AQA GCSE PHYSICS

REVISION GUIDE

Suitable for Combined Trilogy and Triple Science

Lewis Matheson

PhysicsOnline.com

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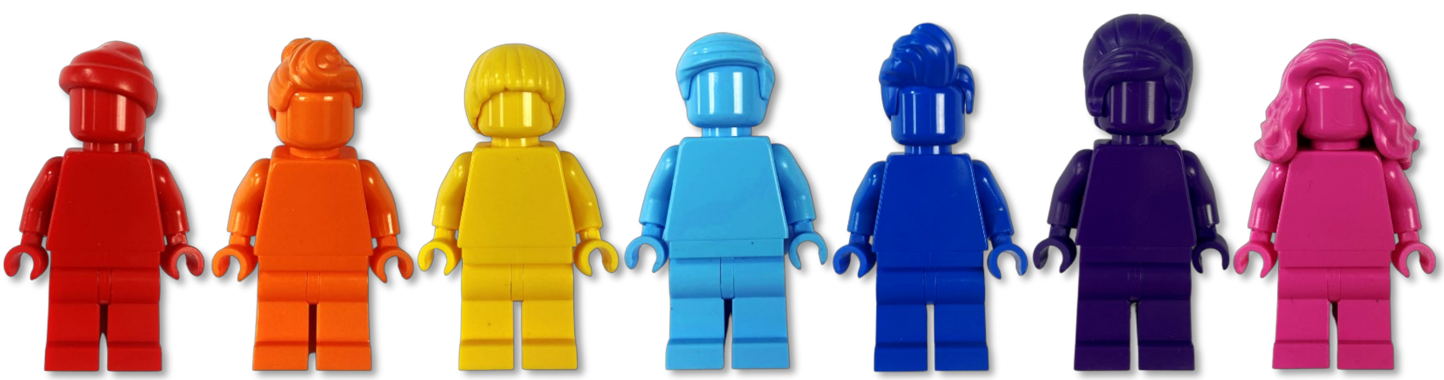


Introduction

This is unlike any other revision guide out there. This guidebook will lead you through your revision making use of tried and tested techniques that will improve your exam grade.

While working as a teacher and a Head of Science I found that there were no short cuts to achieving the results that students were after; it came down to hard work and self-motivation. At times revision will be challenging for you. If you work smartly and use your time effectively then you may see large improvements in a short space of time.

Read through this book, following the tips for effective revision and using the checklists to identify what you are comfortable with and what you need to work on. I have hundreds of videos to support every aspect of the AQA GCSE Physics course in plenty of detail at my GCSE website allowing you to spend time refreshing yourself with this content. Then start working through as many past exam papers as possible. In the last section of this book you will find further tips and a table for you to keep track of the papers you have completed.

Please note that this is not an official AQA endorsed book; instead, it's the advice that I have given students that prepared and enabled them to achieve their full potential in their GCSEs.

Make sure you check the AQA website for the latest version of the specification and for any updates about the exams you will be sitting this year.

Lewis Matheson

Physics Online Ltd

AQA GCSE Physics

YouTube.com/**PhysicsOnline**

Subscribe on YouTube to stay updated with my latest videos - including exam news and livestreams.

Course Structure

GCSE Science, depending on the school you attend, may be started in Year 9 or 10.

There are several exam boards who write and mark the exams. AQA (Assessment and Qualifications Alliance) is the largest exam board - in 2019 there were 303,000 students who sat the Combined Trilogy exams and 125,000 who sat Physics GCSE!

In your science lessons you will learn about various topics, have a go at some practical experiments and see many demonstrations. There will be end of unit tests and school mock exams before you sit your real GCSEs at the end of Year 11. The details of all of this will be explained to you by your teachers.

Combined Trilogy or Physics

The majority of students study Biology, Chemistry and Physics topics as '**Combined Science Trilogy'**, resulting in two GCSEs awarded (this is sometimes referred to as Double Science).

Some students study additional topics in Biology, Chemistry and **Physics** (sometimes called Triple Science) and receive a total of three Science GCSEs.

Foundation and Higher Tiers

There are two tiers for the final exams. The **Foundation** tier has grades from 1 to 5, while the **Higher** tier exams assess additional challenging content with grades awarded ranging from 4 to 9 (the highest possible grade).

This Revision Guide

This book is suitable for both Foundation and Higher tier students studying either Trilogy or Physics. **Higher tier content is in bold** and light blue is for Physics only.

If you are unsure about which course you are taking then do speak to your science teacher as soon as possible.

Combined Trilogy Exams

There are six exams at the end of Year 11 for AQA GCSE Combined Trilogy 8464. In addition to two exams for both Biology and Chemistry there are two Physics exams.

Physics Paper 1	▪ Energy ▪ Electricity ▪ Particle Model ▪ Atomic Structure	Multiple choice, structured, short answer and extended response	1 hour 15 minutes	70 marks
Physics Paper 2	▪ Forces ▪ Waves ▪ Magnetism and Electromagnetism (Including an understanding of energy transfer from Paper 1)	Multiple choice, structured, short answer and extended response	1 hour 15 minutes	70 marks

Each paper will have questions that allow you to **demonstrate** knowledge (~40%), **apply** knowledge (~40%) and **analyse** information and ideas (~20%).

There are both Foundation and Higher tiers available with grades from 1-1 (lowest) to 9-9 (highest) as well as a U for really low marks (unclassified).

Foundation	U	1-1	1-2	2-2	2-3	3-3	3-4	4-4	4-5	5-5

Higher	**U**		**4-4**	**4-5**	**5-5**	**5-6**	**6-6**	**6-7**	**7-7**	**7-8**	**8-8**	**8-9**	**9-9**

Your grade will be calculated from the total mark you score out of 420 from all papers.

Physics Exams

There are two exams at the end of Year 11 for AQA GCSE Physics 8463 (Triple Science).

Physics Paper 1	▪ Energy ▪ Electricity ▪ Particle Model ▪ Atomic Structure	Multiple choice, structured, short answer and extended response	1 hour 45 minutes	100 marks
Physics Paper 2	▪ Forces ▪ Waves ▪ Magnetism and Electromagnetism ▪ Space Physics (Including an understanding of energy transfer from Paper 1)	Multiple choice, structured, short answer and extended response	1 hour 45 minutes	100 marks

Each paper will have questions that allow you to **demonstrate** knowledge (~40%), **apply** knowledge (~40%) and **analyse** information and ideas (~20%).

There are both Foundation and Higher tiers available with grades from 1 (lowest) to 9 (highest) as well as a U for really low marks (unclassified).

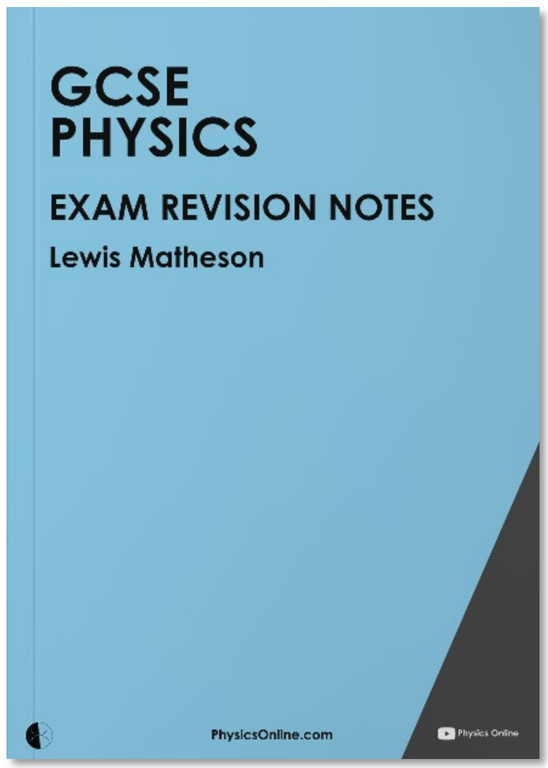
Foundation	U	1	2	3	4	5				
Higher	**U**	**-**	**-**	**-**	**4**	**5**	**6**	**7**	**8**	**9**

Your grade will be calculated from the total marks you score out of 200 from both papers.

TikTok.com/**@PhysicsOnline**

Follow me on TikTok for even more short videos.

Revision



Organise all of your own revision notes in this handy notebook – with sections to structure your definitions, equations and topic summaries.

How to Revise

- Do you often feel that you're spending a lot of time revising but not improving your test results?
- Have you written detailed notes and highlighted keywords in revision guides?

