UNIVERSITY FOUNDATION PROGRAMME

PREPARING YOU FOR UNIVERSITY SUCCESS

PHYSICS SPECIFICATION

FOR TEACHING FROM 2021

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INTRODUCTION

The CATS University Foundation Programme

CATS UFP is a Level 3 course, designed to help international students to move successfully from high school to a UK University. It does this by using a variety of assessment methods that are common in UK Universities, such as practical analysis; presentations; academic posters; and examinations combined with content specifically designed to build on prior learning from courses around the world.

While English for Academic purposes is an essential part of CATS UFP, and all students will take an English course, assessment design focuses on subject knowledge and skills, rather than the ability to cope with English as a second language.

CATS UFP is delivered over nine months (or sometimes six for the Fast Track course - for students on specific visas and used to a rigorous style of study and excellent English), within a pastorally supportive and culturally stimulating context that enables students' learning to prosper - It does this by providing a variety of routes to the qualification, taught by expert staff whilst developing English language proficiency and learn about British culture.

CATS UFP is only available to centres with excellent pastoral care. Centres provide a stimulating intellectual and cultural environment with small classes - thus enabling the best learning to happen.

With CATS UFP, all learning happens with teachers who are expert in creating a positive learning environment for students from a wide range of countries and backgrounds.

CATS UFP has a successful record of accomplishment and is highly respected by UK universities.

With this qualification, students with 12 years of schooling from their own country can make the progression that they want into a wide range of UK universities (including those ranked most highly for both research and teaching).

CATS UFP has strong advocates in its alumni who display the attributes that a CATS UFP qualification can give them.

Graduates report that they feel very well prepared for university study; often, better prepared than students from other Level 3 programmes. Universities have confirmed this through testimonials and through extensive consultation with university based External Examiners - the CATS UFP has gained excellent credibility with UK universities.

Why Choose UFP Physics

Dynamic and Engaging Content

CATS College has a long history and proven track record of providing high quality, successful Physics UFP qualifications that we have continued to improve through teacher and student feedback, operational experience and by working closely with universities and the wider academic community.

The course teaches students theories, modelling and experimental techniques to support the analysis of physical phenomena to the interrelated nature of Physics.

Our content is designed to engage students through topics and issues that are relevant in society.

Real Life Skills

Students will develop the knowledge and skills needed to analyse data, think critically about issues and make informed decisions – all skills that are needed for further study and employment.

Assessment Success

Physics UFP involves a blended learning approach to assessing students that enables them to access content and demonstrate a wide range of skills and abilities. There are 2 methods of assessment- coursework and examination papers.

Our coursework uses a variety of assessment styles including group and individual presentations, reflection, citing sources and essays. Topics are contemporary, engaging and developed specifically for international students.

Our examination papers use a variety of assessment styles including multiple choice, short answer, extended answer, data response, essay and case studies so that students feel more confident and engage with the questions.

Real life case studies will be used wherever possible to make it easier for students to relate to and apply their knowledge and skills developed throughout the course.

Sensitivity towards international students

The Physics UFP course has been designed to address the challenges that international students will face when studying a British qualification. Coursework and examination assessments are tailor made to ensure students can access, understand, progress and achieve to the best of their abilities.

Extra-Curricular Opportunities

CATS College ensures all Physics UFP students are provided with a wealth of extra-curricular opportunities that enable them to apply and enhance their learning from the classroom.

These include; related lectures, visits / fieldwork, university workshops, Olympiads / competitions and many other events organised by individual centres.

Progression onto University

Combined with other academic subjects, students who have successfully studied and completed UFP Physics have gone onto many different universities including:

- Glasgow
- Exeter
- Loughborough
- Bath
- Newcastle
- Leeds
- Aberdeen
- Nottingham

Many students who choose Physics are looking for a career in the science sector.

Here are some of the related courses chosen by UFP students:

- Civil Engineering
- Physics
- Architecture
- Natural Sciences
- Computer Science
- Electrical Engineering
- Astrophysics

Aims of the Course

Enable students

CATS College wants to enable students to:

- Develop their interest in, and enthusiasm for Physics, including developing an interest in further study and careers in Physics.
- Appreciate how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society.
- Develop and demonstrate a deeper appreciation of the skills, knowledge and understanding of how science works.
- Develop essential knowledge and understanding of different areas of Physics and how they relate to each other.

Harness Key Skills

Students taking this course will be encouraged to develop into independent learners with the ability to think critically, understand the key importance of research and presentational skills. The course covers these key skills in the following ways:

Reasoning and Critical Thinking:

- Use problem-solving skills to interpret and consider situations where more than one approach is possible.
- Select, organise, and communicate relevant information in a variety of forms.
- Use mathematical techniques in a multitude of situations applicable to the real world.
- Analyse, explain and evaluate their own and others' experimental and investigative results in a variety of ways.

Independent Learning:

- Organise a student's own learning through management of time and material.
- Work on own initiative to prioritise tasks.
- Work independently to support understanding of material.
- Carry out self-directed learning tasks.

Research Skills:

- Research an area of interest and find data suitable to analyse, statistically if necessary.
- Ensure all research is referenced and not plagiarised.
- Use ICT to develop information literacy skills, to communicate and collaborate with others.

Presentational Skills:

- Systematic documentation of findings and analysis.
- Use of word processing and other forms of ICT for communication.
- Organise information clearly and coherently, using specialist vocabulary where appropriate.

Prior Knowledge

Suggested Prior Subject Specific Topic Knowledge

For most students some previous exposure to formal Physics education would be necessary. Specific topic details are not expected, but students who have studied an equivalent national science qualification (for example a Level 1 or 2 qualification, such as GCSE) would be well prepared for UFP Physics.

However, experience shows that students will be able to study UFP Physics successfully with no background in, or previous knowledge of, Physics - in this case their approach to learning will be significant in their need to meet the requirements and pace of the course.

The table below shows prior learning in Physics that is recommended to allow the building of the more complex ideas in UFP Physics.

Suggested Prior Mathematical Knowledge

In order to access all aspects of the Physics UFP course, students need to have acquired competence in the appropriate areas of Mathematics. The required skills are:

- Arithmetic and numerical computations.
- Making use of appropriate units in calculations, expressing answers in decimal and standard form.
- Using ratios, percentage, and fractions.
- Using trig functions in degree and radians & using Pythagoras theorem and the angle sum of a triangle.
- Understanding the equation of a line.
- Handling data by using the correct number of significant figures.
- Finding means and constructing frequency tables, bar charts and histograms.
- Using calculators to find exponential, power, and logarithmic functions.
- Order of magnitude calculations.
- Changing the subject of an equation and solving equations.
- Determining slope (gradient) and intercept of a graph.
- In addition, the calculation of area and circumference of circles and volumes and areas of spheres, rectangular block and cylinders should be known.

SUBJECT CONTENT

Examinable Content Overview

The topics in the table below will be assessed through the final examinations.

There is also one self-study topic where students are expected to study the topic themselves with little teacher guidance (an expectation on university courses) – it is highlighted in the syllabus and below in yellow.

There are 5 Modules.

Module 1 – Reporting & Mechanics	
1.1 Observing and Reporting in Physics	• Physical quantities & International System of Units (S.I. Units) • Significant figures • Errors and Uncertainties
1.2 The Motion of Objects	• Kinematics • Projectile Motion
1.3 Dynamics	• Newtons Laws in action • Momentum and Impulse

Module 2 – Energy & Power	
2.1 Work	• Energy, efficiencies and power.

Module 3 – Waves & Electromagnetism	
3.1 Traveling Waves	• Traveling waves
3.2 Diffraction	• Slit diffraction
3.3 Simple Harmonic Motion (SHM)	• Simple Harmonic Motion (SHM)
3.4 Stationary waves & The Doppler Effect	• Stationary waves • The Doppler Effect
3.5 Electric Fields	• Electric fields
3.6 Electric Circuits	• Heating effect of electric current & Electric circuits • Electromotive force (E.m.f.) & internal resistance
3.7 Magnetic Effects of Electric Current & Electromagnetic Induction	• Magnetic effects of electric current • Electromagnetic induction

Module 4 – Circular Motion, Gravity & Space	
4.1 Circular Motion	• Centripetal Acceleration
4.2 Laws of Universal Gravitation	• Newton's Law of Gravitation
4.3 Astrophysics	• Using physics in space.

