HS6

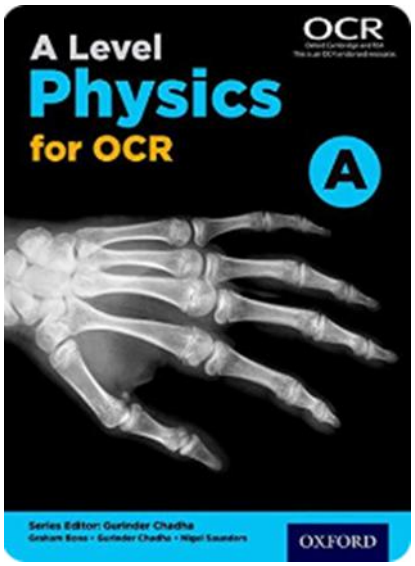
Welcome to A level Physics!

https://www.ocr.org.uk/qualifications/as-and-a-level/physics-a-h156-h556-from-2015/

- ***Minimum Entry Requirement*** **– 6:6**

- ***Main Topic Areas*** **– Quantum Phenomena, Mechanics, Waves, Electricity, Fields, Applied Physics (Stars/Cosmology, Medical Physics)**

- ***Practical Activity Groups - PAGS***
  As part of your course (amongst other practical's) you will be required to complete a series of experiments that you will be assessed on in terms of practical skills, measurement and analysis. This will build on your experience at GCSE and deepen your understanding of good experimental technique and limitations in measurement. 6 are required to be carried out in Y12 and 6 in Y13 making a total of 12 altogether. All the practical work follows the specification closely and you will be required to pass all of them under the CPAC assessment criteria.



Content Overview	Assessment Overview	
Content is split into six teaching modules: • Module 1 – Development of practical skills in physics • Module 2 – Foundations of physics • Module 3 – Forces and motion • Module 4 – Electrons, waves and photons • Module 5 – Newtonian world and astrophysics • Module 6 – Particles and medical physics Component 01 assesses content from modules 1, 2, 3 and 5. Component 02 assesses content from modules 1, 2, 4 and 6. Component 03 assesses content from all modules (1 to 6).	Modelling physics (01) 100 marks 2 hours 15 minutes written paper	**37%** of total A level
	Exploring physics (02) 100 marks 2 hours 15 minutes written paper	**37%** of total A level
	Unified physics (03) 70 marks 1 hour 30 minutes written paper	**26%** of total A level
	Practical Endorsement in physics (04) (non exam assessment)	Reported separately (see Section 5g)

Y12 Course Outline;

Aut.Term	**Foundations of Physics** Quantities and units Derived units Scalar and vector quantities Adding vectors Resolving vectors More on vectors Electrons, Waves and Photons Current and charge Moving charges Kirchhoff's first law Mean drift velocity Practice questions Energy, Power and Resistance Circuit symbols Potential difference and electromotive force The thermistor The electron gun The LDR Resistance Electrical energy and power *I-V* characteristics Paying for electricity Diodes Practice questions Resistance and resistivity	**Quantum Physics** The photon model The photoelectric effect Einstein's photoelectric effect equation Wave–particle duality **Motion** Distance and speed Displacement and velocity Acceleration More on velocity–time graphs Equations of motion Car stopping distances Free fall and *g* Projectile motion **Forces in Action** Force, mass, and weight Centre of mass Free-body diagrams Drag and terminal velocity Moments and equilibrium Couples and torques Triangle of forces Density and pressure $p = h\rho g$ and Archimedes' principle Work, Energy and Power Kinetic energy and gravitational potential energy Power and efficiency Work done and energy Conservation of energy
Spr.Term	**Electrical Circuits** Kirchhoff's laws and circuits Combining resistors Analysing circuits Internal resistance Potential divider circuits Sensing circuits	**Materials** Springs and Hooke's law Elastic potential energy Deforming materials Stress-strain, and the Young modulus **Laws of Motion and Momentum**