This isn't effective!

The key to revising, and actually learning the content, is to spend your time on strategies that have a proven record of working.

Here are my suggested ways to revise for your GCSE exams:

- Use the **checklists** in this book to ensure that you're revising the correct content and address any gaps in your knowledge as soon as possible – my videos cover every aspect of the course and explain each topic clearly and concisely.
- Make your revision as **active** as possible.
    - Make **flashcards** with key information that you constantly refer to and test yourself with.
    - Try the **blurting** technique; write down from memory a mind map of everything you can remember from reading about a topic, making any notes as brief as possible.
- Regularly review your revision notes and revisit the topics you have already covered - '**spaced repetition**' is a great way to increase your longer-term memory.
- **Apply** your knowledge by attempting multiple **questions**.
    - Use your textbook or other workbooks.
    - Access over fifty GCSE worksheets at GCSEPhysicsOnline.com/**worksheets**
    - Isaac Physics is a great source of free self-marked questions.
- **Past papers** are so important that I have dedicated a whole section of the book to them. These are easy to access online on my website and are the best way to prepare for real exams.

GCSEPhysicsOnline.com/**aqa-past-papers**

Find all the AQA papers in one place

Video Resources

I have made a few GCSE videos to help you…

- Significant Figures
- Significant Figures: Example A
- Significant Figures: Example B
- Using Standard Form
- Standard Form: Example A
- Standard Form Explained
- Standard Form and Sig Fig
- Equations in Physics
- Re-Arranging Equations
- Re-Arranging Equations: Example A
- Re-Arranging Equations: Example B
- Mathematical Symbols
- Greek Letters
- Linear Graphs and Calculating Gradients
- Calculating Gradients: Example A
- Calculating Gradients: Example B
- Tangents to a Curve
- Tangents: Example A
- Area under a Graph
- Calculating Means
- Calculating Means: Example A
- Calculating Means: Example B
- Modes and Medians
- Modes and Median: Example A
- Scale Drawing
- Scale Drawing: Example A
- Pythagoras
- Pythagoras: Example A
- Pythagoras: Example B
- Trigonometry
- Trigonometry: Example A
- Trigonometry: Example B
- Equipment You Need for Physics
- Using a Protractor to Measure Angles
- Measuring Angles: Example
- Using a Set Square
- Quantities, Symbols and Units
- Base and Derived Units
- Prefixes
- Prefixes: Example A
- Prefixes: Example B
- Plotting Data
- Lines of Best Fit
- Anomalous Data on Graphs
- Drawing Graphs: Example A
- Drawing Graphs: Example B
- Calculators - Standard Form
- Calculators - Sin, Cos and Tan
- Calculators - Decimals and Fraction
- Energy Stores
- More Energy Stores
- Types of Energy Transfer
- Dealing with Energy Stores and Transfers
- Energy Transfers for an Object Projected Upwards
- Energy Transfers for a Moving Object Hitting an Obstacle
- Energy Transfers for an Object Accelerated by A Constant Force
- Energy Transfers for a Vehicle Slowing Down
- Energy Transfers for a Kettle Heating Up Water
- Energy Transfers for a Balloon Bursting
- Conservation and Wasted Energy
- Efficiency
- Sankey Diagrams
- Reducing Unwanted Energy Losses
- Kinetic Energy
- Kinetic Energy: Example A
- Kinetic Energy: Example B
- Gravitational Potential Energy
- Gravitational: Example A
- Gravitational: Example B
- Gravitational: Example C
- Elastic Potential Energy
- Elastic: Example A
- Elastic: Example B
- Specific Heat Capacity
- Specific Heat Capacity: Example A
- Specific Heat Capacity: Example B
- Power
- Power: Example A
- Power Example B
- Power of a Motor
- Convection
- Conduction
- Energy Efficient Buildings
- Renewable and Non-Renewable Energy Resources
- Generating Electricity in a Power Station
- Fossil Fuel Energy Resources
- Nuclear Energy Resources
- Renewable Energy Resources – Wind
- Renewable Energy Resources - Solar

Find links to all these videos from one page → GCSEPhysicsOnline.com/**video-list**

- Renewable Energy Resources - Geothermal
- Circuit Symbols
- The Rope Loop Model
- Electric Charge and Current
- Conventional Current
- Charge and Current: Example A
- Charge and Current: Example B
- Potential Difference and Resistance
- Voltage and Resistance: Example A
- Voltage and Resistance: Example B
- The Resistor
- Resistor: Example
- The Filament Lamp
- Lamp: Example A
- Lamp: Example B
- The Diode
- The Van de Graaff Generator
- Reading an Oscilloscope
- Oscilloscope: Example
- Density
- Density: Example A
- Density: Example B
- The Particle Model
- Building the Lego NZ Graph
- Parts of The Atom
- Representing Atoms
- Isotopes
- Representing Atoms: Example
- The Alpha Scattering Experiment
- Scalars and Vectors
- Contact and Non-Contact Forces
- Weight
- Friction and Drag
- Normal Contact Force
- Identifying Forces: Example
- Calculating Resultant Forces
- Calculating Resultant Forces: Example A
- Calculating Resultant Forces: Example B
- Distance and Displacement
- Distance: Example
- Speed
- Calculating Speeds of Real Objects
- Speed: Example A
- Speed: Example B
- Converting from mph to m/s
- Transverse and Longitudinal Waves
- Transverse and Longitudinal Waves
- Wave Period and Frequency
- Waves: Example A
- Waves: Example B
- Wave Speed Equation
- Wave Speed Equation: Example A
- Wave Speed Equation: Example B
- Measuring the Speed of Sound in Air
- Measuring the Speed of Water Waves
- Reflection
- Reflection: Example
- Interaction of Waves
- Sound and the Ear
- Echo Sounding, Sonar
- Ultrasound Scanning
- Seismic Waves
- Colour Filters
- Reflection of Colour
- Colour: Example
- Colour Mixing (with LEDs)
- Permanent Magnets and their Fields
- Specific Heat Capacity of Solids
- Specific Heat Capacity of Solids RESULTS
- Specific Heat Capacity of Liquids
- Specific Heat Capacity of Liquids RESULTS
- Resistance of a Length of Wire
- Resistance of a Length of Wire RESULTS
- Resistors in Series and Parallel
- Resistors in Series and Parallel RESULTS
- Lamps in Series and Parallel
- Lamps in Series and Parallel RESULTS
- IV Characteristics of a Resistor
- IV Characteristics of a Resistor RESULTS
- IV Characteristics of a Lamp
- IV Characteristics of a Lamp RESULTS
- IV Characteristics of a Diode
- IV Characteristics of a Diode RESULTS
- Characteristics of a Wire
- Characteristics of a Wire RESULTS
- Density of Regular and Irregular Objects
- Density of Regular and Irregular Objects RESULTS

Many of these videos are exclusive to my website (you won't find them on YouTube)

- The LDR
- LDR: Example
- The Thermistor
- Thermistor: Example
- LDRs And Thermistors in Circuits
- Current and Voltage in Series Circuits
- Current and Voltage in Parallel Circuits
- Resistance of Resistor Combinations
- Calculating Resistance in Parallel
- Calculating Resistance in Parallel: Example
- Circuits: Example A
- Circuits: Example B
- Circuits: Example C
- Circuits: Example D
- Circuits: Example E
- Building Real Circuits
- Alternating Current and Domestic Mains Electricity
- Three Core Cable
- Plugs and Fuses
- Safety Devices - The Circuit Breaker
- Safety Devices - The RCCB
- Electrical Power in Circuits (P=VI)
- Power: Example A
- Power: Example B
- Electrical Power in Circuits (P=I2R)
- Power: Example C
- Power: Example D
- Energy Transfer in Circuits (E=QV)
- Energy Transfer in Circuits (E=IVt)
- Energy Transfer in Circuits: Example
- Power of Domestic Appliances
- The National Grid and Transformers
- Static Electricity
- Electric Fields
- Electric Field Between Parallel Plates
- Uses of Static Electricity
- Solids, Liquids and Gases
- Changing State and Internal Energy
- Specific Latent Heat
- Specific Latent Heat: Example A
- Specific Latent Heat: Example B
- Heating and Cooling Curves
- Pressure and Temperature of a Gas
- Pressure and Volume of a Gas
- Pressure and Volume of a Gas: Example A
- Pressure and Volume of a Gas: Example B
- Temperature of a Compressed Gas
- Alpha, Beta and Gamma Radiation
- Real Radioactive Sources
- Beta Plus
- Activity and Count-Rate
- Uses of Radiation
- Alpha Decay Equations
- Alpha Decay: Example
- Beta Decay Equations
- Beta Decay: Example
- Gamma Decay Equations
- Half-life of Radioisotopes
- Half-life: Example A
- Half-life: Example B
- Hazards of Radiation
- Background Radiation
- Uses of Radiation in Hospitals
- PET Scanners
- Nuclear Fission
- Fission Reactors
- Nuclear Fusion
- Drawing Free Body Diagrams
- Drawing Free Body Diagrams: Example
- Resolving Forces
- Vector Diagrams
- Resolving Forces: Example A
- Resolving Forces: Example B
- Parallelogram of Forces
- Work Done
- Work Done: Example A
- Work Done: Example B
- Deformation and the Spring Constant
- Stretching Springs - The Energy Stored
- Springs: Example A
- Springs: Example B
- Moments and Equilibrium
- Moments in Equilibrium: Example A
- Moments in Equilibrium: Example B
- Levers
- Gears
- Pressure of a Fluid
- Pressure at a Depth
- Velocity
- Velocity: Example A
- Velocity: Example B
- Acceleration
- Acceleration: Example A
- Acceleration: Example B
- Motion in a Circle
- Distance-Time Graphs
- Distance-Time Graphs: Example