Module 5 – Quantum Physics	
5.1 Atomic Theory	• Energy levels of the atom • The nuclear atom
5.2 Nuclear Physics	• Mass defect & Binding energy • Fusion and fission • Half life • Radioactive decay
5.3 Quantum Theory	• The photon model • Energy levels and photon emission • The photoelectric effect • Wave – particle duality

Content Details (Syllabus)

Mathematics will account for 55 – 60% of the available marks in the examination- **specific mathematics is highlighted in the syllabus with an asterisk (*) and mentioned in the "prior knowledge" section of the specification.**

Required investigations are highlighted in the syllabus and are required to be completed successfully in order to be awarded with a "Practically Confident" commendation at the end of the course.

Learners should be able to demonstrate and apply their knowledge and understanding of:

Module 1 – Reporting & Mechanics

1.1 Observing & Reporting in Physics

Spec ID	Assessment statement	Additional Guidance
1.1.1	**Fundamental and derived SI units**	Students need to know the following fundamental units: Kilogram (kg), metre (m), second (s), ampere (A), mole and kelvin (K).
1.1.2*	**Convert between different units of quantities.**	
1.1.3	**State values in scientific notation and use suitable numeral prefixes.**	Use and know prefixes from peta to femto
1.1.4	**State units in the accepted SI format**	Students should use **m s^{-2}** not **m/s^2** and **m s^{-1}** not **m/s**.
1.1.5*	**State final answer to correct number of significant figures**	Students need to know the rules for calculations with significant digits and rounding
1.1.6	**Know and identify random and systematic error**	Include zero error and reaction time
1.1.7	**Distinguish between precision and accuracy**	Students should know how to reduce the effect of errors

Spec ID	Assessment statement	Additional Guidance
1.1.8*	**Understand how to record and propagate uncertainties as absolute, relative, fractional and percentage errors**	Errors in final answer should not have more than 1 or at most two sf's
1.1.9*	**Be able to calculate percentage difference**	% difference = $\frac{accepted\ value - experimental\ value}{accepted\ value} x\ 100\%$
1.1.10*	**Interpret uncertainties as error bars in graphs**	Only the larger error of IV or DV need to be included
1.1.11*	**Determine the uncertainties in the gradient**	Know how to use maximum and minimum trendline to find the uncertainty in the gradient
1.1.12*	**Understand how to process data to linearize graphs**	Include hyperbola and parabola
1.1.13	Introduce a guided practical to demonstrate 1.1.8 – 1.1.12	For example: calculating the volume of a block

1.2 The Motion of Objects		
Spec ID	**Assessment statement**	**Additional Guidance**
1.2.1	**Vector and scalar quantities**	Definition and examples
1.2.2*	**Adding and subtracting vectors graphically and mathematically**	
1.2.3*	**Resolving vectors into components**	Express vectors as their component in x and y directions
1.2.4*	**Understand the terminology and mathematical deduction of:** **displacement, speed, velocity and acceleration.**	Know how to calculate average speed using the equation $v = \frac{s}{t}$ and finding instantaneous and average speed fro m a d-t graph

Spec ID	Assessment statement	Additional Guidance
1.2.5*	**Use of -t graphs, gradient equals velocity, v-t graphs, gradient equals acceleration and area under graph distance travelled, a-t graph, area under graph is velocity**	
1.2.6*	**Know and use the equations of motion to deduce constant acceleration (in a straight line).** **This includes, falling in a uniform gravitational field without air resistance.**	$v = u + at$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$
1.2.7	**REQUIRED PRACTICAL** **Determining "g" from free fall (using any valid method available, like gravity balls or ruler, timer and ball).**	Using only: $h = \frac{1}{2}gt^2$
1.2.8	**Know that vertical and horizontal motion of a projectile are independent from each other**	
1.2.9*	**Explain and draw the path of a projectile in the absence of air resistance.**	Understand that horizontal motion is constant Apply the equations of free fall to the vertical motion
1.2.10*	**Solve problems involving projectile motion (from any angle from the horizontal plane)**	

1.3 Dynamics

Spec ID	Assessment statement	Additional Guidance
1.3.1	**Identify and draw free-body diagrams representing the forces acting on an object.**	This includes labelling (with a name or symbol) and having vectors that a proportional to their magnitudes.
1.3.2*	**Calculate the weight of a body**	$W = mg$
1.3.3*	**Determine the resultant force in moving and equilibrium situations**	

Spec ID	Assessment statement	Additional Guidance
1.3.4	**State Newton's laws**	Students should explain the meaning of inertia $F = ma$ Students should understand the requirements for forces to be an action-reaction pair $F_{AB} = -F_{BA}$
1.3.5	**Fluid resistance and terminal velocity**	Qualitatively describe the effects of fluid resistance on falling objects including reaching terminal velocity
1.3.7	**Define linear momentum and impulse**	$p = m\Delta v, I = F\Delta t$
1.3.9	**State the law of conservation of momentum**	
1.3.10*	**Determine the impulse by interpreting a force–time graph.**	This includes a varying force. The area under a force - time graph is equal to impulse
1.3.11*	**Apply Newton's 2nd law**	Resultant force defined as rate of change of momentum.
1.3.12*	**Solve problems involving momentum and impulse.**	
1.3.13*	**Distinguish between elastic and inelastic collisions.**	

Note that section 1.3.6 is removed in version 2.4 of the specification

2.1 Work		
Spec ID	**Assessment statement**	**Additional Guidance**
2.1.1	**Explain what is meant by work**	Using the equations: W = Fs & $W = \Delta E$
2.1.2*	**Solve problems involving the work done by a force.**	Problems include $W = Fs\,cos\theta$
2.1.3	**Define and use kinetic energy.**	$KE = \frac{1}{2}mv^2$
2.1.4*	**Define and use change in gravitational potential energy.**	GPE = mgΔh
2.1.5	**State the principle of conservation of energy.**	Students need to know the transfer of energy between KE and GPE $KE = GPE$ (without friction) including work of resistive force: $\Delta E = GPE - KE$
2.1.6	**Understand how to design and carry out an investigation to show the conservation of energy from GPE to KE.**	
2.1.7	**Define power, including units**	$P = \frac{E}{\Delta t}$
2.1.8	**Define and apply the concept of efficiency.**	Efficiency in terms of work, energy and power. Students need to know what wasted energy means and which forms it can take $eff = \frac{useful\ work/energy/power}{total\ work/energy/power} x100\%$
2.1.9*	**Solve problems including momentum, work, energy and power**	

3.1 Traveling Waves		
Spec ID	**Assessment statement**	**Additional Guidance**
3.1.1	**Be able to describe the wave form using the terms displacement, amplitude, frequency**	
3.1.2	**Understand that progressive waves are a means to transfer energy from one place to another.**	
3.1.3	**Describe (with examples) transverse (light) and of longitudinal (sound) waves.**	Understand the oscillation of particles and the direction of the energy transfer.
3.1.4	**Describe and use appropriately; crest, trough, compression and rarefaction.**	
3.1.5	**Be able to describe and interpret wave form using the terms displacement, amplitude, frequency, period, wavelength, wave speed.**	Apply and use the wave equation $v = f\lambda$
3.1.6*	**Draw and interpret displacement–time graphs and displacement–position graphs.**	For both transverse and longitudinal waves.
3.1.7	**EM waves characteristics and the speed of light c.**	Explain the order of the EM spectrum in terms of increasing and decreasing wavelength and frequency and recall the orders visible light.
3.1.8	**Describe the reflection and transmission of waves at a boundary between two media.**	Know the law of reflection. This should include the sketching of incident, reflected and transmitted waves.
3.1.9	**Calculate distances using echoes**	
3.1.10	**Doppler effect using sound**	Moving source: $f' = f\left(\frac{v}{v \pm u_s}\right)$

