IBS Physics – L6

Curriculum Intent

Physics is the most fundamental science which aims to understand everything from tiny particles to vast galaxies. The aim of all IB programmes is to develop internationally minded people who strive to create a better society.
The course aims for all students to: ·

- Understand that science is only one of eight ways of knowing
- Understand how science is an international pursuit and the benefits and impacts of international collaborations in science.
- Become critically aware, as global citizens, of the ethical implications of the use of science and technology
- To recognise the contributions of all civilisations that led us to our current understanding of the physics
- develop experimental and investigative scientific skills using up to date technology
- 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.

"However difficult life may seem, there is always something you can do and succeed at" – Stephen Hawking

Students will learn: - Term 1:-

Topic B The Particulate Nature of Matter

Molecular theory of solids, liquids. and gases. Temperature and absolute temperature. Internal energy. Specific heat capacity. Phase change. Specific latent heat. Kinetic model of an ideal gas. Mole, molar mass, and Avogadro constant. Differences between real and ideal gases. Charge. Electric field. Coulomb's law. Electric current. Direct current. Potential difference. Circuit diagrams. Kirchhoff's circuit laws. Heating effect of current and its consequences. Resistance. Ohm's law. Resistivity. Power dissipation. Cells. Internal resistance. Secondary cells. Terminal potential difference. Electromotive force

Term 2 - Topic C Wave Behaviour

Simple harmonic oscillations. Time period, frequency, amplitude, displacement, and phase difference. Conditions for simple harmonic motion. Travelling waves. Wavelength, frequency, period, and wave speed. Transverse and longitudinal waves. The nature of electromagnetic waves. The nature of sound waves. Wavefronts and rays. Amplitude and intensity. Superposition. Polarisation. Reflection and refraction. Snell's law, critical angle, and total internal reflection. Diffraction through a single-slit and around objects. Interference patterns. Double slit interference. Path difference. The nature of standing waves. Boundary conditions. Nodes and antinodes.

Term 3 - Topic A Space, Time and Motion

Physical quantities. S.I. units. Measurements and uncertainties. Scalars and vectors. Newton's equations of motion. Car stopping distances. Freefall and g. Projectile motion. Force, mass, and weight. Drag and terminal velocity. Couples and torques. Archimedes' principle. Conservation of energy. Power and efficiency. Newton's law. Linear momentum and impulse.

Knowledge, understanding & Skills

An elementary explanation of the physical differences between solids, liquids and gases in terms of the molecular model is required.

The conversion of Kelvin and Celsius scales is required.
The terms melting, freezing, boiling, condensing and evaporation should be familiar.
The luminosity of a star can be expressed in watts or in terms of the luminosity of the Sun $L_\odot$.

Problems will include the estimation of equilibrium temperature of a body using energy balance between incoming and outgoing radiation intensity, including albedo, emissivity, and solar or other constants.
Energy balance problems will include energy exchanged between the surface and the atmosphere of a body.
The burning of fossil fuels is a primary cause of the enhanced greenhouse effect.

The assumption of the kinetic model is of an ideal gas.
The differences between an ideal gas and a real gas should be understood.
Gas laws are limited to constant volume, constant temperature, constant pressure and the ideal gas law.
Changes of state of an ideal gas can be represented on pressure–volume diagrams.
A qualitative explanation of the macroscopic properties of an ideal gas in terms of molecular behaviour is required. Solving problems using the equation of state for an ideal gas and gas laws. Sketching and interpreting changes of state of an ideal gas on pressure–volume, pressure–temperature and volume–temperature diagrams. Investigating gas laws experimentally.

How will we assess impact?