- Measuring Speed from a Curved Distance-Time Graph
- Velocity-Time Graphs
- Velocity-Time Graphs: Example A
- Velocity-Time Graphs: Example B
- Vehicle Stopping Distances
- Measuring Reaction Time
- Pressure at a Depth: Example A
- Pressure at a Depth: Example B
- Upthrust, Floating and Sinking
- Upthrust: Example
- Hydraulics Explained
- Demonstration of a Simple Hydraulic System
- The Earth's Atmosphere
- v^2-u^2 = 2as
- v^2-u^2 = 2as: Example A
- v^2-u^2 = 2as: Example B
- Deriving v^2-u^2 = 2as
- Terminal Velocity
- Terminal Velocity Explained
- Terminal Velocity: Example
- Newton's First Law
- Newton's Second Law
- F=ma and Inertial Mass
- F=ma: Example A
- F=ma: Example B
- Newton's Third Law
- Newton's Third Law: Example
- Momentum
- Momentum: Example
- Momentum Calculations
- Momentum Calculations: Example A
- Momentum Calculations: Example B
- Rate of Change of Momentum
- Safety Features and Momentum
- The Electromagnetic Spectrum
- Radio, Micro, IR And Visible
- UV, X-Rays, Gamma and Hazards
- Refraction
- Refraction Explained
- Refraction: Example
- Total Internal Reflection
- Refraction Equations
- How Radios Work
- Lenses
- Ray Diagrams - Convex (Converging) Lens
- Ray Diagrams - Convex Magnifying
- Convex: Example
- Ray Diagrams - Concave (Diverging) Lens
- Concave: Example
- Magnification, Real and Virtual Images
- Magnification: Example
- Temperature and Infrared
- Infrared Emission from a Leslie Cylinder
- Temperature of The Earth
- Magnetic Fields around Wires and Solenoids
- Electromagnet: Example
- The Motor Effect and Fleming's Left-Hand Rule
- Force on a Wire: Example
- Force on a Particle
- How Electric Motors Work
- How Loudspeakers Work
- The Generator Effect
- Alternators and Dynamos and Graphs
- PD Graph: Example
- How a Microphone Works
- Why Transformers Are Used
- How a Transformer Works
- The Transformer Equations
- Transformers: Example A
- Transformers: Example B
- Milky Way, Solar System, Planets and Moons
- Lifecycle of a Star Like Our Sun
- The Lifecycle of Massive Stars
- Fusion in Stars
- Circular Orbits
- Red Shift and The Big Bang
- Dark Matter and Dark Energy
- Effectiveness of Thermal Insulators
- Effectiveness of Thermal Insulators RESULTS
- Investigating Convection
- Investigating Conduction
- Temperature-Time Graph for Melting Ice
- The Power of a Person and RESULTS
- How an Insulator can be Charged by Friction
- Gases - Boyle's Law Practical
- Gases - Boyle's Law RESULTS
- Half-life of a Model Radioactive Source
- The Penetration of Different Types of Radiation
- Trolley on a Ramp and RESULTS
- Terminal Speed of a Falling Object and RESULTS

- Investigating Acceleration by Varying Force (Constant Mass)
- Investigating Acceleration by Varying Force (Constant Mass) RESULTS
- Investigating Acceleration by Varying Mass (Constant Force)
- Investigating Acceleration by Varying Mass (Constant Force) RESULTS
- Force and Extension for a Spring
- Force and Extension for a Spring RESULTS
- Force and Extension for Rubber
- Force and Extension for Rubber RESULTS
- The Principle of Moments and RESULTS
- Centre of Mass of a 2D Shape and RESULTS
- Water Waves (Frequency and Wavelength) Ripple Tank
- Water Waves (Speed and Distance) Gratnells Tray
- Water Waves (Speed and Distance) Ripple Tank
- Waves in a Solid and RESULTS
- Speed of Sound in Air
- The Frequency of Sound Using an Oscilloscope
- Refraction of Light
- Refraction of Light RESULTS
- Refraction of Light (and calculating Refractive Index) RESULTS
- Reflection of Light (and RESULTS)
- Infrared Radiated by a Surface
- Infrared Radiated by a Surface RESULTS
- Infrared Absorbed by a Surface and RESULTS
- Electromagnet Investigation and RESULTS
- The Magnetic Field Around a Magnet and RESULTS
- The Output of a Transformer and RESULTS
- And many more…

Sign up for the individual Premium Plan to watch any video whenever you need it.

or

School Subscriptions are also available - just ask your teacher to sign up so your whole class can access these resources.

Content

Physics Topics

As you study GCSE Physics, you need to make sure that you cover all the material in each section of the specification. For each topic, I have made a checklist for you to complete as you revise, helping identify aspects of that topic you need to be more familiar with before the exams begin.

I've colour coded each topic in this book and also across my website and videos.

- Energy
- Electricity
- Particle Model and Gases
- Atomic Structure
- Forces
- Waves
- Magnetism and Electromagnetism
- Space Physics

H = Higher Tier in Bold

Content in bold is only for those taking the Higher Tier exam papers (grades 4-9). If you are sitting the Foundation Tier exams (grades 1-5) then you will not be assessed on these topics.

P = Physics GCSE Highlighted in Light Blue

Material highlighted in light blue throughout this book is only for those taking Physics as part of Triple Science. If you are taking Combined Trilogy this content won't be covered as part of your course.

Energy

Find videos for all these topics by scanning ← this or going here → GCSEPhysicsOnline.com/**aqa-energy**

Use these checklists to make sure you revise all parts of the course - and identify areas for further study.

	Energy changes and stores	R	A	G
	Describe all the changes involved in the way energy is stored for: ▪ an object projected upwards ▪ a moving object hitting an obstacle ▪ an object accelerated by a constant force ▪ a vehicle slowing down ▪ a kettle heating up water			✓
	Calculate the changes in energy stored by a system when: ▪ it is heated ▪ work is done by forces ▪ work is done when a current flows		✓	
	Use calculations to show how the overall energy in a system (an object or group of objects) is redistributed when the system changes.			✓
	Calculate the amount of energy associated with a moving object: kinetic energy = ½ x mass x speed² $E_k = \frac{1}{2} m v^2$			
	Calculate the amount of energy associated with stretching (or compressing) a spring: elastic potential energy = ½ x spring constant x extension² $E_e = \frac{1}{2} k e^2$			
	Calculate the amount of energy associated with an object raised above ground level: gravitational potential energy = mass x gravitational field strength x height $E_p = m g h$			
	Calculate the amount of energy stored or released from a system as its temperature changes: change in thermal energy = mass x specific heat capacity x change in temperature $\Delta E = m c \Delta\theta$			
	Recall that the specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.			