Spec ID	Assessment statement	Additional Guidance
3.1.11*	**State and apply Snell's law using light**	Students should be able to define refractive index in terms of the ratio of the speeds of the wave in the two media and in terms of the angles of incidence and refraction. $\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$
3.1.12	**REQUIRED PRACTICAL** **Be able to plan and carry out an experiment to deduce the refractive index of a material.**	

3.2 Slit Diffraction

Spec ID	Assessment statement	Additional Guidance
3.2.1	**State the principle of superposition and explain what is meant by constructive interference and by destructive interference.**	
3.2.2	**State and apply the conditions for constructive and for destructive interference in terms of path difference and phase difference.**	Constructive interference path difference = nλ Destructive interference path difference = $(n + \frac{1}{2})\lambda$
3.2.3	**Apply the principle of superposition to determine the resultant of two waves.**	
3.2.4	**State the conditions necessary to observe interference between two sources.**	Coherent and monochromatic light source
3.2.5	**Outline and carry out a method for a double-slit experiment for light.**	Students should know the Young experiment and be able to draw the intensity distribution of the observed fringe pattern.
3.2.6*	**Solve problems involving two-source interference.**	$x = \frac{\lambda D}{a}$

Spec ID	Assessment statement	Additional Guidance
3.2.7	Describe the effect on the double-slit intensity distribution when increasing the number of slits in the experiment.	
3.2.8*	Solve problems involving a diffraction grating	Student should be able to use $d \sin\theta = n\lambda$ to determine the maximum numbers of orders produced

3.3 Simple Harmonic Motion (SHM)		
Spec ID	**Assessment statement**	**Additional Guidance**
3.3.1	Interpret the wave form using the terms angular frequency, period, and phase difference.	$T = \frac{1}{f}$
3.3.2	Define angular frequency $\omega = \frac{2\pi}{T}$ or ω = 2πf	
3.3.3	Define simple harmonic motion (SHM) and state the defining equation as $a = -\omega^2 x$	Students should understand the meaning of the negative sign in the equation and recall the connection between ω and T.
3.3.4*	Solve problems using the defining equation for SHM.	
3.3.5*	Apply the equations $v = v_0 cos\omega t, v = v_0 \sin\omega t,\ x = x_0 \cos\omega t\ and\ x = x_0 \sin\omega t$ as solutions to the defining equation for SHM	
3.3.6*	Solve problems, both graphically and by calculation, for acceleration, velocity and displacement during SHM.	
3.3.7	REQUIRED PRACTICAL Carry out an investigation that graphically displays how the period of oscillation relates to the length of the pendulum.	

Spec ID	Assessment statement	Additional Guidance
3.3.8	**Describe the interchange between kinetic energy and potential energy during SHM.**	
3.3.9*	**Solve problems graphically involving energy changes during SHM.**	Energy calculations are not required

3.4 Stationary waves		
Spec ID	**Assessment statement**	**Additional Guidance**
3.4.1	**Describe and solve problems of standing (stationary) waves.**	The character of these waves in terms of energy transfer, amplitude and phase should be considered.
3.4.2	**Explain how one-dimensional standing waves are formed.**	Using the terms nodes and antinodes.
3.4.3	**Discuss the modes of vibration of strings and air in open and in closed pipes.**	The lowest-frequency mode is known either as the fundamental or as the first harmonic. The term overtone will not be used.
3.4.4*	**Know how to find higher frequencies**	$f_1 = nf_0$
3.4.5	**Compare and contrast both stationary and travelling waves.**	

3.5 Charge, Current and Electric Circuits		
Spec ID	**Assessment statement**	**Additional Guidance**
3.5.1	**Define electric current and explain the difference between conventional current and electron flow**	$I = \frac{\Delta Q}{\Delta t}$
3.5.2	**Identifying drift speed of charge carriers**	I=nAqv, where n is the number density of charge carriers

Spec ID	Assessment statement	Additional Guidance
3.5.3	**Compare conductors, semiconductors and insulators.**	In the terms of n
3.5.4*	**Drawing and interpreting circuit diagrams**	Know basic circuit symbols
3.5.5	**Analyse $\frac{V}{I}$ graphs**	Using Ohm's law $R = \frac{V}{I}$ Know $\frac{V}{I}$ diagrams for ohmic (resistor) and non –ohmic (filament lamp).
3.5.6*	**Be able to solve problems using the equations:** $R = \rho\frac{l}{A}, P = VI = I^2R = \frac{V^2}{R}$	Students need to know Kirchhoff's 1st and 2nd law. Application of the laws will be restricted to circuits with a maximum number of two source-carrying loops. The terms potential difference, current, charge, Kirchhoff's circuit laws, power, resistance and resistivity should be applied and utilised correctly.
3.5.7*	**Investigating combinations of resistors in parallel and series circuits**	Students need to find equivalent resistance for both $R_{equ} = R_1 + R_2 + \cdots, \frac{1}{R_{eqv}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$

Spec ID	Assessment statement	Additional Guidance
3.5.8	**State characteristics of ideal and not ideal ammeters and voltmeters.**	Understand that non-ideal voltmeters are characterised by constant but finite resistance. Understand that non-ideal ammeters are characterised by constant but non-zero resistance.
3.5.9	**REQUIRED PRACTICAL** **Be able to design an experiment affecting one or more factors that affect resistance in a wire.**	This should be in the context of a wire and how it can be applied to other contexts.
3.5.10	**Definition of emf and PD and the difference between them**	
3.5.11*	**Source of emf and terminal PD.; 'lost volts'**	Use and derivation of equation $\varepsilon = I(R + r)$
3.5.12	**Be able to design an experiment that can determine internal resistance of a source.**	Know that in a $\frac{V}{I}$ diagram the y-intercept is the emf of the cell and the gradient represents the magnitude of the internal resistance r.
3.5.13	**Be able to use the terms emf, internal resistance and other electrical quantities and apply them correctly.**	

3.6 Electric Fields		
Spec ID	**Assessment statement**	**Additional Guidance**
3.6.1	**Be able to Identify two forms of charge.**	Drawing electric field lines between point masses and deduce the direction of the forces between them. Field lines between parallel plates are not required.

3.6.3*	**Be able to use the equation:** $$F = \frac{kQq}{r^2}$$	In context of electric fields and Coulomb's law
3.6.4*	**Be able to use the equation:** $$V = \frac{W}{q}$$	In context of work done in an electric field (in both Joules and electronvolts)

3.7 Magnetic Effects of Electric Current & Electromagnetic Induction

Spec ID	Assessment statement	Additional Guidance
3.7.1	**Determine the direction of force on a charge moving in a magnetic field**	
3.7.2	**Use current direction to determine the direction of the magnetic field (right hand grip r**	
3.7.3*	**Sketch and interpret magnetic field patterns**	Magnetic field patterns will be restricted to long straight conductors, solenoids, and bar magnets
3.7.4	**Determine the direction of force on a current-carrying conductor in a magnetic field (left hand or Fleming's rule)**	
3.7.5*	**Be able to use the terms magnetic forces, fields, current and charges and apply them correctly.**	F = qvB sin θ F = BIL sin θ (or) F = BIL cos θ
3.7.6	**Describe the production of an induced emf by a changing magnetic flux and within a uniform magnetic field**	Only in context of straight conductors moving at right angles to magnetic fields. Or in the context of rectangular coils moving in and out of fields and rotating in fields. Emf= Bvl (N) Magnetic flux Φ; the unit weber; Φ = BA cos θ

Spec ID	Assessment statement	Additional Guidance
3.7.7*	Be able to use the terms magnetic flux, magnetic flux linkage and Faraday's law (qualitatively only) and apply them correctly in problem solving.	

