IBH 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 - <u>Topic B The Particulate Nature of Matter</u>
- B4 Thermodynamics

<u>Term 2 - Topic C Wave Behaviour</u>
- C1 Simple Harmonic Motion
- C3 Wave Phenomena
- C5 Doppler Effect

<u>Term 3 - Topic A Space, Time and Motion</u>
- A4 Rigid Body Mechanics

What does excellence look like?

Students should understand:
- that the first law of thermodynamics as given by $Q = \Delta U + W$ results from the application of conservation of energy to a closed system and relates the internal energy of a system to the transfer of energy as heat and as work
- that the work done by or on a closed system as given by $W = P\Delta V$ when its boundaries are changed can be described in terms of pressure and changes of volume of the system
- that the change in internal energy of a system is related to the change of its temperature
- that entropy S is a thermodynamic quantity that relates to the degree of disorder of the particles in a system
- that entropy can be determined in terms of macroscopic quantities such as thermal energy and temperature and also in terms of the properties of individual particles of the system
- that the second law of thermodynamics refers to the change in entropy of an isolated system and sets constraints on possible physical processes and on the overall evolution of the system
- that processes in real isolated systems are almost always irreversible and consequently the entropy of a real isolated system always increases

Knowledge, understanding & Skills - FOR ADDITIONAL HIGHER LEVEL CONTENT
For information on the core curriculum, please see the the IBS Physics L6 map

A closed system is understood to be one in which no mass can be transferred in or out, but energy can be transferred in both directions as heat or as work.
An isolated system is understood to be one in which neither mass nor energy can be transferred in or out.
Problems will use the Clausius' sign convention where Q is the resultant thermal energy supplied to the system and W is the resultant work done by the system.
The second law of thermodynamics should be described in Clausius form and Kelvin form, as well as in terms of entropy change in reversible and irreversible processes occurring in isolated systems.

Work done on a system is taken to be negative.

Work done by a system is taken to be positive.

In quantitative problems, systems will be limited to monatomic ideal gases, including situations where pressure is not constant.

The microstates of a system are equally probable and can be described in a simple combinatorial model (for example, based on coins).

What does excellence look like?

Students should understand:

- that the entropy of a non-isolated system can decrease locally, but this is compensated by an equal or greater increase of the entropy of the surroundings
- that isovolumetric, isobaric, isothermal and adiabatic processes are obtained by keeping one variable fixed
- that adiabatic processes in monatomic ideal gases can be modelled by the equation (see data book)
- that cyclic gas processes are used to run heat engines
- that a heat engine can respond to different cycles and is characterized by its efficiency
- that the Carnot cycle sets a limit for the efficiency of a heat engine at the temperatures of its heat reservoirs
- that a particle undergoing simple harmonic motion can be described using phase angle
- that problems can be solved using the equations for simple harmonic motion
- single-slit diffraction including intensity patterns
- that the single-slit pattern modulates the double slit interference pattern
- interference patterns from multiple slits and diffraction gratings as given by $n\lambda = d \sin \theta$.
- the observed frequency for sound waves and mechanical waves due to the Doppler effect determined for:
  - moving source
  - moving observer
- the torque τ of a force about an axis as given by $\tau = Fr\sin \theta$
- that bodies in rotational equilibrium have a resultant torque of zero
- that an unbalanced torque applied to an extended, rigid body will cause angular acceleration
- that the rotation of a body can be described in terms of angular displacement, angular velocity and angular acceleration
- that equations of motion for uniform angular acceleration can be used to predict the body's angular position θ, angular displacement $\Delta\theta$, angular speed ω and angular acceleration α (see data book)
- that the moment of inertia I depends on the distribution of mass of an extended body about an axis of rotation
- the moment of inertia for a system of point masses as given by $I = \Sigma mr^2$
- Newton's second law for rotation as given by $\tau = I\alpha$ where τ is the average torque
- that an extended body rotating with an angular speed has an angular momentum L

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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 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.

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.

The vector nature of torque and angular momentum need not be addressed, but the sense (clockwise or counter-clockwise) of a torque should be included.
A calculation of the centre of mass of bodies is not required; there should be an understanding that when considering linear motion, the mass of an extended body may be taken as concentrated at the centre of mass.
The equation for the moment of inertia of a specific mass distribution will be provided when necessary. Simultaneous rotational and translational motion will be restricted to rolling without slipping.
Angular speed will be used rather than angular velocity as a formal vector treatment.
The term angular velocity will be used although a formal vector treatment is not required.
Situations should involve change of moment of inertia in extended bodies and coupled pairs of bodies.

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

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.

ENTRY REQUIREMENTS

To study Standard Level Physics, you will need:

- A grade 6 in GCSE Physics OR a grade 6-6 in Combined Sciences
- In addition, you will need a grade 6 in Maths
- It is also strongly advised that you study Higher Level Maths as part of your diploma

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