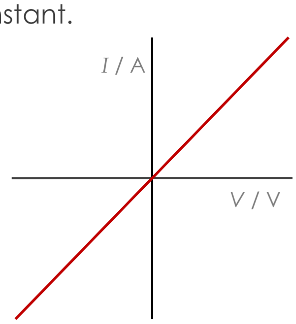
Red for less confident → Green if you're happy

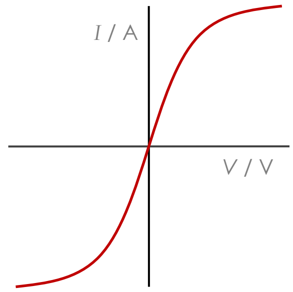
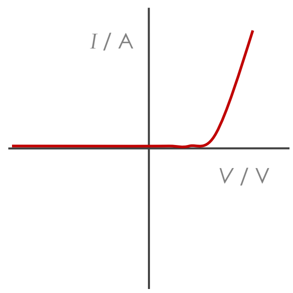
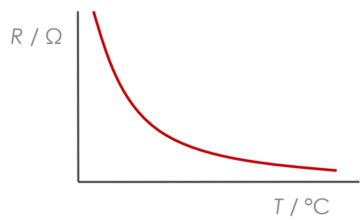
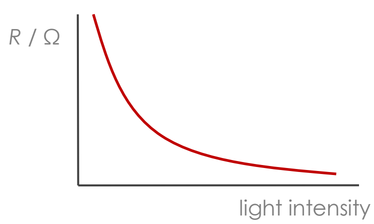
	Recall that power is defined as the rate at which energy is transferred, or at which work is done, and that an energy transfer of one joule per second is equal to one watt of power.			
	Use the equations: power = energy transferred / time $P = E / t$ power = work done / time $P = W / t$			
	Give examples that illustrate the definition of power. For example, comparing two electric motors that lift a weight through the same height but in a different time.			
Conservation and dissipation of energy		R	A	G
	Describe, with examples, that where there are energy transfers in a closed system there is no net change to the total energy of that system (energy cannot be created or destroyed).			
	Describe, with examples, how in all system changes energy is dissipated so it is stored in less useful ways (the energy is 'wasted').			
	Explain ways of reducing unwanted energy transfers. For example, through lubrication or thermal insulation.			
	Realise the higher the thermal conductivity of a material the higher the rate of energy transfer by conduction across the material. [You do not need to know the definition of thermal conductivity]			
	Describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls.			
	Calculate the energy efficiency for an energy transfer using: efficiency = useful output energy transfer / total input energy transfer efficiency = useful power output / total power input			
H	**Describe ways to increase the efficiency of an intended energy transfer.**			

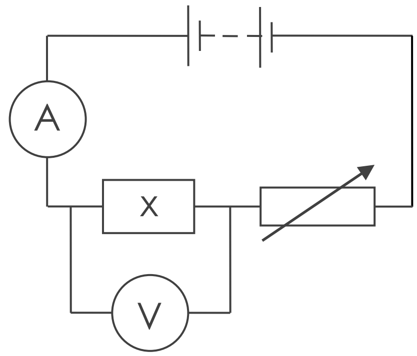
This one is only for higher tier students.

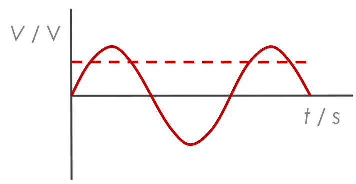
National and global energy resources		R	A	G
	Describe the main energy resources available for use on Earth including fossil fuels (coal, oil, gas), nuclear fuels and renewable energy resources (biofuel, wind, hydro-electric, geothermal, tides, waves and the Sun). [Descriptions of how these resources are used to generate electricity are not required]			
	Distinguish between energy resources that are renewable (one that is, or can be, replenished as it is used) and non-renewable.			
	Compare ways that energy resources are used in transport, electricity generation and heating.			
	Understand why some energy resources are more reliable than others.			
	Describe and consider the environmental impact arising from using these energy resources.			
	Explain patterns and trends in the use of energy resources.			
	Show that science has the ability to identify environmental issues arising from the use of energy resources but not always the power to deal with the issues because of political, social or economic considerations.			

Electricity

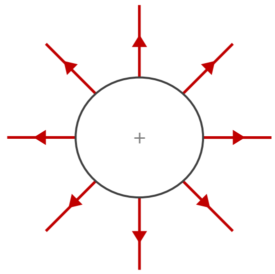
Current, potential difference and resistance		R	A	G
	Draw and use standard circuit symbols. [Please see the Common Circuit Symbols table at the end of this document]			
	Realise that for charge to flow through a closed circuit there must be a source of potential difference (also known as voltage) and that the size of the electric current is the rate of flow of electric charge.			
	Use the equation: charge = current x time $Q = I\,t$			
	Recognise that the current has the same value at any point in a single closed loop of a circuit.			
	The current through a component depends on both the resistance of the component and the potential difference across it. The greater the resistance, the smaller the current for a given potential difference.			
	Use the equation: potential difference = current x resistance $V = I\,R$			
	Explain that for some resistors the resistance remains constant but in others it can change depending on the current through it. The current through an ohmic conductor at constant temperature is directly proportional to the potential difference across it, so its resistance remains constant. 			
	Devices such as filament lamps, diodes, thermistors and light dependent resistors change their resistance.			

	The resistance of a filament lamp increases as the current through it increases.  			
	Current only flows through a diode in one direction because it has a very high resistance in the other direction.  			
	The resistance of a thermistor decreases as the temperature increases.  You should recognise the applications of thermistors in circuits including thermostats.			
	The resistance of an LDR decreases as light intensity increases.  			
	Recall applications of LDRs in circuits including how lights are switched on when it gets dark.			

	Explain how to design and build a circuit used to measure the resistance of a component by measuring the current through it and potential difference across it, and draw an appropriate circuit diagram.  			
Series and parallel circuits		R	A	G
	Describe the difference between series and parallel circuits.			
	Understand that for components joined in series: ▪ there is the same current through each component ▪ the total potential difference of the power supply is shared between the components ▪ the total resistance of two components is the sum of resistances of each component total resistance = sum of individual resistances $R_{Total} = R_1 + R_2$			
	Understand that for components connected in parallel: ▪ the potential difference across each component is the same ▪ the total current through the whole circuit is the sum of the currents through the separate components ▪ the total resistance of two resistors is less than the resistance of the smallest individual resistor [you do not need to be able to calculate this]			
	Use circuit diagrams to construct and check series and parallel circuits containing a variety of common components.			
	Explain why adding resistors in series increases the resistance of the circuit while adding them in parallel decreases the total resistance of the circuit.			
	Explain the design and use of dc series circuits for measurement and testing purposes.			
	Calculate the potential differences, currents and resistances in series circuit problems.			

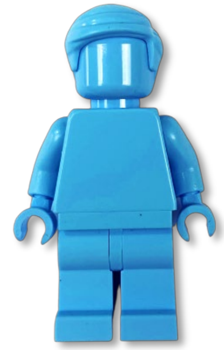
	Solve problems in circuits which include resistors in series using the concept of equivalent resistance ($R_{Total} = R_1 + R_2$).			
Domestic uses and safety		**R**	**A**	**G**
	Know that domestic electricity in the United Kingdom is an ac (alternating current) supply with a frequency of 50 Hz and is about 230 V.			
	Explain the difference between direct and alternating potential difference.  			
	Recall that most electrical appliances are connected to the mains using three-core cable: ▪ the live wire (brown) provides the alternating potential difference from the supply ▪ the neutral (blue) completes the circuit ▪ the earth wire (green and yellow stripes) is a safety wire to stop the appliance becoming live			
	Recall that: ▪ the potential difference between the live wire and earth (0 V) is about 230 V ▪ the neutral wire is at, or close to, earth potential (0 V) ▪ the earth wire is at 0 V and only carries a current if there is a fault			
	Explain that a live wire may be dangerous even when a switch in the mains circuit is open.			
	Explain the dangers of providing any connection between the live wire and earth.			
Energy transfers		**R**	**A**	**G**
	Explain how the power of a circuit device (the energy transferred over a period of time) is related to the potential difference across it and the current through it.			