- Peer and self-assessment
- Previous lesson recap quiz
- Check point tasks
- End of topic tests
- Teacher questioning
- Cumulative linear knowledge tests
- End of L6 and mid- U6 PPE examinations using unseen exam board papers

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.
- Estimate orders of magnitude in a variety of context
- Checking for homogeneity in manipulated equations
- Process uncertainties and present them graphically
- Use qualitative and quantitative data to evaluate precision and accuracy
- Give examples of scalar and vector quantities
- Able to resolve2 or more coplanar vectors by scale drawing or calculation
- Substitute numerical values into algebraic equations using appropriate units for physical quantities
- Solve algebraic equations, including quadratic equations
- Translate information between graphical, numerical and algebraic forms
- Determine the slope and intercept of graphs
- Change the subject of an equation, including non-linear equations
- Apply the concepts underlying calculus by solving equations involving rates of change, e.g., t x Δ Δ = −λ x using a graphical method or spreadsheet modelling.
- Use of pressure gauges, barometers and manometers to take measurements to investigate the gas laws
- Can determine the energy transferred during phase changes both experimentally and by calculation
- Can describe total energy in terms of the potential and kinetic energy of the particles in a substance
- Can use temperature-time graphs to determine energy transferred during phase changes
- Can describe and justify the assumptions that underpin the ideal gas law

Knowledge, understanding & Skills

Advantages and disadvantages of difference sources of electrical energy are required.
Refer to the Physics data booklet for the electrical circuit symbols that are required.
Alternating current (ac) circuits are not required.
Unless otherwise stated, ammeters and voltmeters will be considered as ideal. In cases where non-ideal meters are used, the resistance will be constant.
A metal conductor at a constant temperature will be considered an ohmic device.
Variable resistors will be limited to thermistors, light-dependent resistors (LDR) and potentiometers.
The significance of the minus sign in the defining equation for simple harmonic motion should be understood.
Energy changes during simple harmonic motion (kinetic, potential and total) should be described qualitatively.
A quantitative approach to energy changes during simple harmonic motion is required at higher level only. Radians are used for phase angle calculations.
Problems will involve describing the motion of particles of a medium when a wave passes through it for both transverse and longitudinal waves. This will be in terms of displacement with respect to the position along the wave and with time.
Travelling waves transfer energy, even if there is no resultant displacement of the medium.
Refer to the Physics data booklet for the approximate orders of magnitude of the wavelengths of radio, microwave, infrared, visible, ultraviolet, X-rays and gamma rays.
The wave model should be applied to both mechanical waves and electromagnetic waves.
Problems may involve sketching and interpreting wavefronts and rays. These will be limited to incident, reflected, and transmitted waves.
Interference and diffraction patterns will be limited to those produced at normal incidence.
The effect of slit width on the intensity of the single-slit diffraction pattern should be considered qualitatively.
The discussion of single-slit diffraction will be limited to monochromatic light and rectangular slits.
Multiple slit and diffraction grating patterns produced from white light and a range of monochromatic light wavelengths should be discussed.
The formation of standing waves from the superposition of more than two waves should not be considered.
Pipes will be referred to as open or closed.
End corrections for open pipes are not required.
Boundary conditions for strings include two fixed boundaries, one fixed and one free boundary, and two free boundaries.

What does excellence look like?

- Can use temperature-time graphs to determine energy transferred during phase changes
- Can plot and interpret graphs describing simple harmonic motion including displacement– time, velocity–time, acceleration–time and acceleration–displacement graphs
- Can use and manipulate equations linking displacement, velocity and acceleration in a simple harmonic oscillator
- Can derive the defining equation for simple harmonic motion from first principles
- Can present both longitudinal and transverse waves using wavefronts and rays and use such diagrams to show and determine speed changes in different media Can use and manipulate Snell's law in terms of angle, velocity or refractive index
- Derive expressions for work done, field strength and potential using Coloumb's law
- Use IV graphs to characterise electric components and take measurements from these to determine resistance

How can you enhance your learning at home?

