UNIVERSITY FOUNDATION PROGRAMME

PHYSICS SPECIFICATION

PREPARING STUDENTS FOR UNIVERSITY SUCCESS

FOR TEACHING FROM 2021

August 2021

CATS UFP

CATS UFP is a Level 3 course, specifically designed to help international students move successfully from secondary education to a UK University.

The CATS UFP is delivered over 420 directed hours of teaching and learning, over 3 subjects, and utilises a rigorous style of study, within a pastorally supportive and culturally stimulating environment that enables students' learning to develop and progress successfully. Students are able to access a variety of assessment methods that are common in UK Universities, such as portfolios, presentations academic posters, and examinations combined with content specifically designed to build on prior learning from courses around the world.

English for Academic purposes is an essential part of CATS UFP, and all students will take an English course that supports their learning and prepares them for university life, as well as having access to many extracurricular activities that further reinforce their use of English. Assessment design within each subject carefully focuses on subject knowledge and skills, rather than the ability to cope with English as a second language.

CATS Colleges provide a stimulating intellectual and diverse environment with small classes; thus, enabling the best learning to happen. With CATS UFP, all learning happens with teachers who have excellent subject knowledge and are expert in creating a positive learning environment for students from a wide range of 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, to 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 what 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 it 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.

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		Module 1 – Foundations of Chemistry
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 Simple Harmonic Motion (SHM)	• Simple Harmonic Motion (SHM)
3.3 Diffraction	• Slit diffraction
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.
4.4 Cosmology (self-study	• The "Big Bang Model"

topic)

Module 5 – Quantum Physics	
5.1 Atomic Theory & The Nuclear Atom	• Energy levels of the atom • The nuclear atom • Half life • Radioactive decay
5.2 Nuclear Physics	• Mass defect & Binding energy • Fusion and fission
5.3 The Standard Model	• Evidence for the atomic model
5.4 Quantum Theory	• The photon model • 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
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*	Know the difference between percentage error and percentage discrepancy	% discrepancy = $(accepted\ value - experimental\ value) / (accepted\ value)\ x\ 100\%$

1.1.10*	Recognize 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 and intercepts of a straight-line graph.	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

1.2 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 $v = s/t$ and finding instantaneous and average speed from a d-t graph
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.	$v = u + at$ $v^2 = u^2 + 2as$ $s = ut + 1/2\ at^2$
1.2.7	REQUIRED PRACTICAL Determining "g" from free fall using light gates.	
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	
1.3.4	State Newton's 1st law with example	Students should explain the meaning of inertia
1.3.5*	State Newton's 2nd law and solve problems	$F = ma \text{ and } F = \Delta p/\Delta t$
1.3.6*	Explain Newton's 3rd law and solve problems	Students should understand the requirements for forces to be a 3rd law pair $F\_AB = -F\_BA$
1.3.7	Fluid resistance and terminal velocity	Qualitatively describe the effects of fluid resistance on falling objects including reaching terminal velocity
1.3.8	Understand how to experimentally deduce the terminal velocity of falling objects in differing fluids.	
1.3.9	Define linear momentum and impulse	$p = m\Delta v, I = F\Delta t$

1.3.10	State the law of conservation of momentum	
1.3.11*	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
1.3.12*	Solve problems involving momentum and impulse.	
1.3.13*	Distinguish between elastic and inelastic collisions.	

MODULE 2 – ENERGY & POWER

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	Outline what is meant by kinetic energy.	$KE = 1/2\ mv$^2
2.1.4*	Outline what is meant by 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 $KE = GPE$ $W = \Delta E$
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	$P = E/\Delta t$
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 $eff = (useful\ work/energy/power) /(total\ work /energy /power)\ x100\%$
2.1.9*	Solve problems including momentum, work, energy and power	

MODULE 3 – WAVES & ELECTROMAGNETISM

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 the wave form using the terms displacement, amplitude, frequency, period, wavelength, wave speed and intensity.	Apply and use the wave equation $v = f\lambda$
3.1.6*	Draw and understand displacement–time graphs and displacement–position graphs.	For both transverse and longitudinal waves.
3.1.7	Understand that all electromagnetic (EM) waves travel at the same speed in a vacuum.	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*	State and apply Snell's law	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. $n_1/n_2 = \sin \theta_2 / \sin \theta_1 = v_2/v_1$
3.1.10	REQUIRED PRACTICAL Be able to plan and carry out an experiment to deduce the refractive index of a material.	
3.1.11	Explain and discuss qualitatively the diffraction of waves at apertures and obstacles.	The effect of wavelength compared to aperture or obstacle dimensions should be discussed.

