A Level Physics – U6

Curriculum Intent

Physics is the study of energy and matter and their interactions. The A level Physics course provides an interesting and challenging experience to link key physical ideas and understand how they relate to each other.
The course aims for all students to: ·

- develop essential knowledge, understanding and application of different areas of the subject and how they relate to each other
- understand how society makes decisions about scientific issues and how Physics contributes to the success of the economy and society
- develop competence and confidence in a variety of practical, mathematical and problem-solving skills
- develop and demonstrate a deep appreciation of the skills, knowledge and understanding of scientific methods
- promote students' interest in and enthusiasm for the subject, including an interest in further study and careers associated with the subject.

"Science knows no country because knowledge belongs to humanity and is the torch which illuminates the world"

Students will learn: -

Term 1: Temperature. Solids, liquids, gases. Thermal properties of materials. Ideal gases. Circular motion. Centripetal force. Simple harmonic motion. Damping. Newton's law of gravitation. Planetary motion. Gravitational potential. Stars. Electromagnetic radiation. Cosmology.
Term 2: Capacitors. Energy storage in capacitors. Electric fields. Magnetism. Magnetic fields. The atom. Radioactivity. Nuclear fission and fusion. Medical imaging. Comparing diagnostic methods in medicine.

What does excellence look like?

- Carrying out practical processes logically, precisely, and accurately.
- Linking ideas together to answer questions logically and sequenced.
- Linking big ideas to answer real life Physics problems.
- Can manipulate and combine equations for heat capacity and latent heat to calculate energy changes
- Checking for homogeneity in manipulated equations
- Use pV= $\frac{1}{3}Nm\hat{c}^2$ and pV = NkT to derive $\frac{1}{3}m\hat{c}^2$=$\frac{3}{2}kT$
- Can calculate centripetal force and acceleration using linear and angular velocity equations
- Can convert radians to degrees and vice versa
- Able to explain the relationships between displacement, velocity and acceleration of a simple harmonic oscillator using either calculus or graphical methods
- Can describe and explain the interchange between gravitational potential energy and kinetic energy in a simple harmonic oscillator.
- Can explain practical examples of damped and forced oscillations and resonance
- Can explain why the gravitational field close to the Earth can be considered uniform
- Can derive Kepler's third law from first principles
- Can calculate work done in a gravitational field using a force-distance graph

Knowledge, understanding & Skills

Term 1: Module 5- Newtonian world and astrophysics:

Demonstrate knowledge, application and understanding of:
Temperature measurements in degrees Celsius and in kelvin. Brownian motion in terms of the kinetic model of matter and a simple demonstration using smoke particles suspended in air. Changes in the internal energy of a substance during change of phase; constant temperature during change of phase. specific heat capacity of a substance; the equation $E=mc\Delta\vartheta$. techniques and procedures used for an electrical method to determine the specific heat capacity of a metal block and a liquid. specific latent heat of fusion and specific latent heat of vaporisation; $E = mL$. the equation of state of an ideal gas $pV = nRT$, where n is the number of moles. techniques and procedures used to investigate PV = constant (Boyle's law) and TP = constant.

pV=NkT=1/3 mc^2 = 3/2 *KT*. The radian as a measure of angle. period and frequency of an object in circular motion. techniques and procedures used to investigate circular motion using a whirling bung. displacement, amplitude, period, frequency, angular frequency, and phase difference. the defining equation of simple harmonic motion and its solutions. techniques and procedures used to determine the period/frequency of simple harmonic oscillations. graphical methods to relate the changes in displacement, velocity, and acceleration during simple harmonic motion. energy-displacement graphs for a simple harmonic oscillator. observe forced and damped oscillations for a range of systems. resonance, natural frequency gravitational field lines to map gravitational fields. the concept of gravitational fields as being one of several forms of field giving rise to a force.

Kepler's three laws of planetary motion. geostationary orbit; uses of geostationary satellites. gravitational potential at a point as the work done in bringing unit mass from infinity to the point; gravitational potential is zero at infinity. escape velocity. Formation of a star from interstellar dust and gas in terms of gravitational collapse, fusion of hydrogen into helium, radiation, and gas pressure. Evolution of a low-mass star like our Sun into a red giant and white dwarf; planetary nebula. evolution of a massive star into a red super giant and then either a neutron star or black hole; supernova.