Module 4 – Circular Motion, Gravity & Space

4.1 Circular Motion		
Spec ID	**Assessment statement**	**Additional Guidance**
4.1.1*	Draw vector diagrams to explain that the acceleration of a particle moving with constant speed in a circle is directed towards the centre of the circle	Derivation from 1st principle is not required
4.1.2	Be able to define period, frequency, angular displacement, and angular velocity	$\omega = \frac{2\pi}{T} = 2\pi f$ $v = \omega r$
4.1.3*	Use the expression for centripetal acceleration.	$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$
4.1.4*	Identify and use appropriately the formula below to show the force producing circular motion: $F = \frac{mv^2}{r} = m\omega^2 r$	Problems on banked motion (aircraft and vehicles going around banked tracks) will not be included

4.2 Laws of Universal Gravitation		
Spec ID	**Assessment statement**	**Additional Guidance**
4.2.1*	Define Newton's law of gravitation and apply it to an object orbiting a point mass	$F = G\frac{Mm}{r^2}$
4.2.2	Describe the relationship between gravitational force and centripetal force when in orbit	

Spec ID	Assessment statement	Additional Guidance
4.2.3*	**Explain how gravitational field strength varies and represent it quantitatively and qualitatively**	Students need to know how to draw gravitational field and force lines and demonstrate knowledge of force - distance graphs for a point mass, and work done as the area under the graph $g = \frac{F}{m}$ and $g = \frac{GM}{r^2}$
4.2.4*	**Determine the resultant gravitational field strength due to two bodies**	Assessment will only be in examples along a straight line.

4.3 Astrophysics		
Spec ID	**Assessment statement**	**Additional Guidance**
4.3.1	**Name and describe Celestial Objects and the life cycle of stars.**	Planets, planetary systems and their stars (single and binary). Constellations, stellar clusters (open and globular) and nebulae. Galaxies, clusters of galaxies and super clusters of galaxies comets.
4.3.2*	**Qualitatively describe the hydrostatic equilibrium between radiation pressure outward and gravitational pull inward in stars.**	
4.3.3	**Define and calculate distances in space using light year (ly).**	Conversions from ly to m.

5.1 Atomic Theory		
Spec ID	**Assessment statement**	**Additional Guidance**
5.1.1	**State and apply correctly the terms; proton number; nucleon number; isotopes.**	
5.1.2	**Notation of $^{A}_{Z}X$ for the representation of nuclei**	
5.1.3	**Describe the Rutherford-Geiger-Marsden experiment that led to the discovery of the nucleus**	Using the path of the alpha particles bombarding a gold foil as evidence for the atomic model
5.1.4	**Know the strong nuclear force is a short-ranged, attractive and repulsive.**	Attractive to about 3 fm. Repulsive below about 0.5 fm. Be able to interpret and explain the graph of varying strength with Nucleon separation for electrostatic and strong nuclear force.

5.2 Nuclear Physics		
Spec ID	**Assessment statement**	**Additional Guidance**
5.2.1	**Complete decay equations for alpha, beta and gamma decay**	Neutrino and antineutrino in beta decay equations are included. Students need to know beta plus and beta minus decay
5.2.2*	**Be able to calculate the half-life of a nuclide.**	Radioactive decay involving only integral numbers of half-lives and from a decay curve.
5.2.3	**Determine the activity of a source;**	
5.2.4*	**State the decay constant λ of an isotope; A = λN.**	
5.2.5*	**Apply the equation for half-life of an isotope:** $\lambda T_{\frac{1}{2}} = \ln(2)$	
5.2.6*	**Use the equations in problems** $A = A_0 e^{-\lambda t}$ **and** $N = N_0 e^{-\lambda t}$	A is the activity. N is the number of individual undecayed nuclei.
5.2.7	**REQUIRED PRACTICAL** **Use modelling of radioactive materials to determine half-life and radioactive constant and understand its limitations and reasoning.**	This should ideally use graph modelling if possible.
5.2.8	**The unified atomic mass unit**	
5.2.9*	**Define mass defect**	$\Delta E = \Delta m c^2$
5.2.10	**Explain the concept of nuclear binding energy (BE).**	Energy required to completely separate the nucleons. Or the reverse, the energy released when a nucleus is formed from its nucleons
5.2.11*	**Solving problems involving mass defect and binding energy (including calculations).**	

Spec ID	Assessment statement	Additional Guidance
5.2.12	**Describe both processes of Nuclear fission and nuclear fusion**	Describe the processes of nuclear fission and nuclear fusion and how it relates to the binding curve.
5.2.13*	**Solve problems involving the energy released in radioactive decay, nuclear fission and nuclear fusion**	

5.3 Quantum Theory

Spec ID	Assessment statement	Additional Guidance
5.3.1	**Understand the particulate nature of electromagnetic (EM) radiation.**	The photon model.
5.3.2*	**Use the equation to calculate the Photon as a quantum of energy of electromagnetic radiation.**	$E = hf = \frac{hc}{\lambda}$
5.3.3	**Describe emission and absorption spectrum of common gases**	Include exited atoms and discrete energy levels, difference between energy levels equals the absorption or emission of electrons / photons $E_{upper} - E_{lower} = hf$
5.3.4*	**Be able to use the term atomic spectra using the equations:** **E = hf** $\lambda = \frac{hc}{E}$	For photons emitted during atomic transitions.
5.3.5	**REQUIRED PRACTICAL** **Be able to use LEDs to estimate the value of Planck constant, h.**	Using the equation: $eV = \frac{hc}{\lambda}$
5.3.6	**Use and understand the gold-leaf electroscope and zinc plate to show the photoelectric effect.**	Use the information to show that he classical wave theory of light cannot explain these phenomena.

Spec ID	Assessment statement	Additional Guidance
5.3.7	Explain the one-to-one interaction between photons and surface electrons.	
5.3.8*	Use Einstein's photoelectric equation both graphically and algebraically. $hf = \emptyset + KE_{max}$	
5.3.9*	Work function; threshold frequency	$\emptyset = hf_0$
5.3.10	State that the maximum kinetic energy of the photoelectrons is independent of the intensity of the incident radiation.	
5.3.11	State that rate of emission of photoelectrons above the threshold frequency is directly proportional to the intensity of the incident radiation.	
5.3.12	Describe the de Broglie hypothesis and the concept of matter waves and wave-particle duality. De Broglie equation: $\lambda = \frac{h}{p}$	Be able to outline the experiment of Davisson–Germer.
5.3.13*	Calculate and solve the wavelength of electrons after acceleration through a given potential difference and other matter/wave problems.	

COURSE ASSESSMENT

Assessment Objectives

Assessment objectives (AOs) are recommended by OFQUAL (March 2017) and are the same across all Level 3 Science specifications and all exam boards. The Physics UFP will also place a stronger emphasis on the use of Physics in an international context compared to other Level 3 qualifications.

Objective	Objective Detail	Overall Course Weighting
AO1	**Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures.** • **scientific evidence and concepts** • **scientific methods and systems** • **scientific terminology** • **logical presentation of scientific information**	20 – 25%
AO2	**Apply knowledge and understanding and use:** • **scientific evidence and concepts** • **scientific methods and systems** • **scientific terminology to transfer information efficiently.** • **suitable logical steps are evident to present scientific information**	30- 35%
AO3	**Analyse, interpret and evaluate scientific information, ideas, and evidence, including in relation to issues, to:** • **aim, research questions and predictions.** • **scientific methods and systems** • **scientific explanations of concepts, projects, and investigations**	25 - 30%
AO4	**Demonstrate the appropriate research, experimental skills, and personal skills necessary to carry out insightful and ethical investigations and presentations:** • **develop and apply 21st century communication skills.** • **become critically aware, as global citizen, of the ethical implications of using science and technology.** • **carry out practicals in groups effectively**	15 – 20%

ASSESSMENT OBJECTIVE WEIGHTING PER COURSE ELEMENT

Course Element Information			Assessment Objective Weighting			
Type of Assessment	**Name of Assessment**	**Overall Course %**	**AO1**	**AO2**	**AO3**	**AO4**
MCQ Exam	**Basics of Science**	7	30 – 40%	40 – 50%	20 – 30%	
MCQ Exam	**Beyond Basics**	13				
Exam	**Written Exam**	40				
Coursework	**Poster and Presentation**	15			45 – 55%	45 – 55%
In-Class assessment	**Exam style questions**	5		40 – 50%	30 – 40%	30 – 40%
Controlled Assessment	**Practical Skills**	20		40 – 50%	30 – 40%	30 – 40%
Practical Skills	**Practically Confident**	n/a				
Totals (Considering Weighting)		**100**	**20 – 25%**	**30 – 35%**	**25 – 30%**	**15 – 20%**

N.B. In the Examinations Mathematics will account for 10 – 15% of the available marks.