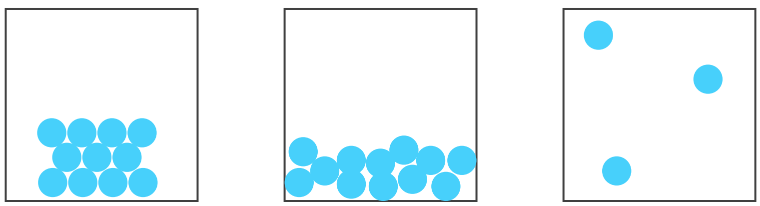
	Calculate the electrical power transferred using: power = potential difference x current $P = V I$ power = current² x resistance $P = I^2 R$			
	Describe how domestic appliances transfer energy from batteries or ac mains to the kinetic energy of motors, the thermal energy of heating devices or lighting devices.			
	Recall that work is done when charge flows in a circuit. The amount of energy transferred by electrical work can be calculated using: energy transferred = power x time $E = P t$ energy transferred = charge x potential difference $E = Q V$			
	Describe, with examples, the relationship between the power ratings of domestic appliances and the changes in stored energy when they are used.			
	Recall that the National Grid is a system of cables and transformers linking power stations to consumers.			
	Recall that step-up transformers increase the potential difference from the power station to the transmission cables. The potential difference is then decreased in a step-down transformer for domestic use.			
	Explain why the National Grid is an efficient way to transfer energy.			
Static electricity		R	A	G
P	Explain how the transfer of electrons between objects causes static electricity. When two insulating material are rubbed together they become electrically charged. This is because negative electrons are rubbed off one material (which then becomes positive) and onto a material which gains electrons (equally negatively charged).			
P	Two electrically charged objects will exert a non-contact force on each other when they are brought close together. Similar charges repel while opposite charges attract.			
P	Describe the production of static electricity (and sparks) by rubbing materials together.			

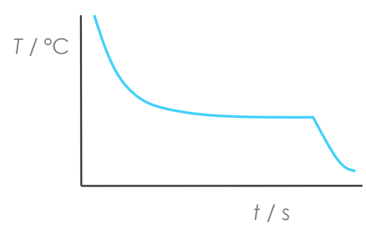
P	Describe evidence that charged objects exert forces of attraction or repulsion when not in contact.			
P	Explain the concept of an electric field. A charged object creates a field around itself that is strongest close to the object. A second object placed in the field experiences a force which is stronger closer to the object.			
P	Draw the electric field pattern around an isolated charged sphere. 			
P	Explain how the concept of an electric field explains the non-contact forces between charged objects as well as electrostatic phenomena including sparking.			

These sections in blue are only for students studying Physics (not Combined Trilogy).

Particle Model & Gases



	Changes of state and the particle model	R	A	G
	Calculate the density of materials using the equation: density = mass / volume $\rho = m / V$			
	Realise that the particle model can be used to explain the different states of matter and differences in density due to the arrangement of atoms or molecules.			
	Draw and recognise simple diagrams to model solids, liquids and gases. 			
	Describe how when materials change state their mass is conserved (including melting, evaporating, boiling, condensing, freezing and subliming).			
	Realise that changes of state are physical changes not chemical changes, as the material will recover its original properties if the change is reversed.			
	Internal energy and energy transfers	**R**	**A**	**G**
	Recall that the energy stored inside a system by the particles is called the internal energy and can be defined as the total kinetic and potential energy of all the particles that make up a system.			
	Recall that heating a system changes the energy stored and this either raises the temperature or changes the state.			
	The amount the temperature of a system increases is related to the type of material, its mass and the energy input. This can be calculated by the following equation: change in thermal energy = mass x specific heat capacity x change in temperature $\Delta E = m\ c\ \Delta\theta$			
	Define the specific heat capacity of a substance as the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius.			

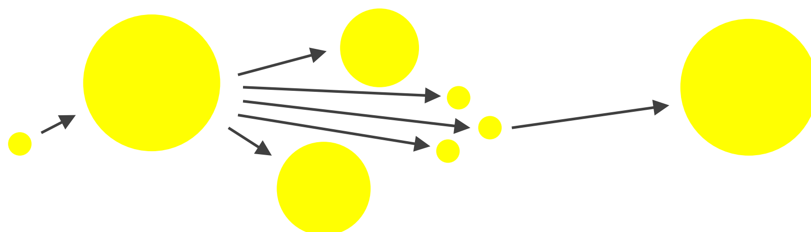
	Recall that when a change of state occurs the energy inputted changes the internal energy but not the temperature of the substance.			
	Define the specific latent heat of a substance as the amount of energy required to change the state of one kilogram of the substance with no change in temperature.			
	Use the equation for a change of state: energy for a change of state = mass x specific latent heat $E = m L$			
	Interpret heating and cooling curves that include changes of state. 			
Particle model and pressure		R	A	G
	Explain how the motion of molecules in a gas is related to both its temperature and pressure (this is related to the average kinetic energy of the molecules that are in constant random motion).			
	Explain qualitatively that there is a proportional relationship between pressure and temperature of a gas at constant volume.			
P	Recall that the pressure of a gas produces a net force at right angles to the wall of the container (or surface) containing the gas.			
P	Use the particle model to explain how increasing the volume of a gas can lead to a decrease in pressure if it remains at a constant temperature.			
P	Use the relationship: pressure x volume = constant $p V = constant$			
P	For a fixed mass of gas at constant temperature calculate the change in pressure (or volume) of a gas if its volume (or pressure) changes.			
P H	**Explain how doing work (transferring energy by a force) on a gas increases its internal energy which can cause its temperature to increase, for example, using a bicycle pump.**			

Atomic Structure

Atoms and isotopes		R	A	G
	Recall that the radius of an atom is about 1 x 10^{-10} m and the radius of the nucleus is about 10 000 times smaller. Most of the mass of an atom is concentrated in the nucleus which is made up of protons and neutrons, surrounded by negatively charged electrons.			
	Recall that the electrons are arranged in different energy levels at different distances from the nucleus. Electrons can absorb electromagnetic radiation and move further away from the nucleus or drop to a lower energy level by the emission of electromagnetic radiation.			
	Recall that atoms have no overall charge and contain the same number of protons and electrons, with the number of protons called the atomic number. The total number of protons and neutrons is called the mass number. If an atom loses one or more electrons it then becomes a positive ion.			
	Represent atoms in the following way: mass number ^{12} atomic number $_{6}$C $^{12}_{6}C$			
	Define isotopes as atoms of the same element with a different number of neutrons.			
	Describe how new experimental evidence may lead to a scientific model being changed or updated, in this example: ▪ atoms were first thought of as tiny spheres that could not be broken up ▪ after the electron was discovered the model that was used was called the plum pudding model. This is a ball of positive charge with negative charges embedded throughout the atom ▪ the alpha scattering experiments then showed that the mass of an atom was concentrated in a central charged nucleus ▪ Niels Bohr then adapted this nuclear model by suggesting that the electrons orbit the nucleus at specific distances. His theoretical calculations agreed with experimental evidence ▪ later experiments found that the positive nucleus could be subdivided into smaller positive particles called protons ▪ James Chadwick then discovered neutrons about twenty years after the discovery of the nucleus			

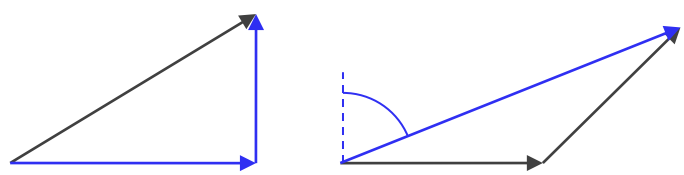
		R	A	G
	Explain how evidence from the scattering experiments led to a change in the atomic model, and differences in the plum pudding and nuclear model.			
Atoms and nuclear radiation		R	A	G
	Recall that some unstable atomic nuclei may give out radiation as they change to become more stable. This is called radioactive decay.			
	Define activity as the rate at which a source of unstable nuclei decays.			
	Define count-rate as the number of decays recorded each second by a detector (for example, a Geiger-Muller tube).			
	Recall the properties of alpha, beta and gamma radiation including their penetration through materials, their range in air and their ionising powers: ▪ alpha (α) consists of two neutrons and two protons ▪ beta (β) is a high speed electron emitted from the nucleus when a neutron decays to a proton ▪ gamma (γ) is a wave of electromagnetic radiation emitted from the nucleus ▪ neutrons (n) can also be emitted			
	Apply your knowledge to the uses of radiation and evaluate the best source or radiation for a given situation.			
	Use the names and symbols of common nuclei and particles to write balanced nuclear equations for alpha and beta decays. Alpha decay $^{200}_{80}X \longrightarrow ^{196}_{78}Y + ^{4}_{2}He$ Beta decay $^{20}_{8}W \longrightarrow ^{20}_{9}Z + ^{0}_{-1}e$ Gamma decay The mass or charge of the nucleus does not change [The identification of daughter nuclei from such equations is not required]			
	Use the names and symbols of common nuclei and particles to write balanced equations for alpha and beta decays. [The identification of daughter nuclei from such equations is not required]			
	Explain the concept of half-life and how this is related to the random nature of radioactive decay.			

