A level Physics

Specification

OCR A A-level Physics (H556)

https://www.ocr.org.uk/Images/171726-specification-accredited-a-level-gce-physics-a-h556.pdf

Course Overview

Year 1 Subject Content	Year 2 Subject Content
Module 1: Development of practical skills in physics **Module 2: Foundations Physics** The study of physical quantities and units. **Module 3: Forces and Motion** The study of Motion; Forces in action; Work, energy and power; Materials; Newton's laws of motion and Momentum. **Module 4: Electrons, waves, and photons** This unit involves the study of Charge and current; Energy, power and resistance; Electrical circuits; Waves and Quantum physics.	**Module 5: Newtonian World and Astrophysics** This unit involves the study of Thermal physics; Circular motion; Oscillations; Gravitational fields and Astrophysics. **Module 6: Particles and Medical Physics** This unit involves the study of Capacitors; Electric fields; Electromagnetism; Nuclear and particle physics and Medical imaging.

Practical Endorsement
There is no coursework component to the course and 15% of the marks for A-level Physics are based on what you learned in your practicals. You will achieve a qualification following the successful completion of twelve practicals throughout the A level course. This is separate to your Physics examination grade.

Recommended reading / revision/viewing

When you start the course you will be given an exam board specific textbook;
https://global.oup.com/education/product/9780198352181/?region=uk
So don't buy this one. You will also get the option to buy the relevant CGO revision guide at a discounted rate.

Books: It will help you to stand back and see physics in its wider context, and also to look in more detail at some areas of physics that you may currently know very little about. All of them are written at a level that assumes very little about your prior subject knowledge, but reading them will stretch you into areas that go beyond far beyond A-level. Aim to read a couple of them, there is no need to read them all.

- A Short History of Nearly Everything by Bill Bryson
- Six Easy Pieces: Fundamentals of Physics Explained by Richard P Feynman (or any other book by the same author)
- A Brief History of Time by Stephen Hawking
- Big Bang: The Most Important Scientific Discovery of All Time and Why You Need to Know About It by Simon Singh

Online video clips:

You could spend your whole life watching physics video clips on youtube. No need, however, as the minutephysics is all you'll ever really need – and all clips are only a minute long.

http://www.youtube.com/user/minutephysics

Review gcse physics and look ahead to A-level with 'GCSE and A-level Physics online'

https://www.youtube.com/channel/UCZzatyx-xC-Dl_VVUVHYDYw

Websites:

http://physicstube.org/
http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
https://www.physicsandmathstutor.com/
http://i-want-to-study-engineering.org/

Transition work for Physics A level students-Answer on file paper.

1. Physical Quantities

Maths and Physics have an important but overlooked distinction by students. Numbers in Physics have meaning – they are the size of physical quantities which exist. To give numbers meaning we suffix them with units. There are two types of units:

Base units These are the seven fundamental quantities defined by the Système international d'Unités (SI units). Once defined, we can make measurements using the correct unit and make comparisons between values.

Basic quantity	Unit	
	Name	Symbol
Mass	kilogram	kg
Length	metre	m
Time	second	s
Current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Derived units These are obtained by multiplying or dividing base units. Some derived units are complicated and are given simpler names, such as the unit of power Watt (W) which in SI units would be m^2kgs^{-3}.

Derived quantity	Unit	
	Name	Symbols
Volume	cubic metre	m^3
Velocity	metre per second	ms^{-1}
Density	kilogram per cubic metre	kgm^{-3}

Notice that at A-Level we use the equivalent notation ms^{-1} rather than m/s.

Do not become confused between the symbol we give to the quantity itself, and the symbol we give to the unit. For some examples, see the table on the right.

Quantity	Quantity symbol	Unit name	Unit symbols
Length	L or l or h or d or s	metre	m
Wavelength	λ	metre	m
Mass	m or M	kilogram	kg
Time	t	second	s
Temperature	T	kelvin	K
Charge	Q	coulomb	C
Momentum	p	kilogram metres per second	$kg\ ms^{-1}$

Prefix	Symbol	Name	Multiplier
femto	f	quadrillionth	10^{-15}
pico	p	trillionth	10^{-12}
nano	n	billionth	10^{-9}
micro	μ	millionth	10^{-6}
milli	m	thousandth	10^{-3}
centi	c	hundredth	10^{-2}
kilo	k	thousand	10^{3}
mega	M	million	10^{6}
giga	G	billion	10^{9}
tera	T	trillion	10^{12}
peta	P	quadrillion	10^{15}

Often the value of the quantity we are interested in is very big or small. To save space and simplify these numbers, we prefix the units with a set of symbols.

Knowledge of standard form and how to input it into your calculator is essential.

For example: 245×10^{-12} m = 245 pm

2.45×10^{3} m = 2.45 km

We may need to convert units to make comparisons.

For example: Which is bigger, 0.167 GW or 1500 MW?

0.167 GW = 0.167×10^{9} W

Physical Quantities - Questions

1) The unit of energy is the joule. Find out what this unit is expressed in terms of the base SI units.