ASSESSMENT STRUCTURE OVERVIEW

Chemistry UFP involves five methods of assessment:

A scientific research poster and presentation– relating a subject matter from Physics to another subject.
An In Class Assessment- questions based on Forces in Action
3 examination papers – 2 Multiple Choice Papers and one written exam.
A controlled assessment - a practical write up of a practical given to you.
A "Practically Confident" teacher assessment of your practical skills throughout the course.

Assessment Name	% Weighting	Marks Available	Additional Information
Coursework - Poster and presentation	15	44	Relating a subject matter from Physics to another subject and give a presentation on it
In-class assessment	5	15-20	Forces in Action
Controlled Assessment – Practical Skills	20	36: 6 marks awarded by the teacher on the day of the experiment and 30 marks awarded through the exam questions	A practical will be done under exam conditions where the health and safety skills and the competency of currying the experiment will be assessed for the first day and the second-day examination questions will be answered under exam conditions using DigiExam platform.
Practically Confident	n/a	n/a	Required practicals assessed by your teacher throughout the course.
Exam Paper 1 – Basics of Physics	7	20	Multiple Choice Paper on Modules 1 & 2 only. 30 minutes.
Exam Paper 2 – Beyond the Basics ofPhysics.	13	30	Multiple Choice Paper on all topics. 45 minutes.
Exam Paper 3 – Written Paper	40	90	Long and short answer questions on all topics (including practical applications mentioned in the syllabus and self-study topic)2 hour 45 minutes.

An overall grade in Physics is given at the end of the course.

ASSESSMENTS

Coursework - Poster and Presentation

The Poster topics must be different for each science and based on the science under study, however, the assessment requirements are the same for biology, chemistry and physics.

The poster is worth 15% of the course and consists of the following stages:

- Students pick an appropriate subject (in the form of a specific question) that relates a topic from the science being studied to a cross curricular issue, some examples are:

Chemistry - Why is chemistry required for XXXXXX?	Business / Economics - How has XXXXXX shaped the economy?
Physics - Why does physics provide answers to XXXXXX?	Maths - How maths and XXXXXX aim to find solutions.
Biology - How can Biology help XXXXXX?	History - What in history has shaped XXXXXX?
General Science - How has working together helped solve XXXXXX?	Law - How does law shape XXXXX?

- A short-written article of why the topic was chosen by the student and why it is important to others.
- A written report of 1500 words that allows you to discuss research in more detail (not including references).
- An abstract (a summary of the key points of your research) of 250 words.
- Production of a digital A1 sized poster using the information from your essay and including appropriate referencing of sources and an abstract that summarises your research.
- Your written reflections regarding - on your production of the poster; the sources used and the extending the ideas of your research.
- A PowerPoint presentation of the Poster and Oral Presentation.

The mark scheme, documents that need to be provided and additional information for the poster is in the Assessment Guidance document.

In-class assessment

This part is worth 5% of the course and consists of the following stages:

- Students will be given questions that will assess the following areas:

: Forces in Action
Understand that force is a vector

: Understand the difference between scalars and vector

Draw free-body diagrams and label forces on an object, e.g. an aircraft moving at constant horizontal velocity

Resolve a force into two perpendicular components

Add and subtract forces graphically and mathematically

Calculate the resultant force on an object

Apply Newton's second law to calculate the acceleration of an object

Understand how an object falling through a fluid reaches a terminal velocity

Controlled Assessment – Practical Skills

A practical will be performed by the student under exam conditions the first day and the second students will answer exam questions, under exam conditions using the DigExam platform based on the following:

- Carrying out a risk assessment.
- Drawing an appropriate table.
- Drawing an appropriate graph.
- Writing a conclusion.
- Evaluating the method.
- Manipulating data (in addition to their data row data will be provided)

The mark scheme, documents that need to be provided and additional information for the practical writeup is in the Assessment Guidance document.

Practically Confident

Students will achieve a "Practically Confident" grade upon successful completion of the required practical procedures and analysis during the course.

Students will be awarded with a "Practically Confident Shown" grade if they meet the requirements of the required practicals as judged by their subject teacher – please see "required Investigations" section for more details.

The requirements for each practical to be deemed as "Confidence Shown" shall be that the practical has been:

- Carried out effectively (either in a group or individually) – Teacher judgment based on raw data.
- Analysed correctly – Teacher judgement based upon viewing appropriate presentation of data in tabular and/or graph form (where appropriate).
- Evaluated appropriately – Teacher judgment based upon written evaluation of procedure after carrying out the investigation.

Teachers will be given a spreadsheet to record the date of when the 3 criteria above for each practical have been reached.

This will then be monitored by your teacher so as the "practically confident" grade is given or not stated.

Required Practicals

Physics is the study of life. Physicists attempt to understand the living world at all levels using many different methods and procedures. Students are expected to gain an understanding of how a scientific investigation is carried out.

The following practicals are a requirement of the course.

Students must complete all the below practicals successfully throughout the course in order to be awarded with the "Practically Confident Shown" grade to be awarded.

Students who miss or do not reach the requirements mentioned in the section for the "Practically Confident" material are responsible for arranging another suitable time with their teacher to show they have reached the criteria.

The required practicals

- Determining "g" from free fall using light gates.
- Carry out an investigation that graphically displays how the period of oscillation relates to the length of the pendulum.
- Factors that affect resistance in a wire.
- Deduce the refractive index of a material.
- Use modelling of radioactive materials to determine half-life.
- Use LEDs to estimate the value of Planck constant.

Exam Papers

Exam Paper 1 – Basics of Physics

This paper is a multiple-choice paper and will mostly consist of AO1 questions.

It will be under controlled conditions, worth 20 marks and last for 30 minutes.

It will assess only:

1.1 Observing and Reporting in Physics
1.2 The Motion of Objects
1.3 Dynamics
2.1 Work
3.1 Traveling Waves
3.2 Simple Harmonic Motion (SHM)

Exam Paper 2 – Beyond the Basics of Physics

This paper is a multiple-choice paper and will mostly consist of AO1& AO2 questions.

It will be under controlled conditions, worth 30 marks and last for 45 minutes.

It will assess all areas of the course (including practical applications mentioned in the syllabus and self-study topic).

Exam Paper 3 – Written Paper

This paper is a long and short answer questions paper and will mostly consist of AO2 & AO3 questions.

It will be under controlled conditions, worth 90 marks and last for 2 hours 15 minutes.

It will assess all areas of the course (including practical applications mentioned in the syllabus and self-study topic).

PLANNING

Suggested Teaching Plan

Spec ID	Topic	Recommended Hours	Recommended Teaching Month (September Start)	Recommended Teaching Month (Fast Track)
1.1	**Observing and Reporting in Physics**	5	September	January
1.2	**The Motion of Objects**	10	September	January
1.3	**Dynamics**	9	October	January / February
2.1	**Work**	6	October	February
3.1	**Traveling Waves**	10	October / November	February
3.2	**Slit Diffraction**	6	November	February / March
Review & Prepare for Exam Paper 1 – Basics of Physics		(5)	December / January **Exam Paper 1**	March / April **Exam Paper 1**
3.3	**Simple harmonic motion (SHM)**	10	December / January	February
3.4	**Stationary waves & The Doppler Effect**	5	January	February
3.5	**Charge current and Electric circuits**	15	January	February
3.6	**Electric Fields**	3	February	February / March
3.7	**Magnetic Effects of Electric Current & Electromagnetic Induction**	5	February	March

Spec ID	Topic	Recommended Hours	Recommended Teaching Month (September Start)	Recommended Teaching Month (Fast Track)
4.1	Circular Motion	5	February / March	March
4.2	Laws of Universal Gravitation	5	March	March
4.3	Astrophysics	(5 hours self-study topic)	N/A	N/A
5.1	Atomic Theory & The Nuclear Atom	5	March / April	March / April
5.2	Nuclear Physics	5	March / April	April
5.3	Quantum Theory	10	April / May	May
Review & Prepare for Exam Papers 2 & 3		(5)	May **Exam Papers 2 & 3**	May **Exam Papers 2 & 3**

Total = 140 Hours teacher contact time minimum.