	Define the half-life of a radioactive isotope as: ▪ the time it takes for the number of nuclei of the isotope in a sample to halve or ▪ the time it takes for the count-rate, or activity, from a sample containing the radioactive isotope to fall to half its initial level			
	Determine the half-life of a radioactive isotope from information given in a question.			
H	**Calculate the net decline, as a ratio, after a given number of half-lives.**			
	Define contamination as the unwanted presence of material containing radioactive atoms on other material while irradiation is the process of exposing an object to nuclear radiation.			
	Compare the hazards associated with contamination versus irradiation, and that suitable precautions must be taken to protect against any hazards from the radioactive sources used in irradiation.			
	Understand that it is important for the findings of research into the effects of radiation on humans to be published, shared with scientists and peer reviewed.			
Hazards and uses of radioactive emissions and of background radiation		R	A	G
P	Realise that background radiation is all around us and comes from: ▪ natural sources including cosmic rays from space and rocks underground ▪ man-made sources including medical, nuclear testing and nuclear accidents			
P	Understand that the level of background radiation and radiation dose received (measured in sieverts) depends on occupation and location. [You do not need to recall the unit of radiation dose]			
P	Realise that some radioactive isotopes have very long half-lives and explain how the hazards differ according to the half-life involved.			
P	Describe and evaluate the uses of nuclear radiation for the exploration of internal organs and control or destruction of unwanted tissue.			
P	Evaluate the perceived risks of using radiation in relation to given data and consequences.			
Nuclear fission and fusion		R	A	G
P	Define nuclear fission as the splitting of a large and unstable nucleus (usually uranium or plutonium).			

P	Realise that for fission to occur, an unstable nucleus must absorb a neutron. This then splits into two smaller daughter nuclei and also releases two or three neutrons and gamma radiation. Energy is released in this reaction in the form of kinetic energy of the fission products. The neutron released may go on to be absorbed by other unstable nuclei causing a chain reaction. In a nuclear reactor this is controlled, but in a nuclear bomb the chain reaction is uncontrolled.			
P	Draw and interpret diagrams representing nuclear fission and how a chain reaction may occur. 			
P	Define nuclear fusion as the joining of two light nuclei to form a heavier nucleus.			

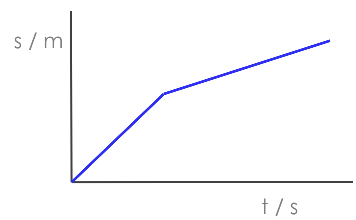
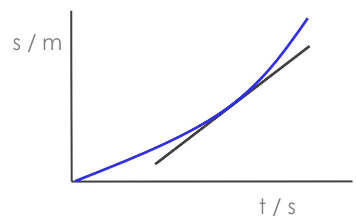
Forces

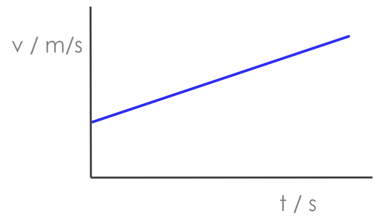
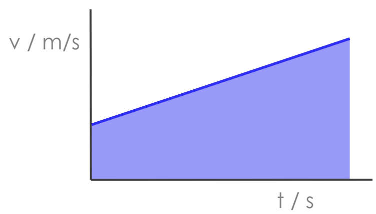
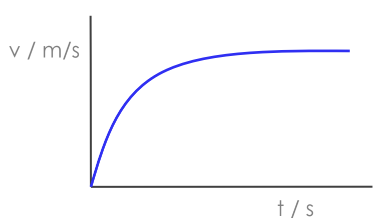
	Forces and their interactions	R	A	G
	Recall that scalars have only magnitude (size) while vectors have magnitude and direction and can be represented by arrows.			
	Recall that a force is a push or a pull that acts on an object due to its interacting with another object. For contact forces the objects are physically touching and include: ▪ friction ▪ air resistance ▪ tension ▪ normal contact force For non-contact forces the objects are physically separated and include: ▪ gravitational ▪ electrostatic ▪ magnetic			
	Recall that weight is the force acting on an object due to gravity. On Earth it is due to the gravitational field around the Earth.			
	Realise that the weight of an object also depends on the size of the gravitational field strength where that object is.			
	Calculate the weight of an object using the equation: weight = mass x gravitational field strength $W = m\ g$ The value of g will always be given in any questions, and it can be seen that weight and mass are directly proportional ($W \propto m$).			
	Recall that the weight of an object acts at a single point called the centre of mass.			
	Recall that weight can be measured with a calibrated spring-balance, also known as a newtonmeter.			
	If a number of forces act on an object, they may be replaced by a single force that has the same effect. This is called the resultant force. You should be able to calculate the resultant force of two forces that act in a straight line.			
H	**Describe examples of the forces acting on an isolated object or system.**			

H	**Use free body diagrams to show examples where several forces act on an object leading to a resultant force, or when they are balanced and the resultant force is zero.**			
H	**Resolve a single force into two components that act at right angles to each other.**			
H	**Use vector diagrams to resolve forces, show equilibrium and determine the resultant of two forces showing both magnitude and direction.** 			
Work done and energy transfer		R	A	G
	Recall that when a force causes an object to move through a distance, work is done on the object, i.e. the force does work on the object when the force causes a displacement of the object.			
	Calculate the work done by a force using: work done = force x distance (moved along the line of action of the force) $W = F s$			
	Define one joule as the work done when a force of one newton causes a displacement of one metre.			
	Describe the energy transfers involved when work is done.			
	Convert between newton metres and joules.			
	Realise that work done against frictional forces acting on an object causes the object's temperature to rise.			
Forces and elasticity		R	A	G
	Give examples of the forces involved in stretching, bending or compressing an object.			
	Explain why, for a stationary object, to change its shape by bending, stretching or compression, more than one force must be applied.			
	Describe the difference between elastic and inelastic deformation of stretched objects.			

	Recall that the extension of an elastic object, like a spring, is directly proportional to the force applied, provided the limit of proportionality is not exceeded.			
	Recall and use the equation: force = spring constant x extension $F = k\,e$ Including for the compression of an object.			
	Recall that the force that stretches or compresses an object does work and this potential energy is stored in the spring. Provided the spring is not elastically deformed the work done is equal to the elastic potential energy stored.			
	Describe the difference between a linear and non-linear relationship between force and extension.			
	Calculate a spring constant and interpret data from an investigation between force and extension.			
	Calculate the amount of energy associated with stretching (or compressing) a spring: elastic potential energy = ½ x spring constant x extension^2 $E_e = \frac{1}{2}\,k\,e^2$			
Moments, levers and gears		R	A	G
P	Recall that a force, or system of forces, may cause an object to rotate and describe examples of this.			
P	Recall that the turning effect of a force is called the moment of a force and is equal to the force multiplied by the perpendicular distance from the pivot to the line of action of the force.			
P	Apply the equation: moment of a force = force x distance $M = F\,d$			
P	Recall that if an object is balanced, the total clockwise moment about the pivot equals the total anti-clockwise moment about the pivot.			
P	Calculate the size of a force, or its distance from a pivot, if an object is balanced.			
P	Explain how a simple lever, or simple gear system, can transmit the rotational effect of a force.			
Pressure and pressure differences in fluids		R	A	G
P	Realise that a pressure in a fluid (liquids and gases) causes a force at right angles to any surface.			

