OCR Physics A 2 year Long Term Plan

Assessment Objectives

AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures.

AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures:
- in a theoretical context
- in a practical context
- when handling qualitative data
- when handling quantitative data.

AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to:
- make judgements and reach conclusions
- develop and refine practical design and procedures.

Year 12 (except in bold)

1. **How Science Works skills identified and developed through teaching and learning**

- HSW1 Use theories, models and ideas to develop scientific explanations
- HSW2 Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas
- HSW3 Use appropriate methodology, including information and communication technology (ICT), to answer scientific questions and solve scientific problems
- HSW4 Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts
- HSW5 Analyse and interpret data to provide evidence, recognising correlations and causal relationships
- HSW6 Evaluate methodology, evidence and data, and resolve conflicting evidence
- HSW7 Know that scientific knowledge and understanding develops over time
- HSW8 Communicate information and ideas in appropriate ways using appropriate terminology
- HSW9 Consider applications and implications of science and evaluate their associated benefits and risks
- HSW10 Consider ethical issues in the treatment of humans, other organisms and the environment
- HSW11 Evaluate the role of the scientific community in validating new knowledge and ensuring integrity
- HSW12 Evaluate the ways in which society uses science to inform decision making
- HSW11 Evaluate the role of the scientific community in validating new knowledge and ensuring integrity
- HSW12 Evaluate the ways in which society uses science to inform decision making.

2. **Mathematical skills identified and developed through teaching and learning**

- M0 – Arithmetic and numerical computation: recognise and make use of appropriate units in calculations, recognise and use expressions in decimal and standard form; use ratios, fractions and percentages, estimate results; use calculators to find and use power, **exponential and logarithmic functions**; use calculators to handle sin x, cos x and tan x when x is expressed in degrees or radians
- M1 – Handling data: use an appropriate number of significant figures, find arithmetic means, understand simple probability, make order of magnitude calculations; identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined by addition, subtraction, multiplication, division and raising to powers
- M2 – Algebra: understand and use symbols; change the subject of an equation, including nonlinear equations; substitute numerical values into algebraic equations using appropriate units for physical quantities; solve algebraic equations, including quadratic equations; **use logarithms in relation to quantities**

that range over several orders of magnitude

- M3 – Graphs: translate information between graphical, numerical and algebraic forms, plot two variables from experimental or other data, understand that y = mx + c represents a linear relationship, determine the slope and intercept of a linear graph, calculate rate of change from a graph showing a linear relationship, draw and use the slope of a tangent to a curve as a measure of rate of change, distinguish between instantaneous rate of change and average rate of change; understand the possible physical significance of the area between a curve and the x axis and be able to calculate it or estimate it by graphical methods as appropriate; Apply the concepts underlying calculus (but without requiring the explicit use of derivatives of integrals) by solving equations involving rates of change, using a graphical method or spreadsheet modelling; **interpret logarithmic plots; use logarithmic plots to test exponential and power law variation**s, sketch relationships which are modelled by y = k/x, y = kx2, y = k/x2, y = kx, y = sin x, y = cos x, **y = e±x , and y = sin2x, y = cos2x as applied to physical relationships**
- M4 – Geometry and trigonometry: use angles in regular 2D and 3D structures, visualise and represent 2D and 3D forms including two dimensional representations of 3D objects; calculate areas of triangles, circumferences and areas of circles, surface areas and volumes of rectangular blocks, cylinders and spheres; use Pythagoras' theorem, and the angle sum of a triangle; use sin, cos and tan in physical problems; use of small angle approximations; understand the relationship between degrees and radians and translate from one to the other

3. <u>Transferable learning skills (developed throughout)</u>

- structure independent study time between lessons to complete teacher set consolidation tasks and pre reading to deadline.
- build the habit of returning to prior learning to consolidate, deepen the understanding and reapplying it in familiar contexts.
- to establish note taking and retrieval revision habits outside of the classroom.
- self mark work, in green pen, adding modelled solutions where needed both in class and independently using mark schemes.
- use teacher provided feedback to identify gaps in knowledge and target those areas in private study.

<u>Year 13 (including in bold)</u>

1. <u>How Science Works skills identified and developed through teaching and learning (as year 12)</u>

2. <u>Mathematical skills identified and developed through teaching and learning (as year 13)</u>

3. <u>Transferable learning skills (developed throughout)</u>

- structure independent study time between lessons to complete teacher set and personalised consolidation tasks as well as pre reading to deadline.
- refine the habit of returning to prior learning to consolidate, deepen the understanding and reapplying it in complex and less familiar contexts.
- to further develop note taking and retrieval revision habits outside of the classroom. Developing the ability to apply appropriate spacing techniques to maximise the benefit from revision time.
- self mark work, in green pen, adding modelled solutions where needed both in class and independently using mark schemes.
- develop as a self aware learner, able to identify gaps in knowledge and target those areas in private study.

