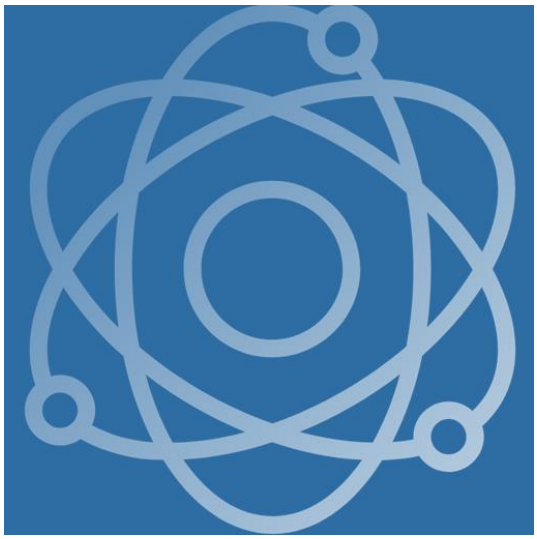
Year 11 - 12 Bridging the Gap

GCSE → A Level

A Level Physics



DEADLINE: 1st lesson back in September

The aim of this preparation work is to revise GCSE physics topics ready for year 12. Some combined science students will have not seen some of the topics before.

Summer Preparation Work – AS Physics

Welcome to A-level physics – the science of everything

This pack has been designed to help you bridge the gap from GCSE to AS Level and prepare as much as you can for starting the course in September.

We follow the OCR "Physics A" specification in the United Sixth Form. A visit to OCR's website will allow you to look at this in more detail, should you so wish.

You will start by:

- looking at the topics covered in Year 12 and 13 in the Physics OCR A course, to give you an idea of how the course will be structured;
- what resources are available;
- when you will be sitting exams and carrying out practical assessments.

The tasks on the following pages allow the practice of skills needed for starting the course. Please complete the tasks before the start of term and bring the completed booklet to your **FIRST** physics lesson.

I would also encourage you to read anything related to physics, or even regularly watch videos about areas of science that interest you. I will do my best to include anything that interests you into our lessons.

Have a safe summer and see you in September.

Mr White

CONTENTS

Y12 Physics – course outline (2023-24)

AUTUMN TERM

Bridging Course

1-2 weeks – revision of all vital GCSE work, including core maths skills.
INTERMEDIATE ASSESSMENT
(individual student targets will be reviewed at appropriate stages in the course)

Module 1 – Development of practical skills in physics.

Practical skills assessed throughout the year and in the final written examinations.
"Practical Activity Groups" or PAGs are a series of experiments carried out with a spectrum of guidance. Experiments will cover, e.g., measuring the acceleration of free fall, investigating the strength of materials and the resistivity of a metal.

Module 2 – Foundations of physics

- Physical quantities and units
- Derived units.
- Making measurements and analysing data.
- Scalar and vector quantities.
- Adding and resolving vectors.
- Nature of quantities.

Module 3 – Forces and motion

Forces in action

- Displacement, velocity and acceleration
- Motion in a straight line
- Projectile motion
- Forces in 1D and 2D
- Air resistance and terminal velocity
- Equilibrium – moments and triangles of forces
- Density and pressure

Work and energy (1)

- Defining 'work'
- Conservation of energy
- Types of work done: kinetic and potential
- Power and efficiency

Newton's Laws of motion and momentum

- The three laws
- The role of momentum in collisions

Work and energy (2)

- Materials – springs and mechanical properties

SPRING TERM

Module 1 – Development of practical skills in physics.

Practical skills assessed throughout this term are, e.g.:
PAG 3.3 Determining the maximum power from a cell.
PAG 4.1 Investigating electrical circuits.
PAG 5.1 Determining wavelength with diffraction grating.
PAG 5.3 Using an oscilloscope.
PAG 6.1 Planck constant determination.

Module 4 – Electrons, waves and photons

Electric current

- Charge and current
- Kirchhoff's first law
- Mean drift velocity

Resistance

- Circuit symbols
- Resistance and resistivity.
- Energy and power.
- Ohm's law.
- I-V graphs.
- E.M.F. and p.d.

DC circuits

- Series and parallel circuits.
- Thermistors, LDRs and potential dividers.
- Kirchhoff's second law.

Waves

- Types of wave motion
- Wave properties
- Electromagnetic waves including refraction
- Superposition/interference
- Stationary waves

Quantum physics

- Photons
- The photoelectric effect
- Wave particle duality.

ASSESSMENT in DECEMBER	END OF YEAR EXAM in JUNE (UCAS mock).
"Breadth of Physics" (Paper 1) and "Depth of Physics" (Paper 2) examined in June 2024	

Y13 Physics – course outline (2024-25)

AUTUMN TERM

Module 1 – Development of practical skills in physics.