P	Calculate the pressure of a fluid on a surface using the equation: pressure = force normal to the surface / area of the surface $p = F / A$			
P H	**Calculate the pressure due to a column of liquid using the equation:** **pressure = height of column x density x gravitational field strength** $p = h \rho g$			
P H	**Explain why, in a liquid, pressure increases with the height of the column and density of the liquid.**			
P H	**Calculate the differences in pressure at different depths in a liquid.**			
P H	**Recall that, for a submerged object, it experiences a greater pressure at the bottom than the top. This creates a resultant force upwards, called upthrust.**			
P H	**Describe factors that influence floating and sinking.**			
P	Describe a simple model of the Earth's atmosphere and atmospheric pressure. ▪ the atmosphere is a thin layer or air that gets less dense with altitude ▪ the air molecules colliding with a surface cause pressure			
P	Explain why atmospheric pressure varies with height above the Earth's surface. ▪ the air molecules colliding with a surface cause pressure ▪ the number of air molecules (and the weight or air molecules above that point) decreases with increasing height ▪ so atmospheric pressure decreases with increasing height			
	Forces and motion	R	A	G
	Recall that distance is a scalar quantity and it is how far an object moves. Displacement includes both the distance an object moves and the direction it moves from its start point, so is a vector.			
	Express displacements with both magnitude and direction.			
	Recall that speed is a scalar quantity.			
	Recall that the speed of a person depends on age, fitness and terrain. Typical values are in the region of: ▪ walking 1.5 m/s ▪ running 3 m/s ▪ cycling 6 m/s			

	Recall that the speed of sound in air is about 330 m/s.			
	Take measurements of distance and time to calculate speeds.			
	For an object travelling at a constant speed use the equation: distance travelled = speed x time $s = v\ t$			
	Calculate the average speed for non-uniform motion.			
	Define the velocity of an object as its speed in a given direction. Velocity is a vector quantity.			
H	**Explain qualitatively that motion in a circle involves constant speed but changing velocity.**			
	Realise that if an object moves along a straight path, the distance travelled can be represented on a distance-time graph and its speed can be determined from the gradient of the line.  			
H	**Determine the speed of an accelerating object by drawing a tangent to the line on a distance-time graph and measuring the gradient of this line.**  			
	Draw distance-time graphs from measurements and interpret data from them.			
	Calculate the acceleration of an object by using: acceleration = change in velocity / time taken $a = \Delta v\ /\ t$			
	Realise that an object slowing down is decelerating.			

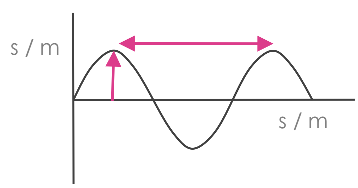
	Estimate the magnitude of everyday accelerations.			
	Draw velocity-time graphs from measurements and interpret data from them.			
	Calculate the acceleration of an object from the gradient of a velocity-time graph. 			
H	**Calculate the distance travelled (displacement) by an object from the area under a velocity-time graph (including by counting squares if appropriate).** 			
	For uniform motion apply the following equation: final velocity^2 – initial velocity^2 = 2 x acceleration x distance $v^2 - u^2 = 2\,a\,s$			
	Recall that near the Earth's surface, any object falling freely under gravity has an acceleration of about 9.8 m/s^2.			
	Recall that an object falling through a fluid initially accelerates due to the force of gravity. Eventually the resultant force on the object will be zero because of air resistance and it will move at its terminal velocity.			
P	Draw and interpret velocity-time graphs for objects that reach terminal velocity and explain the changing motion in terms of the forces acting on them. 			

	Define Newton's First Law: If the resultant force acting on an object is zero and the object is: ▪ stationary, the object remains stationary ▪ moving, the object continues to move at the same velocity E.g. if a vehicle moves at a steady speed it is because the driving force is balanced by the resistive forces, and the velocity of an object will only change if a resultant force acts on the object.			
	Apply Newton's First Law to explain the motion of objects with a uniform velocity and objects where the speed or direction changes.			
H	**Recall that the tendency of objects to continue in their state of rest, or uniform motion, is called inertia.**			
	Define Newton's Second Law: The acceleration of an object is proportional to the resultant force acting on the object and inversely proportional to the mass of the object. resultant force = mass x acceleration $F = m\,a$			
H	**Explain that inertial mass is a measure of how difficult it is to change the velocity of an object and is defined as the ratio of force over acceleration.**			
	Estimate the speed, acceleration and forces involved in large accelerations for everyday road transport, using the **~** symbol to represent an approximate value.			
	Define Newton's Third Law: Whenever two objects interact, the forces they exert on each other are equal and opposite.			
	Apply Newton's Third Law to examples of equilibrium situations.			
	Define the stopping distance of a vehicle as the sum of the distances the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance).			
P	Estimate how the distance for a vehicle to make an emergency stop varies over a range of typical speeds for that vehicle.			
P	Interpret graphs relating speed to stopping distance for a range of vehicles.			
	Recall that reaction times for people range from 0.2 s to 0.9 s and may be affected by tiredness, alcohol, drugs and distractions.			

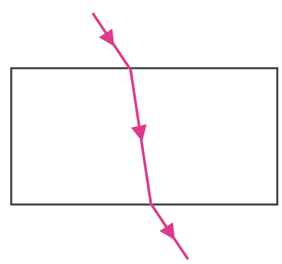
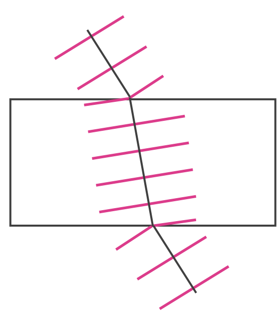
	Explain methods used to measure human reaction times.			
	Evaluate and interpret measurements from simple methods to measure reaction times of different students.			
	Evaluate the effect of various factors on reaction times from given data.			
	Recall that the braking distance of a vehicle can be affected by adverse road and weather conditions (wet and icy) and the poor condition of the vehicle (limited to brakes and tyres).			
	Explain the factors that affect the distance required for vehicles to come to rest in an emergency and the implications for safety.			
	Estimate how the distance required for road vehicles to stop in an emergency varies over a range of typical speeds.			
	Recall that when a force is applied to the brakes of a vehicle, work done by the friction force between the brake pads and the brake disc reduces the kinetic energy of the vehicle and increases the temperature of the brakes.			
	Realise that the greater the speed of a vehicle the greater the braking force needed to stop the vehicle in a certain distance. The greater the braking force the greater the deceleration, which may lead to brakes overheating or loss of control.			
H	**Estimate the forces involved in the deceleration of road vehicles in typical situations on public roads.**			
Momentum		R	A	G
H	**Define momentum as:** **momentum = mass x velocity** $p = m\,v$			
H	**Define the conservation of momentum as in a closed system the total momentum before an event is equal to the total momentum after the event.**			
H	**Describe and explain examples of momentum in an event (such as a collision).**			
P H	**Complete momentum calculations involving an event such as the collision of two trolleys.**			

P H	Recall that when a force acts on a moving object (or one that is able to move) a change in momentum occurs. The equations F = ma and a = Δv / t combine to give the equation: **F = m Δv / t** Meaning that force equals the rate of change of momentum.			
P H	Explain safety features such as air bags, seat belts, gym crash mats and cycle helmets with reference to the rate of change of momentum.			
P H	Apply equations relating force, mass, velocity and acceleration to explain how the changes involved are inter-related.			

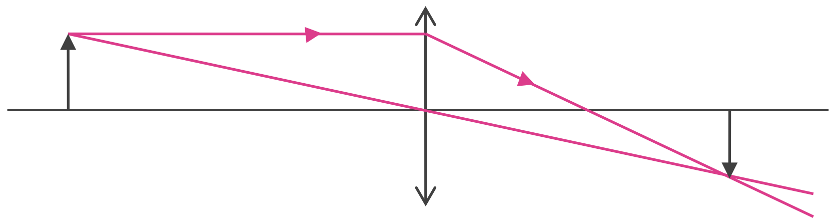
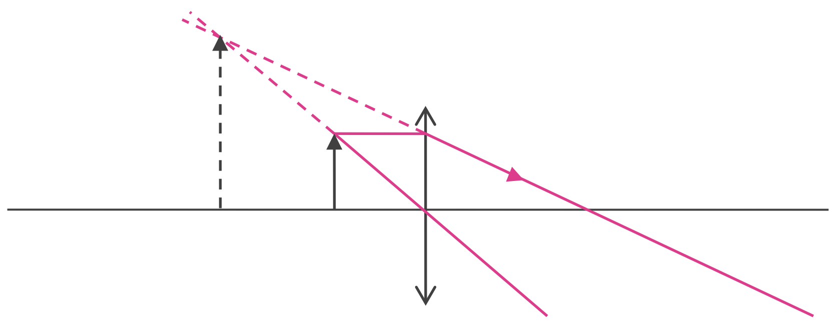
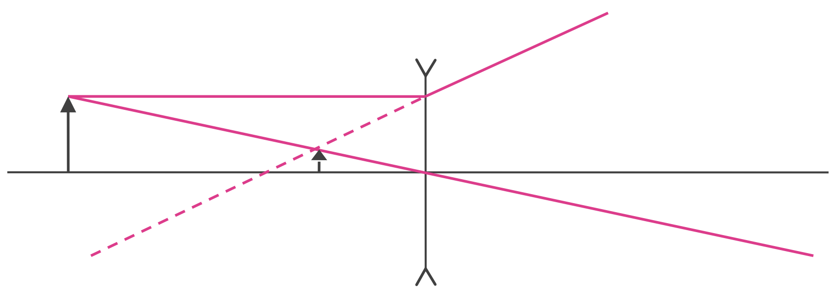
Waves

	Waves in air, fluids and solids	R	A	G
	Describe the differences between longitudinal and transverse waves. Ripples on the surface of water are an example of transverse waves, while sound waves travelling through air show areas of compression and rarefaction so are longitudinal.			
	Describe evidence for both water and sound waves that it is the wave and not the water or air that is travelling.			
	Describe the motion of a wave in terms of amplitude, wavelength, frequency and period. ▪ the amplitude of a wave is defined as the maximum displacement of a point on a wave away from its undisturbed position ▪ the wavelength of a wave is the distance from a point on one wave to the equivalent position on the adjacent wave ▪ the frequency of a wave is the number of waves passing a point each second			
	Use the equation: period = 1 / frequency $T = 1 / f$			
	Use the equation for all waves: wave speed = frequency x wavelength $v = f \lambda$			
	Identify wavelength and amplitude from diagrams. 			
	Describe a method to measure the speed of sound waves in air.			
	Describe a method to measure the speed of ripples on a water surface.			
P	Show how changes in velocity, frequency and wavelength are inter-related in the transmission of sound waves from one medium to another.			