Rationale for the sequencing of texts and skills across the course

At Lipson we follow OCR Physics A. The course uses a content-led approach, enabling a flexible approach to the teaching order. It is laid out clearly in a series of teaching modules, is co-teachable, and embeds practical requirements and skills within the teaching modules. The Physics course has been carefully sequenced to allow a natural transition from GCSE to A level and is designed to enable two teachers to teach different topics simultaneously. This aids memory retention and understanding through spacing out knowledge acquisition, retrieval and memory retention.

At the start of year 12 the teacher with the most contact hours delivers a topic called ‘foundations of physics’, and as its name suggests, is the foundations required to access the course and is continuation of skills learnt at GCSE. The topics taught thereafter reflect and develop on previous knowledge from GCSE whilst also developing a strong basis on which to build future learning i.e. the content delivered in year 13. For example, forces and motion is taught in GCSE, then the module forces and motion is taught at the start of year 12, and then is built upon in year 13 in the module Newtonian world and astrophysics. This transition into and through the A level course provides students with the confidence and knowledge required to be successful in future topics.

Throughout the course the sequence is well structured and coherent to help students manage with the increased knowledge demand of the topics. For example, understanding capacitors (taught in half-term 6) requires an understanding of series and parallel circuits (half-term 3), which itself requires a good understanding of electrical charge, current (half-term 1), resistance and potential difference (half-term 2).

The course has been designed so that it can be taught by two teachers at both year 12 and year 13 independently of each other. The content of these modules does overlap, but they can be taught separately. As such, the year 12 content and year 13 content is taught as per the recommendation of the specification. The course is separated into six modules; one practical based (development of practical skills in physics), one skills based (foundations of physics), and four content based (forces and motion; electrons, waves and photons; Newtonian world and astrophysics, particles and medical physics).

Of the four content modules (modules 3-6), two are delivered in year 12 and two in year 13. The two modules taught in each year are then split between two teachers with each teacher taking one of the modules. These modules are each then split into chapters. The chapters are designed, in the specification, to follow on from one another in each module; as such, these chapters are taught sequentially. Modules 1 and 2 are taught throughout the course where the skills are incorporated where relevant. Module 2 (foundations of physics) is specifically taught before modules 3-6 so that the skills learned can be applied to the content being taught. The course has been planned so that teaching finishes by Easter, allowing adequate time for reviewing content and skills, and preparing for exams.

The course is designed to enthuse students and develop not just a passion for physics but young adults with the ability to succeed at undergraduate level. Transferable skills are equally as important as academic understanding and students develop their cognitive, interpersonal and intrapersonal skills throughout the course, enabling them to meet the demands of further and higher education. The coherent mapping of content alongside disciplinary skills helps to develop young scientists equipped with a comprehensive set of skills to ensure future success, particularly in the physical sciences.

A Level Y12 LTP

Teacher 1: 3 teaching hours per week

Half-Term 1: **Module 2: Foundations in physics** The aim of this module is to introduce important conventions and ideas that permeate the fabric of physics. Understanding of physical quantities, S.I. units, scalars and vectors helps physicists to effectively communicate their ideas within the scientific community (HSW8, 11). **2.1 Physical quantities and units** 2.1.1 Physical quantities 2.1.2 S.I. units **2.2 Making measurements and analysing data** 2.2.1 Measurements and uncertainties 2.3 Nature of quanttes 2.3.1 Scalars and vectors	**Half-Term 2:** **Module 3: Forces in Action** In this module, learners will learn how to model the motion of objects using mathematics, understand the effect forces have on objects, learn about the important connection between force and energy, appreciate how forces cause deformation and understand the importance of Newton's laws of motion. **3.1 Moton** 3.1.1 Kinematics 3.1.2 Linear motion 3.1.3 Projectile motion **3.2 Forces in acton** 3.2.1 Dynamics 3.2.2 Moton with non-uniform acceleration 3.2.3 Equilibrium 3.2.4 Density and pressure	**Half-Term 1** **3.3 Work, energy and power** 3.3.1 Work and conservation of energy 3.3.2 Kinetic and potential energies 3.3.3 Power **3.4 Materials** 3.4.1 Springs 3.4.2 Mechanical properties of matter	**Half-Term 4** **3.5 Newton's laws of motion and momentum** 3.5.1 Newton's laws of motion 3.5.2 Collisions **Module 4: Electrons, waves and photons** **4.4 Waves** 4.4.1 Wave motion 4.4.2 Electromagnetic waves	**Half-Term 5** **4.4 Waves (continued)** 4.4.3 Superposition 4.4.4 Stationary waves **PPE Revision** Revision of content and skills, examination practice, and past paper practice (including H156 papers). H156 PPE papers (OCR Physic A AS) assess the content and skills taught up to this point in the course.	**Half-Term 6** Students sit 2 AS PPE papers which cover the skills and content taught so far in OCR Physics A. **Module 5: Newtonian world and astrophysics** The aim of this module is to show the impact Newtonian mechanics has on physics. **5.1 Thermal physics** 5.1.1 Temperature 5.1.2 Solid, liquid and gas 5.1.3 Thermal properties of materials