Done in Summer term after exams completed.
PAG Estimating absolute zero
PAG Investigating P and V in a gas
PAG Determining the specific latent heat by an electrical method
PAG Investigating materials (research and presentation)

A continuation of Practical skills assessment throughout the year and in the final written examinations.

Done in Autumn term.
PAG 9.1 Charging and discharging capacitors.
PAG 9.2 Capacitors in series and parallel.
PAG 9.3 Capacitance of a capacitor.
PAG 10.1 Simple Harmonic Motion.
PAG 10.2 Forced and damped oscillations.
PAG 10.3 Spring stiffness.
PAG 11.2 Specific heat capacity.

Module 5 – Newtonian world and astrophysics

Thermal physics
- Temperature
- Thermal properties of materials
- Ideal gases

Circular motion
- Kinematics of circular motion
- Centripetal force

Oscillations
- Simple harmonic oscillations
- Energy of a simple harmonic oscillator
- Damping

Gravitational fields
- Point and spherical masses
- Newton's law of gravitation
- Planetary motion
- Gravitational potential and energy

Astrophysics and cosmology
- Stars
- Electromagnetic radiation from stars
- Cosmology

SPRING TERM

Module 1 – Development of practical skills in physics.

Practical skills assessed throughout this term are:
PAG 11.1 Investigating transformers.
PAG 11.3 Magnetic field strength of a magnet.
PAG 7.1 Investigating radioactive decay.
PAG 7.2 Absorption of alpha, beta & gamma.
PAG 7.3 Investigating half-life.

Module 6 – Particles and medical physics

Capacitors
- Capacitors
- Energy in capacitors
- Charging and discharging capacitors

Electric fields
- Point and spherical charges
- Coulomb's law
- Uniform electric field
- Electric potential and energy

Electromagnetism
- Magnetic fields
- Motion of charged particles in magnetic fields
- Electromagnetism

Nuclear and particle physics
- The nuclear atom
- Fundamental particles
- Radioactivity
- Nuclear fission and fusion

Medical imaging
- Using X-rays
- Diagnostic methods in medicine
- Using ultrasound

THE FINAL EXAMS

PAPER 1 "Modelling physics": (37% of final grade – covering modules 1, 2, 3 and 5), 100 marks – 2h15m
PAPER 2 "Exploring physics": (37% of final grade – covering modules 1, 2, 4 and 6), 100 marks – 2h15m
PAPER 3 "Unified physics": (26% of final grade – synoptic covering all modules 1 to 6). 70 marks – 1h30m

Examined in May / June 2025

ASSESSMENT in DECEMBER

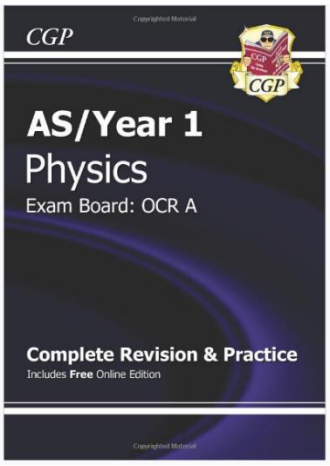
Course preparation resources.

You need to download the course specifications:
A2 specs - http://www.ocr.org.uk/Images/171726-specification-accredited-a-level-gce-physics-a-h556.pdf

This is the detailed specification, written by the exam board.

You also need access to two books to support your learning in AS Physics:

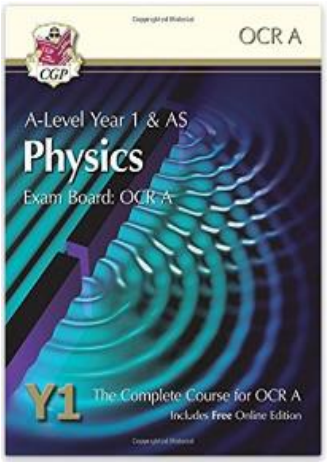
1. A copy of the **A-Level Year 1 & AS Physics** revision guide from CGP, which covers topics linking GCSE to AS level physics (can be ordered through the school). You will need this to help you in class and with self study.
    - Publisher: CGP
    - Price: Around £9 – 11.
    - ISBN: 9781782942955.



2. A copy of the course book: **A Level Year 1 & AS Physics** from CGP books. This is the book you will use throughout Year 12, with all the core knowledge needed. We use these in class, but you won't be able to annotate them, when you need to (can be ordered through the school at a cheaper rate).

    Note: you <u>will</u> need to read other books as well, such as those available in the classroom and in the library.

