West Kirby Grammar School

Curriculum Map – Year 12 – Physics (Teacher 1)

Topic name	Term	Skills developed	Link to subject content	Prior learning	Next link in curriculum
3.1 Measurements and their errors	*Autumn*	MS 1.4 Students should be able to estimate approximate values of physical quantities to the nearest order of magnitude. Students should be able to use these estimates together with their knowledge of physics to produce further derived estimates also to the nearest order of magnitude.	3.1.1 Use of SI units and their prefixes 1. Fundamental (base) units. 2. Use of mass, length, time, amount of substance, temperature, electric current and their associated SI units. 3. SI units derived. 4. Knowledge and use of the SI prefixes, values and standard form. 3.1.3 Estimation of physical quantities 1. Orders of magnitude. Estimation of approximate values of physical quantities	*Links to all required practicals at GCSE.*	Content in this section is a continuing study for a student of physics. A working knowledge of the specified fundamental (base) units of measurement is vital. The ability to carry through reasonable estimations is a skill that is required throughout the course and beyond.
3.4 Mechanics	*Autumn*	MS 0.6, 4.2, 4.4, 4.5 / PS 1.1 Investigation of the conditions for equilibrium for three coplanar forces acting at a point using a force board. MS 3.6, 3.7 / PS 1.1, 3.1 Distinguish between instantaneous velocity and average velocity. MS 3.5, 3.6 Measurements and calculations from displacement–time, velocity–time and acceleration–time graphs. MS 0.5, 2.2, 2.3, 2.4 Calculations involving motion in a straight line.	3.4.1.1 Scalars and vectors 1 Nature of scalars and vectors. 2. Addition of vectors by calculation or scale drawing. Calculations will be limited to two vectors at right angles. Scale drawings may involve vectors at angles other than 90 °. 3. Resolution of vectors into two components at right angles to each other. Problems may be solved either by the use of resolved forces or the use of a closed triangle. 4. 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. 3.4.1.2 Moments 1. Moment defined as force × perpendicular distance from the point to the line of action of the force. 2. Couple as a pair of equal and opposite coplanar forces. 3. Moment of couple defined as force × perpendicular distance between the lines of action of the forces.	Links to GCSE: Year 9 - Motion Year 10 - forces and motion. Year 11 - further forces - moments Year 11 - Momentum Year 10 - Energy Stores and Transfers	• Circular motion (Y13) when discussing quantites that change (velocity, force, acceleration, momentum) and stay constant (energy, speed..) • Circular motion and simple harmonic motion (Y13) When discussing components of forces • Electromagnetism (year 13) couples in motors • Turning Points (Year 13) when suvat is used to explain electron motion in a field

		MS 0.3, 1.2, 3.7 / AT d Students should be able to identify random and systematic errors in the experiment and suggest ways to remove them. MS 3.9 Determine g from a graph PS 2.2, 3.1 Investigation of the factors that determine the motion of an object through a fluid. PS 4.1 / MS 0.5, 3.2 / AT a, b, d Students can verify Newton's second law of motion. MS 4.1, 4.2 Students can use free-body diagrams. MS 2.2, 2.3 Students can apply conservation of momentum and rate of change of momentum to a range of examples. MS 0.3 / PS 3.3, 4.1 / AT a, b, f. 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	4. Principle of moments. 5. Centre of mass. Knowledge that the position of the centre of mass of uniform regular solid is at its centre. 3.4.1.3 Motion along a straight line 1. Displacement, speed, velocity, acceleration. 2. Representation by graphical methods of uniform and nonuniform acceleration. 3. Significance of areas of velocity–time and acceleration–time graphs and gradients of displacement–time and velocity–time graphs for uniform and non-uniform acceleration. 4. Equations for uniform acceleration. 5. Acceleration due to gravity, g 3.4.1.4 Projectile motion 1. Independent effect of motion in horizontal and vertical directions of a uniform gravitational field. 2. Problems will be solvable using the equations of uniform acceleration. 3. Qualitative treatment of friction. Qualitative treatment of lift and drag forces. 4. Terminal speed. Knowledge that air resistance increases with speed. Qualitative understanding of the effect of air resistance on the trajectory of a projectile and on the factors that affect the maximum speed of a vehicle. 3.4.1.5 Newton's laws of motion 1. Knowledge and application of the three laws of motion in appropriate situations. 2. F = ma for situations where the mass is constant. 3.4.1.6 Momentum 1. momentum = mass × velocity		• Turning Points (Year 13) when suvat is used to explain electron motion in a field • Circular motion and simple harmonic motion (Year 13) using Newton's laws to derive centripetal forces and restoring forces • Thermal Physics (year 13) kinetic theory of gases and derivation of equation for pressure of a gas • Electric and gravitational fields (year 13) work done used in discussing the electric potential and gravitational potential fields. • Capacitors (Year 13) Energy stored • Gravitational fields (year 13) when discussing orbits and escape velocity

