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Course Outline

Physics AS LEVEL

Overview

Pearson Edexcel International Advanced Subsidiary in Physics Syllabus at GEMS Wesgreen International School aims to provide the students an opportunity to develop attitudes relevant to Physics such as concern for accuracy and precision, objectivity, and inquiry. Pearson Edexcel International AS Physics helps learners develop the knowledge and skills that will prepare them for successful university study.

Learning Outcomes

Students should be helped to understand how, through the ideas of physics, the complex and diverse phenomena of the natural world can be described in terms of a number of key ideas which are of universal application, and which can be illustrated in the separate topics set out below. These ideas include:

- the use of models, as in the particle model of matter or the wave models of light and of sound
- the concept of cause and effect in explaining such links as those between force and acceleration, or between changes in atomic nuclei and radioactive emissions
- that proportionality, for example between weight and mass of an object or between force and extension in a spring, is an important aspect of many models in science.
- develop effective scientific communication skills, using appropriate terminology and scientific conventions.
- understand their responsibility to others/society and to care for the environment.
- enjoy science and develop an informed interest in the subject that may lead to further study.

Topic Overview

AS Level Term 1

IAS Unit 1: Mechanics and Materials *Unit code: WPH11/01

This unit covers mechanics and materials. This topic may be studied using applications that relate to mechanics, for example sports and to materials, for example spare-part surgery. This topic also enables students to develop practical and mathematical skills.

1.3 Mechanics **Approximate length: 20 hours(theory) + 10hours (practical)**

This topic covers rectilinear motion, forces, energy and power. It may be studied using applications that relate to mechanics such as sports. This unit includes many opportunities for developing experimental skills and techniques by carrying out more than just the core practical experiments.

To develop their practical skills, students should be encouraged to carry out a range of practical experiments related to this topic. Possible experiments include strobe photography or the use of a video camera to analyse projectile motion, determine the centre of gravity of an irregular rod, investigate the conservation of momentum using light gates and air track,

Specific objectives with the Pearson Edexcel syllabus covered:

- to use the equations for uniformly accelerated motion in one dimension
- to draw and interpret displacement-time, velocity-time and acceleration-time graphs.
- to know the physical quantities derived from the slopes and areas of displacement-time, velocity-time and acceleration-time graphs, including cases of non-uniform. acceleration and understand how to use the quantities.
- to understand scalar and vector quantities and know examples of each type of quantity and recognise vector notation.
- to resolve a vector into two components at right angles to each other by drawing and by calculation
- to find the resultant of two coplanar vectors at any angle to each other by drawing, and at right angles to each other by calculation
- to understand how to make use of the independence of vertical and horizontal motion of a projectile moving freely under gravity.
- to draw and interpret free-body force diagrams to represent forces on a
- to particle or on an extended but rigid body using the concept of centre of gravity of an extended body
- to use the equation $\sum F = ma$, and understand how to use this equation in situations where m is constant (Newton's second law of motion), including Newton's. first law of motion where a = 0, objects at rest or travelling at constant velocity Use of the term 'terminal velocity' is expected.
- to use the equations for gravitational field strength and weight W = mg
- CORE PRACTICAL 1: Determine the acceleration of a freely falling object.
- to know and understand Newton's third law of motion and know the properties of pairs of forces in an interaction between two bodies.
- to understand that momentum is defined as p = mv.
- know the principle of conservation of linear momentum, understand how to relate this to Newton's laws of motion and understand how to apply this to problems in one dimension.
- to use the equation for the moment of a force, moment of force
- to use the concept of centre of gravity of an extended body and apply the principle of moments to an extended body in equilibrium.
- to use the equation for work $\Delta W = F\Delta s$, including calculations when the force is not along the line of motion.
- to use the equation for the kinetic energy of a body

- to use the equation for the difference in gravitational potential energy near the Earth's surface
- to know, and understand how to apply, the principle of conservation of energy including use of work done, gravitational potential energy and kinetic energy.
- to use the equations relating power, time and energy transferred or work done.
- to use the equations efficiency

1.4 Materials **Approximate length:16 hours(theory) + 7 hours (practical)**

This topic covers density, flow of liquids, Hooke's law, the young modulus, and elastic strain energy. This topic should be studied using a variety of applications, for example making and testing food, engineering materials, spare-part surgery for joint replacement. This unit includes many opportunities for developing experimental skills and techniques by conducting more than just the core practical experiments. Hooke's law and the young modulus experiments for a variety of materials