    - Publisher: CGP
    - Price: Around £20
    - ISBN: 9781782947905**.**



Other books you may like to buy include:
OCR A Level Physics for OCR Year 1 and AS: ISBN 9780198352174.
Heinemann Revision guide for OCR AS Physics

Should I be studying A-level maths?

It certainly will help, but it is not a deal breaker. The course has been developed so that all the physics in AS level can be explained with a good understanding of GCSE mathematics. At A2 some more difficult maths is necessary to help explain concepts and analyse data but these skills will be developed as you study.

If you have chosen to do maths as one of your AS level courses then you will have an advantage, especially if you are taking, e.g., mechanics modules as there are common topics and techniques. Some of the tasks set in this document will help you to get up to speed before you start.

A summary of the mathematical requirements appear below:

1 Arithmetic and numerical computation:
(a) Recognise and use expressions in decimal and standard form;
(b) Use ratios, fractions and percentages;
(c) Use calculators to find and use power, exponential and logarithmic functions;
(e) Use calculators to handle sin x, cos x, tan x when x is expressed in degrees or radians.

2 Handling data:
(a) Use an appropriate number of significant figures;
(b) Find arithmetic means;
(c) Make order of magnitude calculations.

3 Algebra:
(a) Understand and use the symbols: =, <, <<, >>, >, $\propto$, ~;
(b) Change the subject of an equation;
(c) Substitute numerical values into algebraic equations using appropriate units for physical quantities;
(d) Solve simple algebraic equations.

4 Graphs:
(a) Translate information between graphical, numerical and algebraic forms;
(b) Plot two variables from experimental or other data;
(c) Understand that $y = mx + c$ represents a linear relationship;
(d) Determine the slope and intercept of a linear graph;
(e) Draw and use the slope of a tangent to a curve as a measure of rate of change;
(f) Understand the possible physical significance of the area between a curve and the x axis and be able to calculate it or measure it by counting squares as appropriate;
(g) Use logarithmic plots to test exponential and power law variations;
(h) Sketch simple functions including $y = k/x$, $y = kx^2$, $y = k/x^2$, $y = \sin x$, $y = \cos x$, $y = e^{-x}$.

5 Geometry and trigonometry:

(a) Calculate areas of triangles, circumferences and areas of circles, surface areas and volumes of rectangular blocks, cylinders and spheres;

(b) Use Pythagoras' theorem, and the angle sum of a triangle;

(c) Use sin, cos and tan in physical problems;

(d) Understand the relationship between degrees and radians and translate from one to the other;

(e) Use relationship for triangles: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ and $a^2 = b^2 + c^2 - 2bc \cos A$.

Bridging the Gap

Everything at A-level builds on your GCSE knowledge, skills and understanding. First you will need to review GCSE work at the top end of higher tier.

We will start with a 1 week 'Bridging Course' to help get up to speed before we start the AS course. This culminates in an assessment that tests the content on the following pages.

The tasks in the following pages are all worthwhile and are deserving of the time spent on them. Please complete this before you return.

The 5 tasks – to be completed by the first lesson in September

Task A – practice rearranging formulae; an essential skill for A-level sciences and beyond.

Task B – practising representations of number (decimals, fractions, prefixes, standard form, etc.).

Task C – a first attempt at doing some physics research and writing about your findings.

Task D – an experimental challenge; using everyday objects to find something out about the universe.

Task E – the bio; a short piece of writing detailing your passions and interests, and how you may like to use A-level physics in your life.

Task A

Rearrange each of these physics formulae so that each variable becomes the subject of the formula.

e.g. **F = ma** can be rearranged to give **m = F/a** and **a = F/m** (these are the only three correct combinations of this formula).

Now do the same for these. They will get increasingly more difficult.

1.	$V = I\,R$	I = ...	R = ...	
2.	$P = I^2R$	I = ...	R = ...	
3.	$E_k = \frac{1}{2}mv^2$	m = ...	v = ...	
4.	$E_e = \frac{1}{2}ke^2$	k = ...	e = ...	
5.	$\Delta E = mc\Delta\theta$	m = ...	c = ...	Δɵ=.....
6.	$I = \frac{k}{d^2}$	k = ...	d = ...	
7.	$F = \frac{mv^2}{r}$	m = ...	v = ...	r = ...
8.	$T = 2\pi\sqrt{\frac{l}{g}}$	l = ...	g = ...	
9.	$T^2 = \frac{4\pi r^3}{GM}$	r = ...	G = ...	M = ...
10.	$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$	v = ...	c = ...	

Please write your solutions with full workings in the space below.

Task B

Represent these quantities below in the stated units.

For example: represent 300 000 000 m/s (the speed of light) in m/s, in standard form, and to 2 significant figures.