2) Convert these numbers into normal form:
   a) 5.239×10^{3}
   b) 4.543×10^{4}
   c) 9.382×10^{2}
   d) 6.665×10^{-6}

3) Convert these quantities into standard form:
   a) 65345 N
   b) 765 s
   c) 486856 W
   d) 0.987 cm^2
   e) 0.000567 F
   f) 0.0000605 C
   g) 0.03000045 J

4) Write down the solutions to these problems, giving your answer in standard form:

   a) $(3.45 \times 10^{-5} + 9.5 \times 10^{-6}) \div 0.0024$

   b) $2.31 \times 10^{5} \times 3.98 \times 10^{-3} + 0.0013$

5) Calculate the following:

   a) 20mm in metres

   b) 3.5kg in grams

   c) 589000 μm in metres

   d) $1m^2$ in cm^2 (careful)

   e) 38 cm^2 in m^2

6) Find the following:

   a) 365 days in seconds, written in standard form

   b) 3.0×10^{4} g written in kg

   c) 2.1×10^{6} Ω written in MΩ

   d) 5.9×10^{-7} m written in μm

   e) Which is bigger? 1452 pF or 0.234 nF

2. Significant Figures

Number in Physics also show us how certain we are of a value. How sure are you that the width of this page is 210.30145 mm across? Using a ruler you could not be this precise. You would be more correct to state it as being 210 mm across, since a ruler can measure to the nearest millimetre.

To show the precision of a value we will quote it to the correct number of significant figures. But how can you tell which figures are significant?

The Rules

1. All non-zero digits are significant.

2. In a number with a decimal point, all zeros to the right of the right-most non-zero digit are significant.

3. In a number without a decimal point, trailing zeros may or may not be significant, you can only tell from the context.

Value	# of S.F.	Hints
23	2	There are two digits and both are non-zero, so are both significant
123.654	6	All digits are significant – this number has high precision
123.000	6	Trailing zeros after decimal are significant and claim the same high precision
0.000654	3	Leading zeros are only placeholders
100.32	5	Middle zeros are always significant
5400	2, 3 or 4	Are the zeros placeholders? You would have to check how the number was obtained

When taking many measurements with the same piece of measuring apparatus, all your data should have the same number of significant figures.

For example, measuring the width of my thumb in three different places

with a micrometer: 20.91×10^{-3} m 21.22×10^{-3} m 21.00×10^{-3}m

all to 4 s.f.

Significant Figures - Questions

1) Write the following lengths to the stated number of significant figures:
    a) 5.0319 m to 3 s.f.
    b) 500.00 m to 2 s.f.
    c) 0.9567892159 m to 2 s.f.
    d) 0.000568 m to 1 s.f.

2) How many significant figures are the following numbers quoted to?

a) 224.4343

b) 0.000000000003244654

c) 344012.34

d) 456

e) 4315.0002

f) 200000 stars in a small galaxy

g) 4.0

3) For the numbers in question 2, convert them to standard form and quote to 3 s.f.

4) Calculate the following and write your answer to the correct number of significant figures:

a) 2.65 m x 3.015 m

b) 22.37 cm x 3.10 cm

c) 0.16 m x 0.02 m

3. Using Equations

You are expected to be able to manipulate formulae correctly and confidently. You must practise rearranging and substituting equations until it becomes second nature. We shall be using quantity symbols, and not words, to make the process easier.

Key points

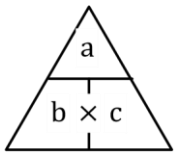
- Whatever mathematical operation you apply to one side of an equation must be applied to the other.
- Don't try and tackle too many steps at once.

Simple formulae

The most straightforward formulae are of the form $a = b \times c$ (or more correctly $= bc$).

Rearrange to set b as the subject: Divide both sides through by c therefore $\frac{a}{c} = \frac{b \times c}{c}$ $\frac{a}{c} = b$ $\frac{a}{b} = a$

Rearrange to set c as the subject: Divide both sides through by b therefore $\frac{a}{b} = \frac{b \times c}{b}$



Alternatively, you can use the formula triangle method. From the formula you know put the quantities into the triangle and then cover up the quantity you need to reveal the relationship between the other two quantities. This method only works for simple formulae, it doesn't work for some of the more complex relationships, so you must learn to rearrange

Formulae with more than 3 terms	Formulae with additions or subtractions	Formulae with squares or square roots
Find ρ $R = \frac{\rho l}{A}$	**Find h** $Ek = hf - \Phi$	**Find g** $\sqrt{\quad}$
Divide by l $\frac{R}{l} = \frac{\rho l}{Al}$	Add Φ $Ek + \Phi = hf - \Phi + \Phi$	Square $T^2 = 4\pi^2 \frac{l}{g}$
Cancel l $\frac{R}{l} = \frac{\rho l}{Al}$	Cancel Φ $Ek + \Phi = hf$	Multiply by g $gT^2 = 4\pi^2 l$
Multiply by A $\frac{R}{l} = \frac{\rho l}{Al}$	Divide by f $\frac{Ek+\Phi}{f} = \frac{hf}{f}$	Divide by T^2 $g = \frac{4\pi^2 l}{T^2}$
Cancel A $\frac{R}{l} = \frac{\rho l}{Al}$	Cancel f $\frac{Ek+\Phi}{f} = h$	

Using equations-questions

1) Make t the subject of each of the following equations:

a) $V = u + at$

b) $S = \frac{1}{2} at^2$

c) $Y = k (t - t_0)$

d) $F = \frac{mv}{t}$

2) Solve each of the following equations to find the value of *t*:

a) $30 = 3t - 3$

b) $4(t + 5) = 28$

c) $3t^2 = 36$

d) $t^{1/3} = 3$