- **Students are expected to supplement this contact time with revision, completion of homework and extra reading around the subject.**

- **Any relevant information that demonstrates extended reading may be awarded credit in the exam if no other creditable information is provided.**

COURSEWORK DEADLINES & SUGGESTED PLANNING

All assessment will be marked centrally and anonymously.

All coursework documents need to be submitted to your teacher digitally (MS Office) for checking on similarity detection software and for marking and moderation.

A first draft of your coursework **(not the controlled assessment)** can be handed to your teacher for feedback if received within the deadline.

Missing the deadline is not acceptable – if you miss the teacher feedback deadline the teacher reserves the right not to give feedback before the final hand in date.

The final deadline is when work needs to be uploaded for moderation and marking, therefore, if this deadline is missed the teacher reserves the right to only award on what has been seen or award 0 marks.

Coursework	Task in Coursework	Deadline for September Start	Deadline for Fast Track	Notes
Coursework – Poster and presentation	Selecting an appropriate Question.	Before October Half – Term	Before February Half – Term	This should be discussed with your teacher before moving onto other tasks.
Coursework – Poster and presentation	First draft of Coursework completed so far (not including reflections).	Last Week in November	Last Week in February	Your teacher will mark what is provided and give verbal or written feedback.
Coursework – Poster and presentation	Coursework completed and digitally sent.	28 th of January 2025	30th of April 2025	Requirements of documents to be provided are in the appendix of this document.
In Class Assessement	Questions and any work to be done will be done under exam conditions in one sitting.	28 May 2025	28 May 2025	

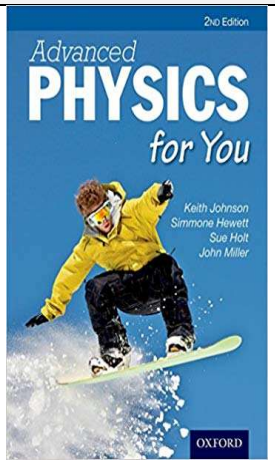
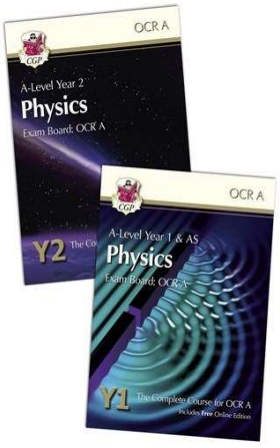
Assessment – Practical Skills Experiment	Practical is performed by students under exam conditions	Beginning of May (One day only)	Last week of March (One day Only)	This will be set from your teacher during a timetabled lesson
Controlled Assessment – Practical Skills Exam Paper based on the practical performed above	Exam paper completed under exam conditions using DigiExam platform.	Beginning of May (One day only)	Last week of March (One day only)	Exam paper will be administered under exam conditions using the DigiExam platform using your own electronic devises (laptop or pad).

For these assessment elements of the course, marks for each element of the marking criteria will be awarded on a points system. Each "Seen Expansively" will be worth three points, each "seen clearly" will be worth two points, each "Seen, but vaguely" will be worth one point, and each "Not Seen" is not worthy of credit.

	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
	0	**1**	**2**	**3**	•

SUPPORT & INFORMATION

Suggested Reading Material

Textbook Name & Author	Front Cover	Publisher & Edition
Advanced Physics for you **KEITH JOHNSON**		OUP Oxford University Press 2nd Edition
A Level Physics for OCR A **CGP Books**		CGP Books 1st Editions

Academic Honesty

All work should be your own and you may be required to declare that it is indeed all your own work.

All work will be checked by the similarity checker and therefore must be provided in a digital format.

If it is believed that the work is not your own due to it being different to other pieces of work and / or scores highly in the similarity checker, you may be asked to redo the work, attend a viva or be given zero marks for that particular area.

EAL (English as an Additional Language)

Students can access the English support offered in their respective CATS College.

Lessons are taught using a Content and Language Integrated Learning (CLIL) approach, so that students can also develop their English language skills.

The course has been designed for international students and therefore, even though the course is conducted in the English language, opportunities to award skills have been considered and teachers are trained in teaching EAL students.

Most UFP students will be expected to attend an EAP programme as Universities will require a workable understanding of the English Language.

SEND (Special Educational Need and Disabilities)

Students can discuss any SEND concerns in their respective CATS College.

Support and extra time will be granted through the SEND coordinator at the respective CATS College in conjunction with the UFP board.

CONTACT US

The best point of contact is usually the subject teacher, the head of the Science department in your college, or the head of centre.

If you have any further questions regarding the Physics UFP Course, please see the useful contacts below:

UFP Chief Examiner for Science subjects

Guildhouse school
43-45 Bloomsbury Square
London
WC1A 2RA

Tel: +44 2045761796

ianagnostopoulos@guildhouseschool.com

Director of CATS UFP

Mob: +44 7891674841

jhawkins@catsglobalschools.com

APPENDICES

Appendix A – Marking Rubric – Coursework Poster and Presentation

Individual and unique posters linking the science with another curriculum aspect. The poster is worth 15% of the whole course.

There are 5 documents to be submitted by the student:
Engage: max 250 words
Abstract: max 250 words
Report: 1500 words
Produce: Poster A1
Reflect: max 250 words

These 5 documents will be gone through Turnitin for detection of plagiarism and AI use. Up to 10% similarity no marks will be deducted. Anything above this 3 marks for every 5% above the 10% will be deducted.

For these assessment elements of the course, marks for each element of the marking criteria will be awarded on a points system. Each "Seen Expansively" will be worth three points, each "seen clearly" will be worth two points, each "Seen, but vaguely" will be worth one point, and each "Not Seen" is not worthy of credit.

The coursework is separated into the following marking criteria that are marked individually:

Criteria	Total Available Marks	Weighting %	Requirements of work provided by student	Marking Responsibility
Engage	4	10	A report of up to 250 words sent in word processed document titled "Engage".	Internal marker
Abstract	4	10	A 250-word maximum report sent in word The processed document is titled "Abstract."	Internal marker
Report	12	20	A 1500-word report sent in word processed document (references not included in word count), titled "Report".	Internal Marker
Reference	4	10	Included in the document titled "Report	Internal Marker
Produce	8	20	A visually appealing A1 poster including all or most of the elements from the "Report" and "Abstract".	Internal Marker
Reflect on the poster.	4	10	A 250-word report sent in word the processed document, titled "Reflect."	Internal Marker
Delivery of the presentation	4	10	Seen During the presentation	Internal Marker and another member of Staff
Reflect on the presentation	4	10	A reflection document created after the presentation has occurred	Internal Marker and another member of Staff
Totals	44	100		

Engage Marking Criteria Form for Teachers (can be shared with students)

The extent to which the student engages with topic exploration and personalization.

Curiosity is recognized through explaining personal interests and showing evidence of curiosity or initiative.

An explanation of why the topic was chosen and how it is relevant to the science studied should be included.

Engage Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Explanation of why question is relevant to student. Conveys a sense of curiosity and/or initiative from the student					•
Explanation of why question is important to others as well as student. Identified the benefit of this understanding to users of the technology					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 11-12 points awarded
3	• 8-10 points awarded
2	• 5-7 points awarded
1	• 3-4 points awarded
0	• 2 or fewer points scored on the table above,

Report Criteria Form for Teachers (can be shared with students)

The extent to which the student informs us of the relationship to answer the question asked.