	[PAG 1.1 - Comparing methods of determining g]	**[PAG 2.1 - Determining the Young's modulus for a metal]**	**[PAG 5.3 - Determining the frequency and amplitude of a wave using an oscilloscope]**		**[PAG 11.2 Determining the Specific heat capacity of a material]**

Teacher 2: 2 teaching hours per week

Half-Term 1:	**Half-Term 2:**	**Half-Term 3:**	**Half-Term 4:**	**Half-Term 5:**	**Half-Term 6:**
Module 4: Electrons, waves and photons The aim of this module is to ultimately introduce key ideas of quantum physics. **4.1 Charge and current** 4.1.1 Charge 4.1.2 Mean drift velocity	**4.2 Energy, power and resistance** 4.2.1 Circuit symbols 4.2.2 E.m.f. and p.d 4.2.3 Resistance 4.2.4 Resistivity 4.2.5 Power	**4.3 Electrical circuits** 4.3.1 Series and parallel circuits 4.3.2 Internal resistance 4.3.3 Potential dividers	**4.5 Quantum physics** 4.5.1 Photons 4.5.2 The photoelectric effect 4.5.3 Wave–particle duality	**Preparation for AS PPE exams**	Students sit 2 AS PPE papers which cover the skills and content taught so far in OCR Physics A. **Module 6: Particles and medical physics** 6.1 Capacitors 6.1.1 Capacitors 6.1.2 Energy 6.1.3 Charging and discharging capacitors
	[PAG 4.1 - Investigating Resistance] **[PAG 3.1 Determine the resistivity of a metal]**		**[PAG 6.1 - Determining the Planck constant]**		**[PAG 9.1 - Investigating the charging and discharging of capacitors]**

A Level Y13 LTP

Teacher 1: 3 teaching hours per week

Half-Term 1: **5.1 Thermal physics (continued)** 5.1.4 Ideal gases **5.2 Circular motion** 5.2.1 Kinematics of circular moton 5.2.2 Centripetal force	**Half-Term 2:** **5.3 Oscillations** 5.3.1 Simple harmonic oscillations 5.3.2 Energy of a simple harmonic oscillator 5.3.3 Damping **5.4 Gravitational fields** 5.4.1 Point and spherical masses 5.4.2 Newton's law of gravitation 5.4.3 Planetary motion 5.4.4 Gravitational potential and energy	**Half-Term 3:** **5.5 Astrophysics and cosmology** 5.5.1 Stars 5.5.2 Electromagnetic radiation from stars	**Half-Term 4:** 5.5.3 Cosmology	**Half-Term 5:** Exam season - exam preparation & revision **Exam Revision** Revision of content and skills, examination practice, and past paper practice (H556 papers).	**Half-Term 6:** Exam season - students leaving during this term
[PAG 8.2 - Investigating the relationship between pressure and volume]	**PAG 10.1 - Investigating factors affecting simple harmonic motion]**		**PAG 12.1 - Materials presentation**		

Teacher 2: 2 teaching hours per week

Half-Term 1: **6.2 Electric fields** 6.2.1 Point and spherical charges 6.2.2 Coulomb's law 6.2.3 Uniform electric	**Half-Term 2:** **6.3 Electromagnetism** 6.3.1 Magnetic fields 6.3.2 Motion of charged particles 6.3.3 Electromagnetism	**Half-Term 3:** **6.4 Nuclear and particle physics** 6.4.1 The nuclear atom 6.4.2 Fundamental particles	**Half-Term 4:** **6.5 Medical imaging** 6.5.1 Using X-rays 6.5.2 Diagnostic methods in medicine 6.5.3 Using ultrasound	**Half-Term 5:** Exam season - exam preparation & revision	**Half-Term 6:** Exam season - students leaving during this term

field 6.2.4 Electric potential and energy		6.4.3 Radioactivity 6.4.4 Nuclear fission and fusion			
		[PAG 7.1 - Investigating the random nature of radioactive decay]			