	Waves – Section 1 Progressive waves Wave properties Reflection and refraction Diffraction and polarisation Intensity Electromagnetic waves Polarisation of electromagnetic waves Refractive index Total internal reflection	Newton's first and third laws of motion Linear momentum Newton's second law of motion Impulse Collisions in two dimensions **Stars** Objects in the Universe The life cycle of stars The Hertzsprung-Russell diagram Energy levels in atoms Spectra Analysing starlight Stellar luminosity
SumTerm	**Waves- Section 2** Superposition of waves Interference The Young double-slit experiment Stationary waves Harmonics Stationary waves in air columns ***Exam Revision and Practice***	**Cosmology** Astronomical distances The Doppler effect Hubble's law The Big Bang theory Evolution of the Universe ***Exam Revision and Practice*** **Medical Physics** X-rays Interaction of X-rays with matter CAT scans The gamma camera PET scans Ultrasound Acoustic impedance Doppler imaging

Practical Activity Groups - PAGS

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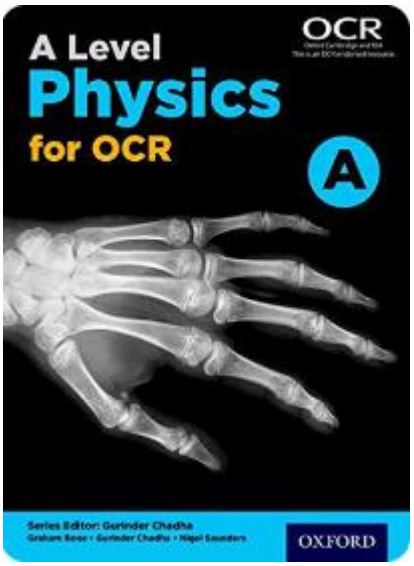
Below are a list of possible experiments that could be assessed. This is only a minimum. Students will carry out more than 12 throughout the course and any amount could be used to assess student competence.

Y12	Y13
Resitivity of a wire	Simple Harmonic Motion - pendulum
Internal Resistance of a power supply	Determination of Absolute Zero – The Gas Laws
Stationary Waves - Harmonics	Charging and Discharging a Capacitor – Time Constant
Measuring the acceleration due to Gravity	Magnetic Force on a current carrying wire
Youngs Two Slits - Interference Patterns	Investigating Magnetic Flux Linkage for a search solenoid
Measuring the Youngs Modulus of a wire.	Verifying in the inverse square law for Radioactive Decay

Textbook Requirement;
It is advisable that you buy this textbook as soon as possible if you are going to study physics at Hendon. It contains the whole A-level course including Astrophysics. There is also a different A-level text available on kerboodle that can be accessed. This textbook is a necessity!



Preparation Tasks for Summer:

TASK 1:

Make 1 page of notes **from each site** covering a topic of your choice.

Prefix	Symbol	Power of ten
Nano	n	x 10^{-9}
Micro	µ	x 10^{-6}
Milli	m	x 10^{-3}
Centi	c	x 10^{-2}
Kilo	k	x 10^{3}
Mega	M	x 10^{6}
Giga	G	x 10^{9}

a) http://home.cern/about

CERN encompasses the Large Hadron Collider (LHC) and is the largest collaborative science experiment ever undertaken. Find out about it here and make a page of suitable notes on the accelerator.

b) http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html

The solar system is massive and its scale is hard to comprehend. Have a look at this award winning website and make a page of suitable notes.

c) https://phet.colorado.edu/en/simulations/category/html

PhET create online Physics simulations when you can complete some simple experiments online. Open up the resistance of a wire html5 simulation. Conduct a simple experiment and make a one page summary of the experiment and your findings.

d) http://climate.nasa.gov/

e) NASA's Jet Propulsion Laboratory has lots of information on Climate Change and Engineering Solutions to combat it. Have a look and make notes on an article of your choice.

f) http://www.livescience.com/46558-laws-of-motion.html

Newton's Laws of Motion are fundamental laws for the motion of all the object we can see around us. Use this website and the suggested further reading links on the webpage to make your own 1 page of notes on the topics.

Symbols and Prefixes

At A level, unlike GCSE, you need to remember all symbols, units and prefixes. Below is a list of quantities you may have already come across and will be using during your A level course.

Quantity	Symbol	Unit
Velocity	v	ms^{-1}
Acceleration	a	ms^{-2}
Time	t	S
Force	F	N
Resistance	R	Ω
Potential difference	V	V
Current	I	A
Energy	E or W	J
Pressure	P	Pa
Momentum	p	$kgms^{-1}$
Power	P	W
Density	ρ	kgm^{-3}
Charge	Q	C

TASK 2:

Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W.
4. Convert 54600 mm into m.
5. How many grams in 240 kg?
6. Convert 0.18 nm into m.
7. Convert 632 nm into m. Express in standard form.
8. Convert 1002 mV into V. Express in standard form.
9. How many eV in 0.511 MeV? Express in standard form.