300 000 000 = 3.0×10^8 m/s

1. 245cm to 2 significant figures in mm
2. the circumference of the Earth to 2 significant figures in standard form, in m (radius of Earth = 6371km)
3. the wavelength of green light, 520nm, in standard form
4. the mass of an ink drop in a printer, 14ng, in standard form in kg
5. the area of a postage stamp measuring 240mm x 165mm, in standard form, to 2 significant figures in cm^2
6. the number of atoms of oxygen in 2×10^{-4} moles of oxygen molecules (O_2) to 2 significant figures in standard form (1 mole = 6.02×10^{23})
7. the volume of a sugar cube, of side 12mm, in standard form to 2 significant figures, in m^3
8. the surface area to volume ratio of a cube of 20cm side
9. a light year in m, in standard form to 3 significant figures (1 year = 3.2×10^7s, speed of light = 3.0×10^8 m/s)
10. the number of Earth masses that would equal one mass of the Sun, in standard form to 2 significant figures (mass of Earth = 5.97×10^{24}kg, mass of Sun = 1.99×10^{30} kg)

Please write your solutions with full workings in the space below.

Task C

For this task, you will be finding out about a current physics topic, and writing a brief piece about what you have discovered. Either choose one of the suggested titles, or choose your own.

Some suggested topics are:

i) Is light speed travel possible?

ii) What has been discovered at the Large Hadron Collider in CERN since it was first operated?

iii) What are some of the challenges of putting humans on Mars?

iv) How do electric cars work?

v) Is thorium the future replacement for uranium in nuclear reactors?

vi) How can physics help to solve climate change?

Task D

Using everyday objects can you do any 1 (or more) of these?

1. Find the value of 'g' – the gravitational field strength of the Earth.
2. Make a motor using a 1.5V battery, wire and a magnet.
3. Make a Cartesian diver to show buoyancy.
4. Construct an electromagnet that can be used to pick up small magnetic objects, e.g., pins and paper clips.

Write a short piece below about how you accomplished this (or another safe experiment of your choice).

Task E

Use the space below to write a short piece detailing your passions and interests, and how you may like to use A-level physics in your life. For example, you may be interested in using your science A-levels to go to university and aim for a particular career. You may not have any idea what you want to do, so write about your physics interests. If you are not sure what to write at all, make note of some questions you would like answered in your lessons, or write about which parts of GCSE you enjoyed, and what you may have found challenging.

Some general advice before embarking on higher level studies.

1. Read books.

Engagement in reading 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. Consider reading the two books in bold below to be the easiest way for you to do this, and they're something that would be easy to obtain and simple for you to take away with you on holiday. Both books 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 university level. The other books are also highly recommended.

- ***A Short History of Nearly Everything*** by Bill Bryson.
- ***Big Bang: The Most Important Scientific Discovery of All Time and Why You Need to Know About It*** by Simon Singh.
- *A Brief History of Time* by Stephen Hawking.
- *Physics of the Impossible – Michio Kaku*
- *The Making of the Atomic Bomb* by Richard Rhodes.
- *Carrying the Fire: An Astronaut's Journeys* by Michael Collins (the Apollo 11 astronaut).
- *13 Things That Don't Make Sense: The Most Intriguing Scientific Mysteries of Our Time* by Michael Brooks.
- *Six Easy Pieces: Fundamentals of Physics Explained* by Richard P Feynman (or any other book by the same author).

If you don't want to pay the full price for the books, then they can often be found in charity shops or e.g., eBay – you can buy the Bill Bryson book (second hand) for 99p. If you don't want to pay anything, remember that your local public library should be able to help you.

2. Watch online video.

- Watch any or all of the "Schools Lecture series" videos made by the Institute of Physics. Don't be put off by the title – they are all presented by experts in physics at the right kind of level, and the topics covered will really help you understand some of the details of the A level course. The link is: http://www.iop.org/resources/videos/education/
- You could spend your whole life watching physics video clips on YouTube. Some recommended channels are PBS Spacetime, Minute Physics, Sixty Symbols, Veritasium, Science Asylum, etc.

3. Follow popular scientists/physicists on Twitter (or other social media).

- **Brian Cox** (@ProfBrianCox)
- **Jim Al-Khalili** (@jimalkhalili)
- **Andy Newsam** (@AstroAndyN)
- **Michio Kaku** (@michiokaku)

4. Study hard.

The work set by your teachers is the starting point for your studies. You should be spending approximately the same time outside of the classroom as you do in it (on a normal week-to-week basis) with more time spend on independent study when exams draw close.

All of the class materials are made available on **Microsoft Teams**, with the forums being used for communication about homework and other matters.

Always make time for leisure and part-time employment – these are important too, but do not fall behind on your academic studies. Keep up – and if you are not… ALWAYS ask for help.