Curriculum Map – Year 12 – Physics (Teacher 2)

West Kirby Grammar School

Topic Name	Term	Skills Developed	Link to subject content	Prior learning	Next link in curriculum
3.5 Electricity	Autumn	Students can construct circuits from the range of components. MS 3.2, 4.3 / PS 1.2 / AT a, b, f, g Investigation of the variation of resistance of a thermistor with temperature. MS 0.3 / PS 4.1 / AT a, b, f, g Students can construct circuits with various component configurations and measure currents and potential differences. MS 3.2 / PS 4.1 / AT f Students can investigate the behaviour of a potential divider circuit. MS 3.2 / AT g Students should design and construct potential divider circuits to achieve various outcomes. MS 3.1, 3.3 / PS 2.2, 3.1 / AT f Required practical 6: Investigation of the emf and internal resistance of electric cells and batteries by measuring the variation	3.5.1.1 1. Electric current as the rate of flow of charge 2. Potential difference as work done per unit charge. 3. Resistance defined as R = V/ I 3.5.1.2 Current-voltage characteristics For an ohmic conductor, semiconductor diode, and filament lamp. Ohm's law as a special case where I ∝ V under constant physical conditions. 3.5.1.3 Resistivity = RA/ L Description of the qualitative effect of temperature on the resistance of metal conductors and thermistors. Only negative temperature coefficient (ntc) thermistors will be considered. Applications of thermistors to include temperature sensors and resistance–temperature graphs. Superconductivity as a property of certain materials which have zero resistivity at and below a critical temperature which depends on the material. Applications of superconductors to include the production of strong magnetic fields and the reduction of energy loss in transmission of electric power. 3.5.1.4 Circuits Resistors: in series, RT = R1 + R2 + R3 + ... in parallel, 1 RT = 1/ R1 + 1/ R2 + 1 /R3 Energy and power equations: E = IVt; P = IV = I 2 R = V2 R The relationships between currents, voltages and resistances in series and parallel circuits, including cells in	Y9 4.2.5.1 Static charge 4.2.1 Current, potential difference and resistance Y10 Domestic electricity	Electric and magnetic fields. F=BIl F=BQv Electric potential Capacitor charging and discharging Motion of a charged particle in a magnetic field. AC theory

		of the terminal pd of the cell with current in it.	series and identical cells in parallel. Conservation of charge and conservation of energy in dc circuits. 3.5.1.5 Potential Divider The potential divider used to supply constant or variable potential difference from a power supply. The use of the potentiometer as a measuring instrument is not required. Examples should include the use of variable resistors, thermistors, and light dependent resistors (LDR) in the potential divider. 3.5.1.6 Electromotive force and internal resistance V = E/ Q , E = I R + r Terminal pd; emf Students will be expected to understand and perform calculations for circuits in which the internal resistance of the supply is not negligible.		
3.2 Particles and radiation	Spring	AT i Demonstration of the range of alpha particles using a cloud chamber, spark counter or Geiger counter. MS 0.2 Use of prefixes for small and large distance measurements. AT i Detection of gamma radiation. MS 1.1, 2.2 Students could determine the frequency and wavelength of the two gamma photons produced when a 'slow' electron and a 'slow' positron annihilate each other.	3.2.1 Particles 3.2.1.2 Stable and unstable nuclei The strong nuclear force; its role in keeping the nucleus stable; short-range attraction up to approximately 3fm, 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. 3.2.1.3 Particle, antiparticles and photons For every type of particle, there is a corresponding antiparticle. Comparison of particle and antiparticle masses, charge and rest energy in MeV.	Y10 Atomic Structure	Use of amu in Nuclear Physics (Y13) Alpha, beta and gamma radiation in Nuclear Physics

		The PET scanner could be used as an application of annihilation. PS 1.2 Momentum transfer of a heavy ball thrown from one person to another. AT k Use of computer simulations of particle collisions. ATI 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.	Students should know that the positron, antiproton, antineutron and antineutrino are the antiparticles of the electron, proton, neutron and neutrino respectively. Photon model of electromagnetic radiation, the Planck constant. E = h f. Knowledge of annihilation and pair production and the energies involved. 3.2.1.4 Particle interactions Four fundamental interactions: gravity, electromagnetic, weak nuclear, strong nuclear. (The strong nuclear force may be referred to as the strong interaction.) The concept of exchange particles to explain forces between elementary particles. Knowledge of the gluon, Z0 and graviton will not be tested. The electromagnetic force; virtual photons as the exchange particle. The weak interaction limited to β− and β+ decay, electron capture and electron–proton collisions; W+ and W− as the exchange particles. Simple diagrams to represent the above reactions or interactions in terms of incoming and outgoing particles and exchange particles. 3.2.1.5 Particle Classification Hadrons are subject to the strong interaction. The two classes of hadrons: • baryons (proton, neutron) and antibaryons (antiproton and antineutron) • mesons (pion, kaon). Baryon number as a quantum number. Conservation of baryon number. The proton is the only stable baryon into which other baryons eventually decay. The pion as the exchange particle of the strong nuclear force. The kaon as a particle that can decay into pions. Leptons: electron, muon, neutrino (electron and muon types only) and their antiparticles. Lepton number as a quantum number; conservation of lepton number for muon leptons		

			and for electron leptons. The muon as a particle that decays into an electron. Strange particles Strange particles as particles that are produced through the strong interaction and decay through the weak interaction (eg kaons). Strangeness (symbol s) as a quantum number to reflect the fact that strange particles are always created in pairs. Conservation of strangeness in strong interactions. Strangeness can change by 0, +1 or -1 in weak interactions. Appreciation that particle physics relies on the collaborative efforts of large teams of scientists and engineers to validate new knowledge. 3.2.1.6 Quarks and antiquarks Properties of quarks and antiquarks: charge, baryon number and strangeness. Combinations of quarks and antiquarks required for baryons (proton and neutron only), antibaryons (antiproton and antineutron only) and mesons (pion and kaon only). The decay of the neutron should be known. 3.2.1.7 Application of conservation laws Change of quark character in β− and in β+ decay. 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 interaction.		
3.2 Particles and radiation	Summer	PS 3.2 / MS 2.3 Demonstration of the photoelectric effect using a photocell or an electroscope with a zinc	3.2.2 Radiation 3.2.2.1 The photoelectric effect Threshold frequency; photon explanation of threshold frequency. Work function, stopping potential. Photoelectric equation: h f = work function + Ek max		Turning points (Y13 option) uses wave-particle duality in exploring how scientific theories are accepted or rejected.

		plate attachment and UV lamp. AT j / MS 0.1, 0.2 Observation of line spectra using a diffraction grating. PS 1.2 Demonstration using an electron diffraction tube. MS 1.1, 2.3 Use prefixes when expressing wavelength values.	3.2.2.2 Collisions of electrons with atoms Ionisation and excitation; understanding of ionisation and excitation in the fluorescent tube. The electron volt. Students will be expected to be able to convert eV into J and vice versa. 3.2.2.3 Energy levels and photoemission Line spectra (eg of atomic hydrogen) as evidence for transitions between discrete energy levels in atoms. h f = E1 – E2 3.2.2.4 Wave-particle duality Students should know that electron diffraction suggests that particles possess wave properties and the photoelectric effect suggests that electromagnetic waves have a particulate nature. Details of particular methods of particle diffraction are not expected. de Broglie wavelength = h/ mv where mv is the momentum. Students should be able to explain how and why the amount of diffraction changes when the momentum of the particle is changed. Appreciation of how knowledge and understanding of the nature of matter changes over time. Appreciation that such changes need to be evaluated through peer review and validated by the scientific community.		