Specific objectives with the Pearson Edexcel syllabus covered:

- to use the equation density 24, understand how to use the relationship upthrust = weight of fluid displaced
- as to use the equation for viscous drag (Stokes' Law), $F = 6\pi\eta rv$.
  b understand that this equation applies only to small spherical objects moving at low speeds with laminar flow (or in the absence of turbulent flow) and that viscosity is temperature dependent
- CORE PRACTICAL 2: Use a falling-ball method to determine the viscosity of a liquid.
- to use the Hooke's law equation, $\Delta F = k\Delta x$, where k is the stiffness of the object
- to understand how to use the relationships.
  • (tensile or compressive) stress = force/cross-sectional area
  • (tensile or compressive) strain= change in length/original length
  Young modulus = stress/strain.
- as to draw and interpret force-extension and force-compression graphs b understands the terms limit of proportionality, elastic limit, yield point, elastic deformation and plastic deformation and be able to apply them to these graphs.
- to draw and interpret tensile or compressive stress-strain graphs and understand the term breaking stress.
- CORE PRACTICAL 3: Determine the Young modulus of a material.
- to calculate the elastic strain energy Eel in a deformed material sample, using the equation $\Delta E_{el} = (½) F\Delta x$, and from the area under the force-extension graph. The estimation of area and hence energy change for both linear and non-linear force-extension graphs is expected.

Term 2-AS Level

IAS Unit 2: Waves and Electricity ***Unit code: WPH12/01**

In this unit topic covers waves and the particle nature of light and electric currents. This topic may be studied using applications that relate to electricity, for example space technology and to waves, for example medical physics. This topic also enables students to develop practical and mathematical skills.

To develop their practical skills, students should be encouraged to carry out a range of practical experiments related to this topic. Possible experiments include estimating power output of an electric motor, using a digital voltmeter to investigate the output of a potential divider and investigating current/voltage graphs for a filament bulb, thermistor and diode, determining the refractive index of solids and liquids, demonstrating progressive and stationary waves on a slinky.

2.3 Waves and Particle Nature of Light **Approximate length:25 hours(theory) + 8 hours (practical)**

This topic covers the properties of different types of waves, including standing waves. Refraction, polarisation and diffraction are also included and the wave/particle nature of light. This topic should be studied by exploring the applications of waves, for example applications in medical physics or music. This unit includes many opportunities for developing experimental skills and techniques by carrying out more than just the core practical experiments.

<u>Specific objectives with the Pearson Edexcel syllabus covered:</u>

- to understand the terms amplitude, frequency, period, speed and wavelength
- to use the wave equation $v = f\lambda$
- to describe longitudinal waves in terms of pressure variation and the displacement of molecules
- to describe transverse waves
- to draw and interpret graphs representing transverse and longitudinal waves including standing/stationary waves.
- CORE PRACTICAL 4: Determine the speed of sound in air using a 2-beam oscilloscope, signal generator, speaker and microphone.
- To know and understand what is meant by wavefront, coherence, path difference, superposition, interference and phase.
- to use the relationship between phase difference and path difference
- to know what is meant by a standing/stationary wave and understand how such a wave is formed, know how to identify nodes and antinodes.
- to use the equation for the speed of a transverse wave on a string $v=\sqrt{(T/\mu)}$
- CORE PRACTICAL 5: Investigate the effects of length, tension and mass per unit length on the frequency of a vibrating string or wire.
- to use the equation for the intensity of radiation $I=P/A$
- to know and understand that at the interface between medium 1 and medium 2 $n_1 \sin \theta_1 = n_2 \sin \theta_2$ where refractive index is n
- to calculate critical angle using $\sin C=(1/n)$
- to predict whether total internal reflection will occur at an interface.

