Physics Year 10 – Autumn Term 2021

	Note: topics 7 and 9 are physics separate only	**What? When? Why?**		
	PHYSICS P8 Energy, work and power P9 Forces and their effects	**PHYSICS P6 Radioactivity**	**PHYSICS P3 Conservation of Energy**	**PHYSICS P4 Waves and P5 EM waves**
Lesson 1 Learning intentions	**Work & Power revising energy stores and transfers** Identify the different ways that the energy of a system can be stored eg thermal, kinetic, gravitational Identify the different ways that the energy of a system can be changed a) through work done by forces b) in electrical equipment c) in heating.	**The structure of the atom (may take more than one lesson if they can't recall it from chemistry)** What is inside atoms? What are the properties of subatomic particles? Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons Be able to do calculations of the numbers of protons, neutrons and electrons in an atom or ion Explain what an isotope is Be able to recall the typical size (order of magnitude) of atoms and small molecules. Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass (nucleon)	**Energy stores & transfers** Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system. Analyse the changes involved in the way energy is stored when a system changes, including: a) an object projected upwards or up a slope b) a moving object hitting an obstacle c) an object being accelerated by a constant force d) a vehicle slowing down e) bringing water to a boil in an electric kettle. Draw and interpret diagrams to represent energy transfers.	**Know the properties of waves** Recall that waves transfer energy and information without transferring matter eg Describe evidence that with water and sound waves it is the wave and not the water or air itself that travels Define and use the terms frequency and wavelength as applied to waves Use the terms amplitude, period, wave velocity and wavefront as applied to waves

		number and using symbols in the format $^{13}_{6}C$		
Lesson 2 Learning intentions	**Kinetic energy calculations** Recall the equations used to calculate kinetic energy Kinetic energy = 0.5 x mass x (speed)^2 Identify the energy being transformed in complex examples including examples where objects change speed	**Development of atomic models** Describe how and why the atomic model has changed over time Include reference to the plum pudding model explaining what this model was like Describe Rutherford's alpha particle scattering experiment and why it replaced the plum pudding model. This lead to the Bohr model (like the chemistry diagrams with the electron shells)	**Energy efficiency** **(H) Explain how efficiency can be increased** Recall and use the equation: efficiency = (useful energy transferred by the device) / (total energy supplied to the device) Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings. Explain ways of reducing unwanted energy transfer, including through lubrication	**How waves travel** Describe the difference between longitudinal and transverse waves by referring to sound, electromagnetic, seismic and water waves Recall and use the equation wave speed = frequency × wavelength $v = f \times \lambda$ Measuring the speed of sound Describe how to measure the velocity of sound in air and ripples on water surfaces Measure the speed of sound, using the equation: wave speed = distance ÷ time $v = x/t$
Lesson 3 Learning intentions	**Gravitational energy calculations** Recall the equations used to calculate gravitational energy	**Electrons & orbits** Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus.	**Keeping warm** Explain ways of reducing unwanted energy transfer, including through… thermal insulation…Describe the effects of the thickness and thermal conductivity of the walls of a building on its rate of cooling qualitatively	**Waves at boundaries** Explain how waves will be refracted at a boundary in terms of the change of direction and speed Recall that different substances may absorb, transmit, refract or

	GPE = mass x gravitational field strength x height Identify the energy being transformed in complex examples including examples where objects fall or are lifted	Explain that electrons change orbit when there is absorption or emission of electromagnetic radiation. Explain how atoms may form positive ions by losing outer electrons.		reflect waves in ways that vary with wavelength
Lesson 4 Learning intentions	**Work Done** Describe how to measure the work done by a force using the equation: work done = force x distance (moved in the direction of the force) $E = F \times d$ Illustrate this with the trainer practical or a similar friction based practical	**Types of radiation** Recall that alpha, β– (beta minus), β+ (positron), gamma rays and neutron radiation are emitted from unstable nuclei in a random process. Demonstrate Americium (alpha and weak gamma source) Know that an alpha particle is a high energy helium nucleus which is the biggest particle with a +2 charge Relate its size to the fact it was first to be found, is most ionising and lowest penetrating. Show the strontium 90 beta source. Know that a beta particle is a high energy electron somehow emitted from the nucleus Its medium mass and charge make it medium ionising and penetrating.	**Stored energies** Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: change in gravitational potential energy = mass × gravitational field strength × change in vertical height $\Delta GPE = m \times g \times \Delta h$ Recall and use the equation to calculate the amounts of energy associated with a moving object: kinetic energy = ½ × mass × (speed)2 $KE = \frac{1}{2} \times m \times v^2$	**Wave Core Practical:** Investigate the suitability of equipment to measure the speed, frequency and wavelength of a wave in a solid and a fluid