3.2 Simple Harmonic Motion (SHM)		
Spec ID	**Assessment statement**	**Additional Guidance**
3.2.1	Be able to describe the wave form using the terms angular frequency, period and phase difference.	$T = 1/f$
3.2.2	Define angular frequency $\boldsymbol{\omega = 2\pi/T}$ or ω = 2πf	
3.2.3	Define simple harmonic motion (SHM) and state the defining equation as $\boldsymbol{a = -\omega^2 x}$	Students should understand the meaning of the negative sign in the equation and recall the connection between ω and T.
3.2.4*	Solve problems using the defining equation for SHM.	

3.2.5*	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	
3.2.6*	Solve problems, both graphically and by calculation, for acceleration, velocity and displacement during SHM.	
3.2.7	REQUIRED PRACTICAL Design and carry out an investigation that graphically displays how the period of oscillation relates to the displacement angle.	
3.2.8	Describe the interchange between kinetic energy and potential energy during SHM.	
3.2.9*	Solve problems graphically involving energy changes during SHM.	Energy calculations are not required

3.3 Slit Diffraction		
Spec ID	**Assessment statement**	**Additional Guidance**
3.3.1	Understand and sketch the angle of diffraction of the relative intensity of light diffracted (single slit only).	
3.3.2	Know and use the formula in problems $\theta = n\lambda/a$	For the position of the first minimum of the diffraction pattern (single slit only).
3.3.3	State the principle of superposition and explain what is meant by constructive interference and by destructive interference.	
3.3.4	State and apply the conditions for constructive and for destructive interference in terms of path difference and phase difference.	Constructive interference path difference = $n\lambda$ Destructive interference path difference = $(n + 1/2)\lambda$
3.3.5	Apply the principle of superposition to determine the resultant of two waves.	
3.3.6	State the conditions necessary to observe interference between two sources.	Coherent and monochromatic light source

3.3.7	Outline and carry out a method for a double-slit experiment for light using callipers.	Students should know the Young experiment and be able to draw the intensity distribution of the observed fringe pattern.
3.3.8*	Solve problems involving two-source interference.	$x = \lambda D/a$
3.3.9	Describe the effect on the double-slit intensity distribution when increasing the number of slits in the experiment.	
3.3.10	Principles of diffraction grating	Know the formula $a = w/N$ to calculate the slit separation
3.3.11*	Know the limit of orders of diffraction	Student should be able to use $d \sin ⟦\theta = n\lambda⟧$ to determine the maximum numbers of orders produced
3.3.12*	Solve problems involving a diffraction grating.	

3.4 Stationary waves & The Doppler Effect		
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.	
3.4.6	Describe what is meant by the Doppler effect.	The apparent shift in frequency / wavelength when there is

		relative motion between an observer and a source
3.4.7	Explain the Doppler effect by reference to wave front diagrams for moving-detector and moving-source situations.	
3.4.8*	Apply the Doppler effect equations for sound.	Moving source: $f' = f\left(\frac{v}{v \pm u_s}\right)$ Moving observer: $f' = f\left(\frac{v \pm u_0}{v}\right)$
3.4.9*	Solve problems on the Doppler effect for sound.	

3.5 Electric Fields		
Spec ID	**Assessment statement**	**Additional Guidance**
3.5.1	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.
3.5.2	Define electric current and explain the difference between conventional current and electron flow	$I = \Delta Q/\Delta t$
3.5.3*	Be able to use the equation: $\boldsymbol{F = kQq/r\text{^}2}$	In context of electric fields and Coulomb's law
3.5.4*	Be able to use the equation: $\boldsymbol{V = W/q}$	In context of work done in an electric field (in both Joules and electronvolts)
3.5.5	Identifying drift speed of charge carriers	I=nAqv, where n is the number density of charge carriers
3.5.6	Compare and contrast conductors, semiconductors and insulators.	In the terms of n
3.5.7*	Be able to able and utilise the drift speed equation.	

3.6 Electric Circuits		
Spec ID	**Assessment statement**	**Additional Guidance**
3.6.1*	Drawing and interpreting circuit diagrams	Know basic circuit symbols
3.6.2	Analyse $\boldsymbol{V/I}$ graphs	Using Ohm's law $R = V/I$ Know V/I diagrams for ohmic and non –ohmic conductors such as filament lamp and diode only and identify their differences.
3.6.3*	Be able to solve problems using the equations: $\boldsymbol{R = \rho\, l/A, P = VI = I^2 R = V^2/R}$	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.
3.6.4*	Investigating combinations of resistors in parallel and series circuits	Students need to find equivalent resistance for both $R_{equ} = R_1 + R_2 + \cdots, 1/R_{eqv} = 1/R_1 + 1/R_2 + \cdots$
3.6.5	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.