10. How many m in 11 km? Express in standard form.

Rearranging formulae

This is something you will have done at GCSE and it is crucial you master it for success at A level. For a recap of GCSE watch the following links:

www.khanacademy.org/math/algebra/one-variable-linear-equations/old-school-equations/v/solving-for-a-variable

www.youtube.com/watch?v=_WWgc3ABSj4

TASK 3:

Rearrange the following:

1. E=m x g x h to find h
2. Q= I x t to find I
3. E = ½ m v^2 to find m
4. E = ½ m v^2 to find v
5. v = u + at to find u
6. v = u + at to find a
7. $v^2 = u^2 + 2as$ to find s
8. $v^2 = u^2 + 2as$ to find u

Significant figures

At A level you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

http://www.purplemath.com/modules/rounding2.htm

TASK 4:

Give the following to 3 significant figures:

1. 3.4527
2. 40.6911.0247
3. 59.972
4. 0.838991

Calculate the following to a suitable number of significant figures:

1. 39+78+120

2. (3.4+3.7+3.2)/3

3. 0.0256 x 0.129

4. 592.3/0.1772

5. 63.2/78.1

Atomic Structure

You will study nuclear decay in more detail at A level covering the topics of radioactivity and particle physics. In order to explain what happens you need to have a good understanding of the model of the atom. You need to know what the atom is made up of, relative charges and masses and how sub atomic particles are arranged.

The following video explains how the current model was discovered www.youtube.com/watch?v=wzALbzTdnc8

TASK 5:

Describe the model used for the structure of an atom including details of the individual particles that make up an atom and the relative charges and masses of these particles. You may wish to include a diagram and explain how this model was discovered by Rutherford

Recording Data

Whilst carrying out a practical activity you need to write all your raw results into a table. Don't wait until the end, discard anomalies and then write it up in neat.

Tables should have column heading and units in this format quantity/unit e.g. length /mm

All results in a column should have the same precision and if you have repeated the experiment you should calculate a mean to the same precision as the data.

Below are link to practical handbooks so you can familiarise yourself with expectations.

http://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDF

http://www.ocr.org.uk/Images/295483-practical-skills-handbook.pdf

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TASK 6:

1) Identify the errors the student has made.

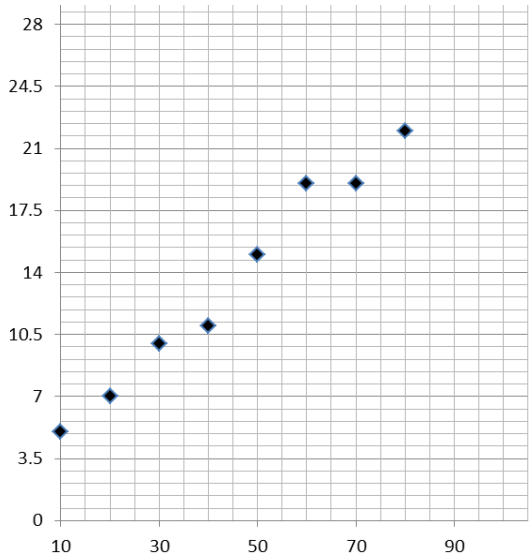
	Time			
Length/cm	**Trial 1**	**Trial 2**	**Trial 3**	**Mean**
10	1.45	1.48	1.46	1.463
22	2.78	2.72	2.74	2.747
30	4.05	4.01	4.03	4.03
41	5.46	5.47	5.46	5.463
51	7.02	6.96	6.98	6.98
65	8.24	9.68	8.24	8.72
70	9.01	9.02	9.0	9.01

Graphs

After a practical activity the next step is to draw a graph that will be useful to you. Drawing a graph is a skill you should be familiar with already but you need to be extremely vigilant at A level. Before you draw your graph to need to identify a suitable scale to draw taking the following into consideration:

