can find/predict new particles** • **Describe what strange particles are** • **Recognise what hadrons are** • **Recognise what are leptons are** • **Explain the importance of lepton numbers** • **Define what quarks are and explain how do we know they exist** • **Explain why there are no antimesons** • **State and explain what is always/sometimes/never conserved in particle interactions** **<u>Topic 7 – On the Move</u>** **Be able to:** • **Describe how displacement differs from**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Topic 2 Quarks and leptons</u>** • Cosmic ray showers as a source of high energy particles including pions and kaons; observation of stray tracks in a cloud chamber; use of two Geiger counters to detect a cosmic ray shower • Application of the conservation laws for charge, baryon number, lepton number and strangeness to particle interactions. The necessary data will be provided in questions for particles outside those specified. • Students should recognise that energy and momentum are conserved in interactions **<u>Topic 7 – On the Move</u>** • Distinguish between instantaneous velocity and average velocity. • Measurements and calculations from displacement–time, velocity–time and acceleration–time graphs. • Calculations involving motion in a straight line. • Investigation of the factors that determine the motion of an object through a fluid. • Qualitative understanding of the effect of air resistance on the trajectory of a projectile and on the	Topic 2 Quarks and leptons Test Topic 7 On the Move Test

	distance • **Describe the importance of uniform acceleration** **at constant acceleration** • **Calculate the displacement of an object** • **Define "free fall"** • **Explain how the velocity of a free falling object changes as it falls** • **State the difference between distance-time graph and displacement-time graph along a straight line** • **Calculate the motion of an object with constant acceleration if its velocity reverse** • **To explain why the acceleration of a projectile is always downwards** • **To state what the horizontal component of a vertical vector is** • **To describe where else we meet projectile motion**	factors that affect the maximum speed of a vehicle	
Topic 3 – Quantum phenomena	**<u>Topic 3 Quantum phenomena</u>** **Be able to:** • **Explain what the photoelectricity is** • **Discuss how the photon model was established** • **Define what is a quantum** • **Explain why can't an electron absorb several photons to**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Topic 3 Quantum phenomena</u>** • Demonstration of the photoelectric effect using a photocell or an electroscope with a zinc plate attachment and UV lamp. • Students will be expected to be able to convert eV into J and vice versa • Students should be able to explain how and why the amount of diffraction changes when the momentum	Topic 3 Quantum phenomena Test Topic 8 Motions and forces Test Topic 9 Forces and momentum Test

	escape from a metal • **Explain ionisation/excitation of an atom** • **Explain what happens when excited atoms 'de-excite'** • **Explain how a fluorescent tube works** • **Explain why do atoms emit characteristic line spectra?** • **Calculate the wavelength of light for a given electron transition?** • **Explain why do we say photons have a dual nature?** • **Describe how do we know that matter particles have a dual nature?** • **Discuss why can we only change the wavelength of a matter particle?**	of the particle is changed **<u>Topic 8– Motion and force</u>** • Students can verify Newton's second law of motion. • Students can use free-body diagrams. **<u>Topic 9 Forces and momentum</u>** • Students can apply conservation of momentum and rate of change of momentum to a range of examples • Quantitative questions may be set on forces that vary with time. Impact forces are related to contact times (eg kicking a football, crumple zones, packaging)	
Topic 8– Motion and force	**<u>Topic 8– Motion and force</u>** **Be able to:** • **State what a resultant force always produces** • **Apply F = ma when the forces on an object are in opposite directions** • **Explain why speed reaches a maximum** • **Define drag force**		

Topic 9 – Forces and momentum	• **Difference between braking distance and stopping distance** • **What should be increased to give smaller deceleration from a given speed?** **<u>Topic 9 Forces and momentum</u>** **Be able to:** • **Calculate force as a rate of change of momentum** • **Calculate Impulse** • **Significance of area under a force-time graph** • **Define principal conservation of linear momentum** • **Describe elastic and inelastic collisions; explosions**		
Topic 11 Materials	**<u>Topic 11 Materials</u>** **Be able to:** • **Define density** • **Measure the density of an object** • **Define spring constant** • **Describe the limit to the linear graph of force against extension for a spring** • **Explain how stress is related to force and strain to extension** • **Define tensile** • **Discuss what happens**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Topic 11 Materials</u>** • Students can compare the use of analogue and digital meters. • Estimate the volume of an object leading to an estimate of its density. • Use of stress–strain graphs to find the Young modulus **<u>Topic 13 – Work, energy and power</u>**	Topic 11 Materials Test Topic 13 Work, energy and power Test

Topic 13-Work, energy and power	**when a metal wire is stretched beyond its elastic limit and then unloaded** **<u>Topic 13 – Work, energy and power</u>** **Be able to:** • **What is energy and how do we measure it?** • **What is meant by work?** • **When an object is lifted, what happens to the work done on it?** • **If it then falls, what energy change then takes place?** • **Which physical quantities are involved in power?** • **What force is mainly responsible for energy 'loss' when mechanical energy is converted from one form to another?**	• Investigate the efficiency of an electric motor being used to raise a mass through a measured height. Students should be able to identify random and systematic errors in the experiment and suggest ways to remove them. • Estimate the energy that can be derived from food consumption • Quantitative and qualitative application of energy conservation to examples involving gravitational potential energy, kinetic energy, and work done against resistive forces	