3.6.6	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.
3.6.7	Definition of emf and PD and the difference between them	
3.6.8*	Source of emf and terminal PD.; 'lost volts'	Use and derivation of equation $\varepsilon = I(R + r)$
3.6.9	Be able to design an experiment that can determine internal resistance of a source.	Know that in a V/I diagram the y-intercept is the emf of the cell and the gradient represents the magnitude of the internal resistance r.
3.6.10	Be able to use the terms emf, internal resistance and other electrical quantities and apply them correctly.	

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	Determine the direction of force on a current-carrying conductor in a magnetic field	
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	Use current direction to determine the direction of the magnetic field.	
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

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; $\Phi = BA \cos \theta$
3.7.7*	Be able to use the terms magnetic flux, magnetic flux linkage and Faraday's law (qualitatively only) and apply them correctly.	

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	Know period, frequency, angular displacement and angular velocity	$\omega = 2\pi/T = 2\pi f$ $v = \omega r$
4.1.3*	Understand the expression for centripetal acceleration.	$a = v^2/r = (4\pi^2 r)/T^2$
4.1.4*	Identify and use appropriately the formula below to show the force producing circular motion: $\boldsymbol{F = (mv^2)/r = m\omega^2 r}$	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	$F = G\,Mm/r^2$
4.2.2	Describe the relationship between gravitational force and centripetal force	
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 $g = F/m$ and $g = GM/r^2$
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 their becoming.	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	Use appropriate astronomical distances and use their appropriate units (AU), light year (ly) and parsec (pc).	The scale of the changes from planets in the same planetary systems and the distance between galaxies should fully understood.
4.3.4*	Use the equation below to deduce Stellar parallax (and describe a method). $d(parsec) = 1/(p(arc - second))$	Also describe its limitations.
4.3.5*	Use the equation below to deduce luminosity, distance and apparent brightness $L = \sigma AT^4; b = L/(4\pi d^2)$	

4.4 Cosmology (Self Study Topic)		
Spec ID	**Assessment statement**	**Additional Guidance**
4.4.1	Describe Cosmic microwave background (CMB) radiation as evidence for the Big Bang model (the cooling of the universe and distances increasing (affecting wavelength).	Describe the characteristics of the CMB with respect to temperature ≈ 2.76K
4.4.2*	Hubble's law $v = H_0 d$ $T = 1/H_0$	Estimate the age of the universe by assuming a constant expansion rate

4.4.3*	The accelerating universe and redshift z $z = \Delta\lambda/\lambda\_0 = v/c$	The redshift of light from galaxies indicates that the Universe is expanding. Solving problems involving z and Hubble's law. How Ia supernovae (using qualitative data) can be used to provide evidence.

MODULE 5 – Quantum Physics

5.1 Atomic Theory & the Nuclear Atom		
Spec ID	**Assessment statement**	**Additional Guidance**
5.1.1	**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 $E\_upper - E\_lower = hf$ c
5.1.2*	Be able to use the term atomic spectra using the equations: E = hf $\lambda = \frac{hc}{E}$	For photons emitted during atomic transitions.
5.1.3	State and apply correctly the terms; proton number; nucleon number; isotopes.	
5.1.4	Notation of ${}^{A}_{Z}X$ for the representation of nuclei	
5.1.5	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
5.1.6*	Be able to calculate the half-life of a nuclide.	Radioactive decay involving only integral numbers of half-lives and from a decay curve.
5.1.7	Determine the activity of a source;	
5.1.8*	State the decay constant λ of an isotope; A = λN.	
5.1.9*	Know and apply the equation for half-life of an isotope: $\lambda T_{\frac{1}{2}} = \ln(2)$	
5.1.10*	Know and 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.
5.1.11	REQUIRED PRACTICAL Use modelling of radioactive materials to determine half-life and radioactive constant and understand its limitations and reasoning.	This should ideally use computer modelling if possible.

5.2 Nuclear Physics		
Spec ID	**Assessment statement**	**Additional Guidance**
5.2.1	The unified atomic mass unit	
5.2.2*	Define mass defect	$\Delta E = \Delta mc^2$
5.2.3	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
5.2.4*	Solving problems involving mass defect and binding energy (including calculations).	
5.2.5	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.
5.2.6*	Solve problems involving the energy released in radioactive decay, nuclear fission and nuclear fusion	

5.3 The Standard Model		
Spec ID	**Assessment statement**	**Additional Guidance**
5.3.1	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
5.3.2	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.
5.3.3*	Define the radius of nuclei; $\boldsymbol{R = R_0 A^{\frac{1}{3}}}$	R_0 is a constant A is the nucleon number
5.3.4*	Use the formula to calculate the mean densities of atoms and their nuclei: $\boldsymbol{\rho = 3u/(4\pi R_0^3)}$	Derive the expression for nuclear density and know that the density is the same for all nuclei.