- the maximum and minimum values of each variable
- whether 0.0 should be included as a data point; graphs don't need to show the origin, a false origin can be used if your data doesn't start near zero.
- the plots should cover at least half of the grid supplied for the graph.
- the axes should use a sensible scale e.g. multiples of 1,2, 5 etc)

Graph 1:



Forces and Motion

At GCSE you studied forces and motion and at A level you will explore this topic in more detail so it is essential you have a good understanding of the content covered at GCSE. You will be expected to describe, explain and carry calculations concerning the motion of objects. The websites below cover Newton's laws of motion and have links to these in action.

http://www.physicsclassroom.com/Physics-Tutorial/Newton-s-Laws

http://www.sciencechannel.com/games-and-interactives/newtons-laws-of-motion-interactive/

TASK 7:

Sketch a velocity-time graph showing the journey of a skydiver after leaving the plane to reaching the ground.

Mark on terminal velocity.

Electricity

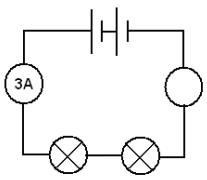
At A level you will learn more about how current and voltage behave in different circuits containing different components. You should be familiar with current and voltage rules in a series and parallel circuit as well as calculating the resistance of a device.

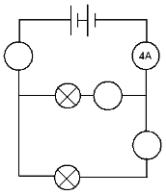
http://www.allaboutcircuits.com/textbook/direct-current/chpt-1/electric-circuits/

http://www.physicsclassroom.com/class/circuits

TASK 8:

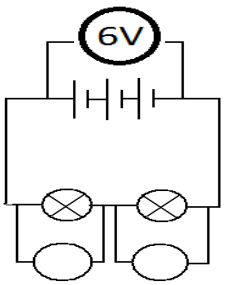
1a) Add the missing ammeter readings on the circuits below.

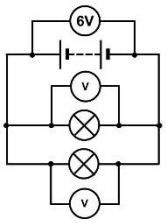




b) Explain why the second circuit has more current flowing than the first.

2) Add the missing potential differences to the following circuits





Waves

You have studied different types of waves and used the wave equation to calculate speed, frequency and wavelength. You will also have studied reflection and refraction.

Use the following links to review this topic.

http://www.bbc.co.uk/education/clips/zb7gkqt

https://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanical-waves/v/introduction-to-waves

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TASK 9:

1) Draw a diagram showing the refraction of a wave through a rectangular glass block. Explain why the ray of light takes this path.

2) Describe the difference between a longitudinal and transverse waves and give an example of each

3) Draw a wave and label the wavelength and amplitude

Making the most of your Physics studies!

Great You tube Videos;

Mithuna Yoganathan – *She is a Phd gradute from Cambridge. Really enthusiastic and interesting short videos on quantum mechanics. Very visual explanations. Easy to follow, as easy as quantum theory can get!*

Walter Lewin – *Great lecturer in physics. Explanations are really clear, visual and effective. Lots of demonstrations.*

Advanced Reading List;

E=mc^2: Biography of World's Most Famous Equation - David Bodanis

Good easy read about Einstein and his achievements

Einstein's Unfinished Revolution- The Search for what Lies beyond the Quantum

Technical in places but good reading for the advanced student

The Emperor's New Mind – Roger Penrose

An expose of quantum physics and consciousness

17 Equations that Changed the World – Ian Stewart

Some great physics equations in there and how they revolutionised science

The Big Bang- Simon Singh

Fantastic book about the history of cosmology and astronomy. Essential read.

In Search of Schrödinger's Cat – John Gribbin

Quantum physics. The first few chapters are very readable and then it gets harder.

Feynman was probably the most famous physicist of the late 20th century. These books explain some tricky concepts with really clever analogies. His lectures are legendary and can be found on the internet. Very interesting and entertaining!

QED: The strange theory of light and matter – R.P Feynman

The Adventures of a Curious Character – R.P Feynman

The Character of Physical Law – R.P Feynman

Newspapers, Magazines and Journals

Try reading journals like New Scientist and Scientific American. Some of the articles are hard work, but don't be put off. If you find out one thing new by looking in a journal, then it is worth it.

And finally, just a few of the possible career paths……..

Professional Physicist, Engineering, Data Analyst, Computing, Academia. Medical Physics	Banking and Finance. Accountancy, Actuarial Science.	Public sector Careers eg. teaching