- to understand how to measure the refractive index of a solid material.
- to understand what is meant by plane polarisation.
- to understand what is meant by diffraction and use Huygens' construction to explain what happens to a wave when it meets a slit or an obstacle.
- to use $n\lambda = d \sin\theta$ for a diffraction grating
- CORE PRACTICAL 6: Determine the wavelength of light from a laser or other light source using a diffraction grating.
- to understand how diffraction experiments provide evidence for the wave nature of electrons.
- to use the de Broglie equation $p = h/\lambda$.
- to understand that waves can be transmitted and reflected at an interface between media.
- to understand how a pulse-echo technique can provide information about the position of an object and how the amount of information obtained may be limited by the wavelength of the radiation or by the duration of pulses.
- to understand how the behaviour of electromagnetic radiation can be described in terms of a wave model and a photon model, and how these models developed over time.
- to use the equation $E = hf$, that relates the photon energy to the wave frequency
- to understand that the absorption of a photon can result in the emission of a photoelectron.
- to understand the terms 'threshold frequency' and 'work function' and be able to use the equation $hf = \phi + (1/2)\, mv^2_{max}$
- to use the electronvolt (eV) to express small energies.
- to understand how the photoelectric effect provides evidence for the particle nature of electromagnetic radiation.
- to understand atomic line spectra in terms of transitions between discrete energy levels and understand how to calculate the frequency of radiation that could be emitted or absorbed in a transition between energy levels.

2.4 Electric Circuits **Approximate length:16 hours(theory) + 7 hours (practical)**

This topic covers the definitions of various electrical quantities, for example current, potential difference and resistance, Ohm's law and non-ohmic conductors, potential dividers, e.m.f. and internal resistance of cells and negative temperature coefficient thermistors. This topic should be studied using applications such as space technology. This unit includes many opportunities for developing experimental skills and techniques by carrying out more than just the core practical experiments.

<u>Specific objectives with the Pearson Edexcel syllabus covered:</u>

- to understand that electric current is the rate of flow of charged particles and be able to use the equation $I = \Delta Q / \Delta t$
- to understand how to use the equation $V = W/Q$
- to understand that resistance is defined by $V = I R$ and that Ohm's law is a special case when $I \propto V$ for constant temperature
- (a) understand how the distribution of current in a circuit is a consequence of charge conservation
  (b) understand how the distribution of potential differences in a circuit is a consequence of energy conservation.

- to derive the equations for combining resistances in series and parallel using the principles of charge and energy conservation and be able to use these equations.
- to use the equations P = VI, W = VIt and be able to derive and use related equations, e.g., $P = I^2 R$ and $P = V^2/ R$
- to understand how to sketch, recognise and interpret current-potential difference graphs for components, including ohmic conductors, filament bulbs, thermistors and diodes.
- to use the equation $R = \rho l/A$
- CORE PRACTICAL 7: Determine the electrical resistivity of a material.
- to use $I = nqvA$ to explain the large range of resistivities of different materials.
- to understand how the potential along a uniform current-carrying wire varies with the distance along it.
- to understand the principles of a potential divider circuit and understand how to calculate potential differences and resistances in such a circuit.
- to analyse potential divider circuits where one resistance is variable including thermistors and light dependent resistors (LDRs)
- to know the definition of electromotive force (e.m.f.) and understand what is meant by internal resistance and know how to distinguish between e.m.f. and terminal potential difference.
- CORE PRACTICAL 8: Determine the e.m.f. and internal resistance of an electrical cell.
- to understand how changes of resistance with temperature may be modelled in terms of lattice vibrations and number of conduction electrons and understand how to apply this model to metallic conductors and negative temperature coefficient thermistors.
- to understand how changes of resistance with illumination may be modelled in terms of the number of conduction electrons and understand how to apply this model to LDRs.

IAS Unit 3: Practical Skills in Physics I ***Unit code: WPH13/01**

(This unit is covered along with unit1 and unit2)

Students are expected to develop experimental skills, and a knowledge and understanding of experimental techniques, by conducting a range of practical experiments and investigations while they study Units 1 and 2. This unit will assess students' knowledge and understanding of experimental procedures and techniques that were developed when they conducted these experiments.

Development of practical skills, knowledge and understanding

Students should conduct a variety of practical work during the IAS course to develop their practical skills. This should help them to gain an understanding and knowledge of the practical techniques that are used in experimental work. To prepare students for the assessment of this unit, centers should give students opportunities to plan experiments, implement their plans, collect data, analyse their data, and draw conclusions. Experiments should cover a range of different topic areas and require the use of a variety of practical techniques.

Assessment

Formative: Throughout the units, the students will complete graded work, quizzes and practical, research activities, which allows the teacher to assess the students' attainment and inform their planning.

For each unit, the students complete a pre and posttest. This allows us to see progress across the units and to inform our planning.

Summative: At the end of first term, we complete internal tests – Unit based and combined Units. Students complete standardized tests such as Mock Exam during the month of March. This allows us to measure the students' progress throughout the term and year.