5.4 Quantum Theory		
Spec ID	**Assessment statement**	**Additional Guidance**
5.4.1	Understand the particulate nature of electromagnetic (EM) radiation.	The photon model.
5.4.2*	Use the equation to calculate the Photon as a quantum of energy of electromagnetic radiation.	$E = hf = hc/\lambda$
5.4.3	REQUIRED PRACTICAL Be able to use LEDs to estimate the value of Planck constant, h.	Using the equation: $eV = hc/\lambda$
5.4.4	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.
5.4.5	Explain the one-to-one interaction between photons and surface electrons.	
5.4.6*	Use Einstein's photoelectric equation both graphically and algebraically. $\boldsymbol{hf} = \emptyset + \boldsymbol{KE_{max}}$	
5.4.7*	Work function; threshold frequency	$\emptyset = hf_0$
5.4.8	State that the maximum kinetic energy of the photoelectrons is independent of the intensity of the incident radiation.	
5.4.9	State that rate of emission of photoelectrons above the threshold frequency is directly proportional to the intensity of the incident radiation.	
5.4.10	Describe the de Broglie hypothesis and the concept of matter waves and wave-particle duality. De Broglie equation: $\boldsymbol{\lambda} = \frac{\boldsymbol{h}}{\boldsymbol{p}}$	Be able to outline the experiment of Davisson–Germer.
5.4.11*	Calculate and solve the wavelength of electrons after acceleration through a given potential difference and other matter/wave problems.	
5.4.12	Outline the Schrödinger model of the hydrogen atom.	In terms of: electrons described by; wavefunctions; its undefined position; the square of the amplitude of the wavefunction giving the probability of finding the electron at a particular point. Also be able to interpret graphs to find the greatest possibility of locating the electron.

5.4.13	Discuss Schroedinger's cat as an example of superposition of matter waves.	Students should know that as soon as an observation is made, the wavefunction collapses everywhere
5.4.14*	Outline the Heisenberg uncertainty principle using the equations: $$\Delta x \Delta p \geq \frac{h}{4\pi}$$ $$\Delta E \Delta t \geq \frac{h}{4\pi}$$	Regarding position–momentum and time–energy. Be aware that the position–momentum and time–energy, cannot be known precisely at the same time. Understand the link between the uncertainty principle and the de Broglie hypothesis (at de Broglie wavelength – momentum is known but position is lost).

COURSE ASSESSMENT

ASSESSMENT OBJECTIVES

Assessment objectives (AOs) 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 chemistry 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 evidences and concepts • scientific methods and systems • scientific terminology • logical presentation of scientific information	20 – 25%
AO2	Apply knowledge and understanding and use: • scientific evidences 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**	15			45 – 55%	45 – 55%
Coursework	**Presentation**	10		40 – 50%	30 – 40%	30 – 40%
Controlled Assessment	**Practical Write Up**	15		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

Physics UFP involves five methods of assessment:

- A scientific research poster – relating a subject matter from Chemistry to another subject.
- A presentation – Presenting a selected Chemistry subject.
- 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 1 - Poster	15	36	• Relating a subject matter from Physics to another subject
Coursework 2 - Presentation	10	24	• Presenting a selected Physics subject.
Controlled Assessment – Practical Writeup	15	36	• A practical write up of a practical provided to you.
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 and parts of 3 only. • 30 minutes.
Exam Paper 2 – Beyond the Basics of Physics.	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 15 minutes.

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

ASSESSMENTS

Coursework 1 - Poster

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.

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

Coursework 2 – Presentation
The Presentation is worth 10% of the course and consists of the following stages:

- Students will be given an elementary particle to research by their subject teacher on either:
    - Hadrons
    - Leptons
    - Bosons

- An 8 – 12-minute presentation should be produced and given that answers the following:
    - A General overview of how elementary particles are classified either as Leptons, Bosons and Hadrons.
    - And the given a presentation on ONE question from below:
        - **Hadrons** - Different quarks and hadrons (mesons and barions) & proton and neutron decay.
        - **Leptons** – Neutrinos as a fundamental particle and beta decay.
        - **Bosons** – What are the fundamental forces and how are they mediated.