Report Marking Criteria					
	Points awarded				
Marking Statement	Not Seen	Seen, but vaguely	Seen clearly	Seen expansively	Comment as to why points were awarded
Evidence Seen that is specific to question. Response is relevant to the question and includes relevant science that develops a compelling narrative.					•
Evidence shows at least 2 quantifiable relationship. For at least 2 quantifiable relationships: Variables identified Explanation of causality Identification of optimisation for its application					•
Evidence includes relevant data in the form of tables and graphs. Supporting data for the 2 or more identified quantifiable relationships is included in the form of tables and graphs.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
12	• 9 points awarded **& Below 1,500 Words**.
11	• 9 points awarded **& Above 1,500 Words.**
10	• 8 points awarded **& Below 1,500 Words.**
9	• 8 points awarded **& Above 1,500 Words.**
8	• At least 6 points awarded **& Below 1,500 Words.**
7	• At least 6 points awarded **& Above 1,500 Words.**
6	• At least 4 points awarded **& Below 1,500 Words.**
5	• At least 4 points awarded **& Above 1,500 Words.**
4	• At least 2 points awarded **& Below 1,500 Words.**
3	• At least 2 points awarded **& Above 1,500 Words.**
2	• 1 point awarded **& Below 1,500 Words.**
1	• 1 point awarded **& Above 1,500 Words.**
0	• None of the other levels are applicable.

Reference Marking Criteria Form for Teachers (can be shared with students)

The extent to which the student displays the choice of sources used.

Reference Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
There are at least 4 appropriate references 4 or more different relevant sources used				Using Harvard style	•
Sources chosen demonstrate a critical concern for quality and impartiality					•
Has appropriate "in body" Referencing "in body" refencing can be clearly traced to its source					•
Has appropriate bibliography in alphabetical order*					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 11-12 points awarded
3	• 8-10 points awarded
2	• 5-7 points awarded
1	• 3-4 points awarded
0	• 2 or fewer points scored on the table above,

*Alphabetical order is a requirement for the "Seen Expansively" criterion. If the list is logically organised in a different way, the "seen clearly" can be awarded.

Abstract Marking Criteria Form for Teachers (can be shared with students)

The extent to which the student summarises the research succinctly.

Abstract Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Abstract summarises main findings from the research. Abstract clearly and succinctly identifies the specific research area, the evidence collected, the conclusions draw and the benefit of application					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	3 points awarded **& Below 250 Words.**
3	3 points awarded **& Above 250 Words** 2 points awarded **& Below 250 Words.**
2	2 points awarded **& Above 250 Words** 1 point awarded **& Below 250 Words.**
1	1 point awarded **& Above 250 Words.**
0	None of the other levels are applicable.

Produce Marking Criteria Form for Teachers (can be shared with students)

The way the student produces a digital A1 sized poster including the elements of the Report, References and Abstract.

Produce Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Poster includes a comprehensive synopsis of the report that is both engaging and informative. Readers are given guidance as how to find out more.					•
The formatting of text and headings are appropriate.					•
The layout of the poster aids understanding.					•
Spelling, Punctuation and appropriate terminology is used.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
8	• 12 points awarded
7	• 11 points awarded
6	• 9-10 points awarded
5	• 7-8 points awarded
4	• 5-6 points awarded
3	• 3-4 points awarded
2	• 2 points awarded
1	• 1 point awarded
0	• None of the other levels are applicable.

Reflect Marking Criteria Form for Teachers (can be shared with students)

The extent to which the student reflects on their poster and their research. This should be written by the student after the hand in of the poster.

Reflect Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Strengths and limitations regarding their poster content and design are mentioned.					•
Strengths and limitations regarding their data are mentioned.					•
Improvements are suggested for both the poster content and design					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 8-9 points awarded
3	• 6-7 points awarded
2	• 4-5 points awarded
1	• 2-3 points awarded
0	• None of the other levels are applicable.

Deliver Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Speaks Clearly and at an understandable pace.					•
Question on an aspect of the science mentioned in the presentation is answered.					•
Not just reading out the text on presentation.					•
Shows confidence through eye contact, etc.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 11-12 points awarded
3	• 8-10 points awarded
2	• 5-7 points awarded
1	• 3-4 points awarded
0	• 2 or fewer points scored on the table above

Reflect Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Reflection on both the strengths and limitations of their presentation is discussed.					•
Improvements are suggested for presentation skills.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 6 points awarded
3	• 5 points awarded
2	• 3-4 points awarded
1	• 2 points awarded
0	• None of the other levels are applicable.

Produce Marking Criteria Form for Teachers (can be shared with students)

The way the student produces the presentation.

Produce Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
The formatting of text and headings is sensible.					•
The layout and balance of visuals and text is sensible and logical.					•
Spelling, Punctuation and appropriate terminology is used.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 8-9 points awarded
3	• 6-7 points awarded
2	• 4-5 points awarded
1	• 2-3 points awarded
0	• None of the other levels are applicable.

Reference Marking Criteria Form for Teachers (can be shared with students)

The extent to which the student displays the choice of sources used.

Referencing should be completed in the Harvard style.

*N.B. While Wikipedia is a useful website for gathering preliminary information, it should not be used as a reference and would not count as "appropriate".

Reference Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
There are at least 4 appropriate references					•
Include both online and offline (or journal) references					•
Has appropriate "in body" Referencing					•
Has appropriate bibliography in alphabetical order					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 11-12 points awarded
3	• 8-10 points awarded
2	• 5-7 points awarded
1	• 2-4 points awarded
0	• None of the other levels are applicable.

Deliver Marking Criteria Form for Teachers (can be shared with students)

The way the student delivers their presentation on the subject matter.

Deliver Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Speaks Clearly and at an understandable pace.					•
Question on an aspect of the science mentioned in the presentation is answered.					•
Not just reading out the text on presentation.					•
Shows confidence through eye contact, etc.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 11-12 points awarded
3	• 8-10 points awarded
2	• 5-7 points awarded
1	• 3-4 points awarded
0	• 2 or fewer points scored on the table above,

Reflect Marking Criteria Form for Teachers (can be shared with students)

The extent to which the student reflects on their presentation.

Reflect Marking Criteria					
	Points awarded				
Marking Statement	**Not Seen**	**Seen, but vaguely**	**Seen clearly**	**Seen expansively**	**Comment as to why points were awarded**
Reflection on both the strengths and limitations of their presentation is discussed.					•
Improvements are suggested for presentation skills.					•

Relevant Level and marked awarded based on above completed form:

Mark to Award	Criteria
4	• 6 points awarded
3	• 5 points awarded
2	• 3-4 points awarded
1	• 2 points awarded
0	• None of the other levels are applicable.

Appendix B – Marking Rubric – Practical Skills

A practical will be performed by the students and then exam questions based on the experiment and the data produced but also raw data provided will be asked under exam conditions using the DigiExam platform. This part is worth 20% of the whole course.

Criteria	Marking Responsibility
Method Writing	Centres
Table Drawing	Centres
Graph Drawing	Centres
Conclusions	Centres
Health and Safety in the Lab	Teacher
Competency of performing the experiment	Teacher
Evaluation	Centres
Totals	

Method Writing Marking Criteria Form for Teachers (can be shared with students)

Table Drawing Marking Criteria Form for Teachers (can be shared with students)

Being able to produce a table of results that reflect the raw data being provided.

Table Drawing Marking Criteria
Columns have specific headings, units and are correctly positioned.
Processed data is calculated correctly and placed correctly in table.
Table has ruled lines and a border.
Decimal Places throughout the table are appropriate.

Graph Drawing Marking Criteria Form for Teachers (can be shared with students)

Being able to produce a graph that reflects the raw data being provided.

Graph Drawing Marking Criteria
Axis are in correct position and labelled appropriately with units.
Graph is with ruled lines, a title and is of an appropriate size.
An appropriate scale is used.
All points are plotted correctly.

Conclusion Marking Criteria Form for Teachers (can be shared with students)

Being able to reach conclusions and describe patterns using the data given and produced.