		Show the radium source (α β and γ), block the others and show the penetration of gamma through lead. Know that a gamma ray is electromagnetic radiation. Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise.		
Lesson 5 Learning intentions	**Power** Define power as the energy transferred per second. Recall and use the equation: power (watt, W) = work done (joule, J) ÷ time taken (second, s) *P = E/T* If possible, work out your personal power as a practical.	**Background and contamination** Clarify the sources of background radiation seen in the demo the previous lesson or demo again with banana skin. Explain what is meant by background radiation including sources of background radiation (and why Keighley is relatively safe.) Describe methods for measuring and detecting radioactivity limited to photographic film and a Geiger–Müller tube. Describe the dangers of ionising radiation in terms of tissue damage and possible mutations and relate this to the precautions needed. Describe the differences between contamination and irradiation effects and compare the hazards associated with these two.	**Non-renewable resources** Describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel…), and compare the ways in which both renewable and non-renewable sources are used. Explain patterns and trends in the use of energy resources	**Topic 5 – Light and the electromagnetic spectrum** **Properties of Electromagnetic Waves** Recall the main groupings of the continuous electromagnetic spectrum including (in order) radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, x-rays and gamma rays Describe the electromagnetic spectrum as continuous from radio waves to gamma rays and that the radiations within it can be grouped in order of decreasing wavelength and increasing frequency Recall that all electromagnetic waves are transverse, that they travel at the same speed in a vacuum

				Explain, with examples, that all electromagnetic waves transfer energy from source to observer Recall that our eyes can only detect a limited range of frequencies of electromagnetic radiation
Lesson 6 Learning intentions	**Objects affecting each other** Describe, with examples, how objects can interact a) at a distance without contact, linking these to the gravitational, electrostatic and magnetic fields involved b) by contact, including normal contact force and friction c) producing pairs of forces which can be represented as vectors Explain the difference between vector and scalar quantities using examples Explain ways of reducing unwanted energy transfer through lubrication	**Decay Equations** Describe the process of β^- decay (a neutron becomes a proton plus an electron) Describe the process of β^+ decay (a proton becomes a neutron plus a positron) Explain the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays (α, β, γ and neutron emission) Use given data to balance nuclear equations in terms of mass and atomic number.	**Renewable resources** Describe the main energy sources available for use on Earth (including… bio-fuel, wind, hydro-electricity, the tides and the Sun), and compare the ways in which both renewable and non-renewable sources are used. Explain patterns and trends in the use of energy resources	**Core Practical:** Investigate refraction in rectangular glass blocks in terms of the interaction of electromagnetic waves with matter
Lesson 7 Learning intentions	**Vector diagrams**	**Half-Life**		**Differences in EM waves**

	(H) Use vector diagrams to illustrate resolution of forces, a net force, and equilibrium situations (scale drawings only) **(H) Draw and use free body force diagrams** **(H) Explain that several forces can ad together to make a resultant force on** **(h) Describe cases of balanced forces when the resultant force is zero**	Describe how the activity of a radioactive source decreases over a period of time. Recall that the unit of activity of a radioactive isotope is the Becquerel, Bq. Explain that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay or the activity of a source to decay by half. Explain that it cannot be predicted when a particular nucleus will decay but half-life enables the activity of a very large number of nuclei to be predicted during the decay process. Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations Tillich blocks (dice) practical can illustrate this well		Recall that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength Explain the effects of differences in the velocities of electromagnetic waves in different substances Recall that the potential danger associated with an electromagnetic wave increases with increasing frequency Recall that changes in atoms and nuclei can a generate radiations over a wide frequency range b be caused by absorption of a range of radiations
Lesson 8 Learning intentions				**Uses and Dangers of EM waves (2 lessons)** Describe the harmful effects on people of excessive exposure to electromagnetic radiation, including: a microwaves: internal heating of body cells

				b infrared: skin burns c ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions d x-rays and gamma rays: mutation or damage to cells in the body
Lesson 9 Learning intentions				**Describe some uses of electromagnetic radiation** a radio waves: including broadcasting, communications and satellite transmissions (Recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits) b microwaves: including cooking, communications and satellite transmissions c infrared: including cooking, thermal imaging, short range communications, optical fibres, television remote controls and security systems d visible light: including vision, photography and illumination e ultraviolet: including security marking, fluorescent lamps,

				detecting forged bank notes and disinfecting water f x-rays: including observing the internal structure of objects, airport security scanners and medical x-rays g gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment
Lesson 10 Learning intentions				