- Your reflections on your production of the presentation, the used sources and the general ideas of your presentation will take place verbally after your presentation has been given.

The mark scheme, documents that need to be provided and additional information for the presentation is in the appendix of this document.

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Controlled Assessment – Practical Writeup
A practical will be viewed by students in their own time.

Raw data will be provided.

Students will have 1 week to complete the task independently and it consists of the following stages:

- Writing a method.
- Carrying out a risk assessment.
- Drawing an appropriate table.
- Drawing an appropriate graph.
- Writing a conclusion.
- Evaluating the method.

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. Biologists 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.
- The period of oscillation relates to the displacement angle.
- 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 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**	10	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	**Simple Harmonic Motion (SHM)**	10	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	**Diffraction**	10	December / January	February
3.4	**Stationary waves & The Doppler Effect**	5	January	February
3.5	**Electric Fields**	10	January	February
3.6	**Electric Circuits**	10	February	February / March
3.7	**Magnetic Effects of Electric Current & Electromagnetic Induction**	5	February	March
4.1	**Circular Motion**	5	February / March	March
4.2	**Laws of Universal Gravitation**	10	March	March
4.3	**Astrophysics**	5	March	March / April
4.4	**Cosmology**	(5 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	**The Standard Model**	5	April	April / May
5.4	**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 work 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 to not 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 1 – Poster	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 1 – Poster	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 1 – Poster	Coursework completed and digitally sent.	January – the week of exam paper 1.	March – the week of exam paper 1.	Requirements of documents to be provided are in the appendix of this document.
Coursework 1 – Poster	Reflections	End of the week of exam paper 1.	End of the week of exam paper 1.	To be completed after the poster hand in.

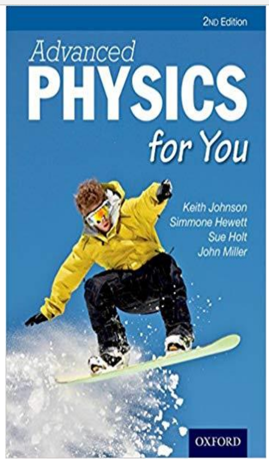
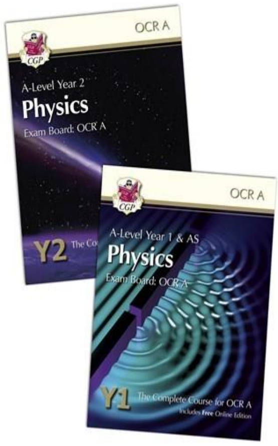
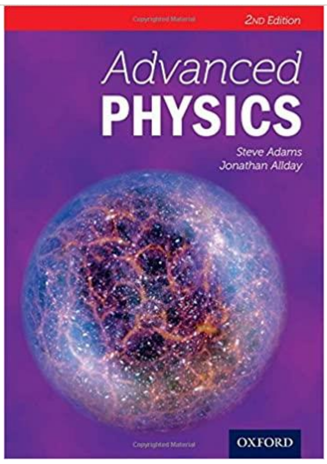
Coursework 2 – Presentation	Research topic given.	Before February Half – Term	After Paper 2 & 3.	This should be confirmed with your teacher before moving onto other tasks.
Coursework 2 – Presentation	First draft of Coursework completed so far (not including reflections).	First week in March.	1 week after Paper 2 & 3.	Your Teacher will mark what is provided and give verbal or written feedback.
Coursework 2 – Presentation	Coursework completed, digitally sent and presented.	First week after Easter vacation.	2 weeks after Paper 2 & 3.	Requirements of documents to be provided are in the appendix of this document.
Controlled Assessment – Practical Writeup	Coursework Given to students	First week of May	First week of May	This will be sent to you to your e-mail address by the Chief Examiner.
Controlled Assessment – Practical Writeup	Coursework completed and digitally sent.	Second week of May	Second week of May	Requirements of documents to be provided are in the appendix of this document.

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**	•

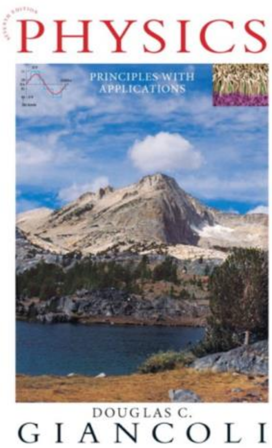
SUPPORT & INFORMATION

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
Advanced Physics (Advanced Sciences) **ADAMS & ALLDAY**		Oxford University Press 2nd Edition

Physics – Principles with Applications

DOUCGLAS C. GIANCOLI



Pearson

7th Edition

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.

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