Demonstrate knowledge, application and understanding of: Hertzsprung–Russell (HR) diagram as luminosity-temperature plot; main sequence; red giants; super red giants; white dwarfs. emission spectral lines from hot gases in terms of emission of photons and transition of electrons between discrete energy levels. use of Wien's. Displacement law and Stefan's law to estimate the radius of a star. distances measured in astronomical unit (AU), light-year (ly) and parsec (pc). Charging and discharging of a capacitor or capacitor plates with reference to the flow of electrons.

What does excellence look like? - Continued

- Can predict and explain likely fate of stars based on their initial mass
- Can use the Hubble constant in units of either kms^{-1} or $kms^{-1}Mpc^{-1}$ to estimate the age of the universe
- Can use and manipulate appropriate equations to calculate the total capacitance of combinations in series in parallel in farads.
- Can use a potential difference vs charge graph to calculate the energy stored in a capacitor
- Use natural log graphs to determine the time constant of a capacitor resistor circuit
- Use and manipulate Coloumb's law to calculate the force between charges
- Can calculate electric potential and electric potential energy of charges in a field by using and manipulating appropriate equations
- Can use Fleming's left hand rule
- Can calculate magnetic field strength in Tesla and Webers per square metre
- Can use and manipulate power equations for an ideal transformer
- Able to calculate nuclear radius of different substances using their atomic numbers
- Can compare mean densities of atoms and nuclei
- Can explain beta decay using the quark model
- Can balance quark transformation equations in terms of charge
- Able to balance nuclear transformation equations
- Can numerically describe the relationship between decay constant and half-life of a radioactive substance
- Can use a spreadsheet and practical methods to model radioactive decay
- Can calculate the energy released or absorbed in nuclear reactions
- Can compare and evaluate the relative merits of different methods of nuclear imaging
- Can describe the structure and function of a gamma camera and its uses in diagnoses
- Can compare ultrasound A and B scan
- Can calculate impedance of different materials and explain the importance of impedance matching
- Can use the Doppler equation to determine the speed of blood using ultrasound measurements

How will we assess impact?

- Peer, self and teacher assessment in lessons
- Previous lesson recap quiz
- Teacher questioning
- Landmark tasks
- End of Topic tests

Knowledge, understanding & Skills

Term 1: Module 5- Newtonian world and astrophysics: the Cosmological principle: universe is homogeneous, isotropic and the laws of physics are universal. Doppler effect; Doppler shift of electromagnetic radiation. Hubble's law, the Hubble constant. The Big Bang Theory. Evolution of the universe. Dark matter.

Term 2: Module 6 – Particles and medical physics: Combining capacitors in series and parallel and calculating total capacitance. techniques and procedures used to investigate capacitors in both series and parallel combinations using ammeters and voltmeters. techniques and procedures to investigate the charge and the discharge of a capacitor using both meters and data-loggers. measuring and calculating the time constant for a capacitor-resistor circuit. graphical and spreadsheet modelling of equations describing capacitor discharge. using field lines to map electric fields. similarities and differences between the gravitational field of a point mass and the electric field of a point charge. Magnetic flux, flux linkage, the Weber, the Tesla. Faraday's law of electromagnetic induction and Lenz's law. techniques and procedures used to investigate magnetic flux using search coils. techniques and procedures used to investigate transformers. alpha-particle scattering experiment; evidence of a small charged nucleus. particles and antiparticles; electron–positron, proton-antiproton, neutron-antineutron and neutrino-antineutrino. classification of hadrons and leptons. Quarks. nuclear decay equations and balancing nuclear transformation equations. techniques and procedures used to determine the half-life of an isotope such as protactinium. Einstein's mass energy equation. binding energy per nucleon against nucleon number curve. Induced nuclear fission, chain reaction. Basic structure of a fission reactor. Environmental impact of nuclear waste. Nuclear fusion, fusion reactions, and temperature. X-rays, CAT scans, PET scans, Ultrasound scans. Doppler effect. Acoustic impedance.

How can you enhance your learning at home?

- Kerboodle
- Physicsandmathstutor
- Seneca learning
- AES student science website

Suggested homework tasks

- Learn spelling and definitions of key terms.
- Past examination questions practice
- Processing and analysis of data from practical activities
- Group and independent research projects

International Opportunities

Visits Programme	Within the curriculum
• **Community lectures on International themes** • **International day across the school** • **Primary research using student cultural diversity**	The Physics A Level curriculum is designed to deepen understanding and appreciation of how our International society makes decisions about world scientific issues. Students are encouraged to research each theme beyond lessons and set work to ensure that they can draw on a worldwide knowledge of the skills, techniques and theoretical understanding required for the further study of Physical Sciences at an International level.