- **IB Physics revision**
- **Grade Gorilla**
- **Isaac Physics**
- **Physics Tube**
- **The institute of physics**
- **Physics and maths tutor**
- **Minute Physics**
- **Hyperphysics**

Suggested homework task

- **Learn definitions of key terms**
- **Group and independent research projects**
- **Past examination question practice**
- **Practical activity preparation, simulations and follow up.**

Knowledge, understanding & Skills

Boundary conditions for air in pipes include two closed ends, one closed and one open end, and two open ends.
Vibration modes of air in pipes will be discussed in terms of displacement nodes and antinodes. For standing waves in air, pressure nodes and antinodes are not required.
The lowest frequency mode of a standing wave will be referred to as the first harmonic. The terms fundamental and overtone are not to be used in this course.
A determination of the wavelength and the frequency of the nth harmonic given the length of the string or pipe and the speed of the wave is required.
Only a qualitative analysis is required concerning the impact of damping on the frequency response of a driven oscillator.
Knowledge of the useful and destructive effects of resonance is required.
Problems will not include situations where both source and observer are moving.
Problems can involve the determination of the velocity of the source/observer.
The use of the Doppler effect in medical physics and in radars should be considered as examples.

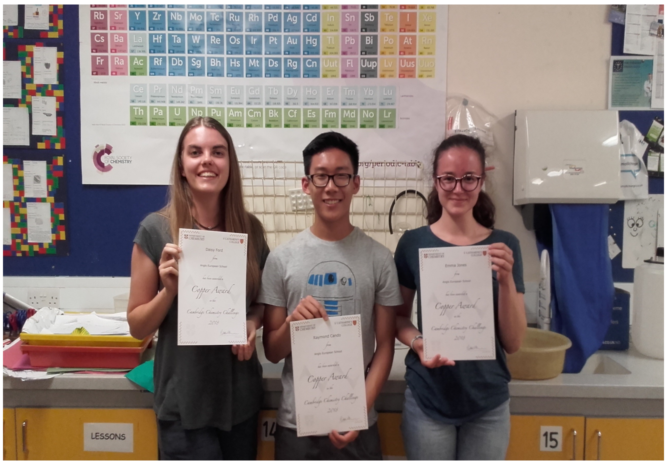
A quantitative approach to projectile motion will be limited to situations where fluid resistance is absent or can be neglected.
The trajectory of projectile motion is parabolic in the absence of fluid resistance, but the equation of the trajectory is not required.
Familiarity with projectiles launched horizontally, at angles above, and at angles below the horizontal is required.
Projectile motion will only involve problems using a constant value of g close to the surface of the Earth. Fluid resistance refers to the effects of gases and liquids on the motion of a body.

Sketches and interpretations of free-body diagrams and a determination of the resultant force are for one- and two-dimensional situations only.
Forces should be labelled using commonly accepted names or symbols.
Newton's first law will be applied to problems involving translational equilibrium.
Examples of Newton's third law will include the identification of force pairs in various situations.
The use of simultaneous equations involving conservation of momentum and energy in collisions is not required.

ENTRY REQUIREMENTS

To study Standard Level Physics, you will need:

- A grade 5 in GCSE Physics OR a grade 5-5 in Combined Sciences
- In addition, you will need a grade 5 in Maths



Knowledge, understanding & Skills

A quantitative approach to collisions and explosions is for one-dimensional situations for standard level students and for two-dimensional situations for higher level students. Situations should involve both uniform and non-uniform circular motion in both horizontal and vertical planes. Analysis of forces on bodies in non-uniform circular motion in a vertical plane at points other than the top or bottom is not required.
Quantitative treatment of problems involving banked surfaces is not required.

Describing the differences between photovoltaic cells and solar heating panels. Sketching and interpreting graphs showing the variation of intensity with wavelength for bodies emitting thermal radiation at different temperatures. Solving problems involving the Stefan–Boltzmann law and Wien's displacement law. Describing the effects of the Earth's atmosphere on the mean surface temperature. Solving problems involving albedo, emissivity, solar constant and the Earth's average temperature. The change in the total mechanical energy of a system should be interpreted in terms of the work done on the system by any non-conservative force.

International Opportunities

Visits Programmes

- **Community lectures on International themes**
- **International day across the school**
- **Primary research using student cultural diversity**

Within the Curriculum

The Physics IB Standard 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 using International research methods 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.

"Physics is really nothing more than a search for ultimate simplicity, but so far all we have is a kind of elegant messiness." **Bill Bryson,** A Short History of Nearly Everything