		and suggest ways to remove them. MS 0.4, 2.2 Estimate the energy that can be derived from food consumption.	2. Conservation of linear momentum. Principle applied quantitatively to problems in one dimension. 3. Force as the rate of change of momentum 4. Impulse = change in momentum $F\Delta t = \Delta mv$, 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 (eg kicking a football, crumple zones, packaging). 5. Elastic and inelastic collisions; explosions. 6. Appreciation of momentum conservation issues in the context of ethical transport design. 3.4.1.7 Work, energy and power 1. Energy transferred 2. rate of doing work = rate of energy transfer, $P = \Delta W \Delta t = Fv$ 3. Quantitative questions may be set on variable forces. 4. Significance of the area under a force–displacement graph. 5. efficiency = useful output power /input power 6. Efficiency can be expressed as a percentage. 3.4.1.8 Conservation of energy 1. Principle of conservation of energy. 2. Quantitative and qualitative application of energy conservation to examples involving gravitational potential energy, kinetic energy, and work done against resistive forces.		• Thermal Physics (Year 13) Internal energy, specific heat capacity, specific latent heat.

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3.4 materials	Spring	• MS 0.2, 4.3 / PS 3.3, 4.1 Students can compare the use of analogue and digital meters. MS 0.4, 4.3 / AT e Estimate the volume of an object leading to an estimate of its density MS 3.1	3.4.2.1 Bulk properties of solids 1. Density 2. Hooke's law, elastic limit, F = kΔL 3. k as stiffness and spring constant. 4. Tensile strain and tensile stress. 5. Elastic strain energy, breaking stress. energy stored = 1 2FΔL = area under force–extension graph 6. Description of plastic behaviour, fracture and brittle behaviour linked to force–extension graphs. 7. Quantitative and qualitative application of energy conservation to examples involving elastic strain energy and energy to deform. Spring energy transformed to kinetic and gravitational potential energy. 8. Interpretation of simple stress–strain curves. 9. Appreciation of energy conservation issues in the context of ethical transport design. 3.4.2.2 The Young modulus 1. Young modulus = tensile stress/ tensile strain = FL/ A Δ L 2. Use of stress–strain graphs to find the Young modulus. (One simple method of measurement is required.) 3. Required practical 4: Determination of the Young modulus by a simple method. Required practical 3: Determination of g by a freefall method.	Links to GCSE: Year 10 - Work done and Elasticity Required practical 4: Determination of the Young modulus by a simple method.	• Nuclear physics (Year 13) when calculating nuclear density • Simple harmonic motion (year 13) when discussing the shm of a mass on a spring.

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3.3.1 Progressive and stationary waves	Spring	• PS 2.3 / MS 0.1, 4.7 / AT a, b Laboratory experiment to determine the speed of sound in free air using direct timing or standing waves with a graphical analysis. • PS 2.2, 2.4 / MS 1.2, 3.2, 3.4, 3.5 / AT i Students can investigate the factors that determine the speed of a water wave. • MS 4.7 / PS 1.2, 2.1 / AT i Students can investigate the factors that determine the frequency of stationary wave patterns of a stretched string.	3.3.1.1 Progressive waves 1. Oscillation of the particles of the medium; amplitude, frequency, wavelength, speed, phase, phase difference, Phase difference may be measured as angles (radians and degrees) or as fractions of a cycle. 2. Longitudinal and transverse waves 3.3.1.2 Principle of superposition of waves and formation of stationary waves Required practical 1: Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string.	.Links to GCSE Year 9 - Waves	• Simple harmonic motion (year 13) when describing the oscillations and their phase • Turning Points (Year 13) when discussing the polarisation of radio waves in Hertz's experiment • Simple harmonic motion (year 13) when describing resonance and forced oscillations
3.3.2 Refraction, diffraction and interference	Summer	AT i Investigation of two-source interference with sound, light and microwave radiation.	3.3.2.1 Interference 1. Path difference. Coherence. Interference and diffraction using a laser as a source of monochromatic light. 2. Young's double-slit experiment: the use of two coherent sources or the use of a single source with double slits to produce an interference pattern. Fringe spacing Production of interference pattern using white light. Students are expected to show awareness of safety issues associated with using lasers.	Required practical 2: Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating.	• Turning Points (year 13) when looking at evidence for the wave-particle nature of light • Turning Points (year 13) when looking at evidence for the

		MS 0.6, 4.1	3. Students will be expected to describe and explain interference produced with sound and electromagnetic waves. 3.3.2.2 Diffraction 1. Appearance of the diffraction pattern from a single slit using monochromatic and white light. 2. Qualitative treatment of the variation of the width of the central diffraction maximum with wavelength and slit width. 3. Plane transmission diffraction grating at normal incidence. Derivation of diffraction grating formula. 4. Applications of diffraction gratings. 3.3.2.3 Refraction at a plane surface 1. Refractive index of a substance, n = c cs 2. Students should recall that the refractive index of air is approximately 1. 3. Snell's law of refraction for a boundary n1sin ⍰1 = n2sin ⍰2 4. Total internal reflection sin ⍰c = n2 n1 5. Simple treatment of fibre optics including the function of the cladding. 6. Material and modal dispersion. 7. Students are expected to understand the principles and consequences of pulse broadening and absorption.	Link to GCSE Year 9 - Wave properties.	wave-particle nature of light Huygen's and Newton's theories of refraction.