Conclusion Marking Criteria
Describes the trends in the graph & data.
Explains the trend(s) seen in the graph & data.
Calculates the uncertainty of the stated equipment and comments on its meaning,
Comments on the presence of anomalies or not.
Additional specific conclusion task

Evaluation Criteria Form for Teachers (can be shared with students)

The extent to which the student evaluates the practical method that has been used.

Reflect Marking Criteria
Identifies at least 2 limitations of the experiment and the main sources of error.
Details how to improve the design of the experiment based on limitation mentioned.
Comments on the reliability and reproducibility of the experiment.

Appendix C – Command Words

Command Word	AO (Assessment Objective)	Requirement in Student Answer
Define / State / Choose / Identify / Label	**AO1**	• Use or match the correct key term / equation (s)
Describe	**AO1**	• Stating what you see or what would happen, including patterns and, if necessary, including numerical information / calculations.
Explain	**AO2**	• Use scientific knowledge to give reasons or potential reasons as to why a pattern is seen.
Compare	**AO2**	• Directly showing similarities or / and differences.
Calculate	**AO2**	• Give a numerical answer (Show workings are optional but recommended).
Show	**AO2**	• Give detailed steps and / or workings to reach the answer (workings must be shown)
Analyse / Evaluate / Discuss	**AO3**	• Use ideas to judge and potentially reach a conclusion. You need to include both sides of an argument if necessary.
Suggest	**AO3**	• Use knowledge to come up with an appropriate solution based on the information provided.
Draw	**AO3**	• Create a diagram / graph / table to show what is required from the question including labels where necessary.
Design	**AO3**	• Give a detailed procedure of how something could work.
Sketch	**AO3**	• A simplistic drawing, still with labels which allows the marker to understand what s drawn.
Deduce / Determine	**AO3**	• Show the steps you have used to reach your conclusion (whether numerical or otherwise).

Appendix D– Data Booklet for use in exams

Constants

Quantity	Symbol	Accepted value
Acceleration of free fall at Earth's surface	g	$9.81\ ms^{-2}$
Gravitational constant	G	$6.67 \times 10^{-11} Nm^2 kg^{-2}$
Stefan Boltzmann constant	σ	$5.67 \times 10^{-8} Wm^{-2} K^{-4}$
Coulomb constant	k	$8.99 \times 10^{9} Nm^2 C^{-2}$
Permittivity of free space	ε_0	$8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$
Speed of light in Vacuum	c	$3.0 \times 10^{8} ms^{-1}$
Planck's constant	h	$6.63 \times 10^{-34} Js$
Elementary charge	e	$1.60 \times 10^{-19} C$
Electron rest mass	m_e	$9.110 \times 10^{-31} kg = 0.000549u = 0.511 MeVc^{-2}$
Proton rest mass	m_p	$1.673 \times 10^{-27} kg = 1.007276u = 938 MeVc^{-2}$
Neutron rest mass	m_p	$1.675 \times 10^{-27} kg = 1.008665 MeVc^{-2}$
Unified atomic mass	u	$1.661 \times 10^{-27} kg = 931.5 MeVc^{-2}$
Fermi radius	R_o	$1.20 \times 10^{-15} m$
Wien Constant	b	λ_{max}T = $2.9 \times 10^{-3} m\ K$

Unit Conversions

- 1 light year (ly) = 9.46×10^{15} m
- 1 parsec (pc)= 3.26 ly
- 1 astronomical unit (AU) =1.50×10^{11}m

Metric Multipliers

Prefix	Abbreviation	Value
Giga	G	10^9
Mega	M	10^6
Kilo	k	10^3
Mili	m	10^{-3}
Micro	μ	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}
Femto	f	10^{-15}

Equations – Module 1 (Reporting & Mechanics) & Module 2 (Energy & Power)

Equations	
$\frac{\Delta y}{y} = \frac{\Delta a}{a} + \frac{\Delta b}{b}$	$\frac{\Delta y}{y} = \frac{n\Delta a}{a}$
$\%\ \text{discrepancy} = \frac{accepted\ value - experimental\ value}{accepted\ value} x\ 100\%$	$F = ma\ and\ F = \frac{\Delta p}{\Delta t}$
$v = u + at$ $v^2 = u^2 + 2as$ $s = ut + \frac{1}{2}at^2$	$p = m\Delta v$ $I = F\Delta t$
$F = ma\ and\ F = \frac{\Delta p}{\Delta t}$	$F_{AB} = -F_{BA}$
$W = Fs\ cos\theta$	$KE = \frac{1}{2}mv^2$
$\text{GPE} = \text{mg}\Delta h$	$P = \frac{E}{\Delta t}$
$eff = \frac{useful\ work/energy/power}{total\ work/energy/power} x100\%$	

Equations – Module 3 (Waves & Electromagnetism)

Equations	
$v = v_0 \cos(\omega t), v = v_0 \sin(\omega t)$	$x = x_0 \cos(\omega t)$ and $x = x_0 \sin(\omega t)$
$v = \pm\omega\sqrt{(x_0^2 - x^2)}$	$v = f\lambda$
$\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$	$\theta = \frac{n\lambda}{a}$
$PD = n\lambda$ and $PD = (n + \frac{1}{2})\lambda$	$x = \frac{\lambda D}{a}$
$a = \frac{w}{N}$	$d \sin\theta = n\lambda$
$f_1 = nf_0$	Moving source: $f' = f\left(\frac{v}{v \pm u_s}\right)$ Moving observer: $f' = f\left(\frac{v \pm u_0}{v}\right)$
$I = \frac{\Delta Q}{\Delta t}$	$F = \frac{kQq}{r^2}$ $k = \frac{1}{4\pi\varepsilon_0}$
$I=nAqv,$	$V = \frac{W}{q}$
$R = \frac{V}{I}$	$R = \rho\frac{l}{A}, P = VI = I^2R = \frac{V^2}{R}$
$R_{equ} = R_1 + R_2 + \cdots, \frac{1}{R_{eqv}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$	$\varepsilon = I(R + r)$
$F = qvB \sin\theta$ $F = BIL \sin\theta$	$emf= Bvl (N)$
$\Phi = NBA \cos\theta$	$emf = -\frac{N\Delta\emptyset}{\Delta t}$

Equations – Module 4 (Circular Motion, Gravity & Space)

Equations	
$\omega = \frac{2\pi}{T} = 2\pi f$ $v = \omega r$	$v = \sqrt{\frac{2GM}{r}}$
$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$	$F = \frac{mv^2}{r} = m\omega^2 r$
$F = \frac{mv^2}{r} = m\omega^2 r$	$g = \frac{F}{m} \quad and\, g = \frac{GM}{r^2}$
$F = G\frac{Mm}{r^2}$	$\frac{T^2}{R^3} = \frac{4\pi^2}{GM}$
$PE = -\frac{GMm}{r}$	$v = \sqrt{\frac{2GM}{r}}$
$d(parsec) = \frac{1}{p(arc - sec)}$	$a = -\omega^2 x$
$L = \sigma A T^4;$	$b = \frac{L}{4\pi d^2}$
$L \propto M^{3.5}$	$v = H_0 d$
$T = \frac{1}{H_0}$	$z = \frac{\Delta\lambda}{\lambda_0} = \frac{v}{c}$
$T = \frac{1}{f}$	$\omega = \frac{2\pi}{T}$ or ω = 2πf

Equations – Module 5 (Quantum Physics)

Equations	
$E_{upper} - E_{lower} = hf$	$E_n = -\frac{13.6}{n^2} eV$
$E = hf$ $\lambda = \frac{hc}{E}$	$A = \lambda N$
$\lambda T_{\frac{1}{2}} = ln(2)$	$A = A_0 e^{-\lambda t}$ and $N = N_0 e^{-\lambda t}$
$\Delta E = \Delta m c^2$	$R = R_0 A^{\frac{1}{3}}$
$\rho = \frac{3u}{4\pi {R_0}^3}$	$E = hf = \frac{hc}{\lambda}$
$hf = \emptyset + KE_{max}$	$\lambda = \frac{h}{p}$
$\Delta x \Delta p \geq \frac{h}{4\pi}$ $\Delta E \Delta t \geq \frac{h}{4\pi}$	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