P	Recall that waves can be reflected, absorbed or transmitted at the boundary between two different materials.			
P	Construct ray diagrams to illustrate the reflection of a wave at a surface.			
P	Describe the effects of reflection, transmission and absorption at a material interface.			
P H	**Recall that sound waves travel through solids by causing vibrations in the solid.**			
P H	**Recall that in the ear, sound waves cause the ear drum and other parts of the ear to vibrate which causes the sensation of sound. This only works over a limited range of frequencies (20 Hz to 20 000 Hz in humans).** **Describe, with examples, processes that convert wave disturbances between sound waves and vibrations in solids (including the ear).** **Explain why such processes can only be detected over a limited frequency range.**			
P H	**Explain, in qualitative terms, how waves can be used for detection and exploration of structures that are hidden from direct observation.**			
P H	**Recall that ultrasound waves have a frequency higher than the audible range of humans (above 20 kHz).** **They are partially reflected when they meet a boundary between two different surfaces and the time taken for the reflected signal to be recorded at a detector is used to calculate the distance to the boundary. They are used in medical imaging and industrial imaging.**			
P H	**Recall that seismic waves are produced in earthquakes and provide evidence for the structure and size of the Earth's core.** ▪ **P-waves are longitudinal and travel at different speeds through liquids and solids** ▪ **S-waves are transverse so can only travel through solids** **The study of seismic waves allowed scientists to discover new parts of the Earth which are otherwise hidden from direct observation.**			
P H	**Recall that echo sounding is used to detect objects in deep water and measure the depth of water.**			
Electromagnetic waves		R	A	G
	Recall that electromagnetic waves are transverse and form a continuous spectrum. They all travel at the same speed through a vacuum.			

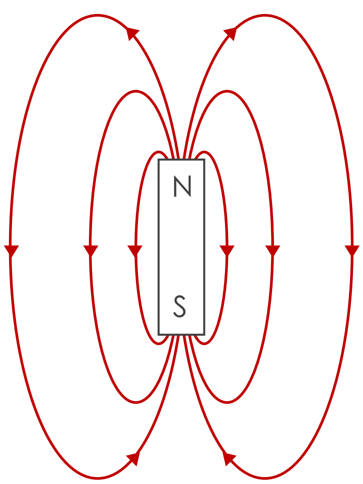
	Recall the order of the EM spectrum: Long wavelength · Radio · Low frequency Microwaves Infrared Visible Ultraviolet X-rays Short wavelength · Gamma · High frequency			
	Realise that our eyes only detect visible light which is a limited range of electromagnetic waves			
	Give examples that illustrate the transfer or energy by EM waves.			
H	**Realise that different substances absorb, transmit, reflect or refract EM waves in ways that vary with their wavelength.** **Some effects are due to the different velocities of the waves in different substances.**			
	Construct ray diagrams to illustrate refraction of waves at the boundary between two media. 			
H	**Explain refraction using wave front diagrams and the change of speed that occurs when a wave travels from one medium to another.** 			
H	**Describe how radio waves can be produced by oscillations in electrical circuits. These radio waves can then be absorbed by another circuit where they cause an alternating current with the same frequency.**			

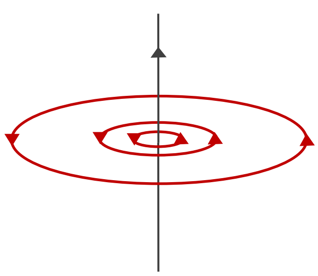
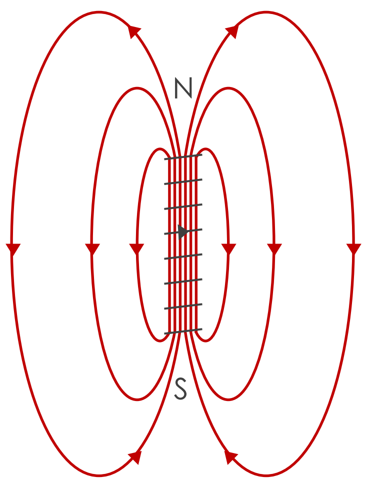
	Recall that changes in atoms and their nuclei can result in the EM waves being generated or absorbed over a wide frequency range. For example, gamma rays originate from the changes in the nucleus of an atom.			
	Recall that ultraviolet, X-rays and gamma rays can be hazardous for humans due to their effect on body tissue, the effect depending on the type of radiation and the size of the dose. UV can cause the skin to age prematurely and increases the risk of skin cancer. X-rays and gamma are ionising radiation that can cause mutations of genes leading to cancer. The radiation dose (measured in sieverts) is a measure of the harm resulting from exposure to radiation. [You do not need to be able to recall the unit of radiation dose]			
	Draw conclusions from given data about the risks and consequences of exposure to radiation.			
	Recall the practical application of EM waves including: Radio — Television and radio Microwaves — Satellite communications and cooking food Infrared — Electrical heaters, cooking food and infrared cameras Visible — Fibre optic communications Ultra Violet — Energy efficiency lamps and sun tanning X-rays and Gamma — Medical imaging and treatments			
H	**Give brief explanations as to why each type of radiation is suitable for its practical applications.**			
P	Recall that a lens forms an image by the refraction of light. For a convex lens, rays of parallel light are brought to a focus at the principal focus at the focal length of the lens.			

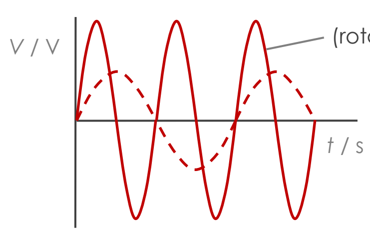
P	Construct ray diagrams for convex lenses, producing either a real or virtual image.  			
P	Construct ray diagrams for concave lenses, producing a virtual image. 			
P	Calculate the magnification produced by a lens using: magnification = image height / object height			
P	Recall that each colour within the visible spectrum has its own wavelength and frequency.			
P	Recall that reflection from a smooth surface is called specular reflection while from a rough surface it is called diffuse reflection.			
P	Explain that colour filters work by absorbing certain wavelengths (colours) while allowing transmission of other wavelengths.			

P	Explain that the colour of an opaque object is determined by which wavelengths of light are most strongly reflected (other wavelengths are absorbed). If all wavelengths are reflected it appears white, while if all are absorbed it appears black.			
P	Recall that objects that transmit light are either transparent or translucent.			
P	Explain that all objects (bodies) emit and absorb infrared radiation no matter what temperature they are at. The hotter the body the more infrared radiated in a given time.			
P	Explain that the intensity and wavelength distribution of any emission depends on the temperature of the body.			
P	Recall that a perfect black body is one that absorbs all the radiation incident on it (it does not reflect or transmit any radiation) and it is also a perfect emitter of radiation too.			
P H	**Explain that a body at a constant temperature is absorbing radiation at the same rate it is emitting radiation. Its temperature will increase if it absorbs radiation faster than it is emitting it, and give every day examples of this.**			
P H	**Explain that the temperature of Earth depends on many factors, including the rate of absorption and emission of radiation and the reflection of radiation into space.**			
P H	**Use information, or draw and interpret diagrams, to show how radiation affects the temperature of the Earth and the atmosphere.**			

Magnetism and Electromagnetism

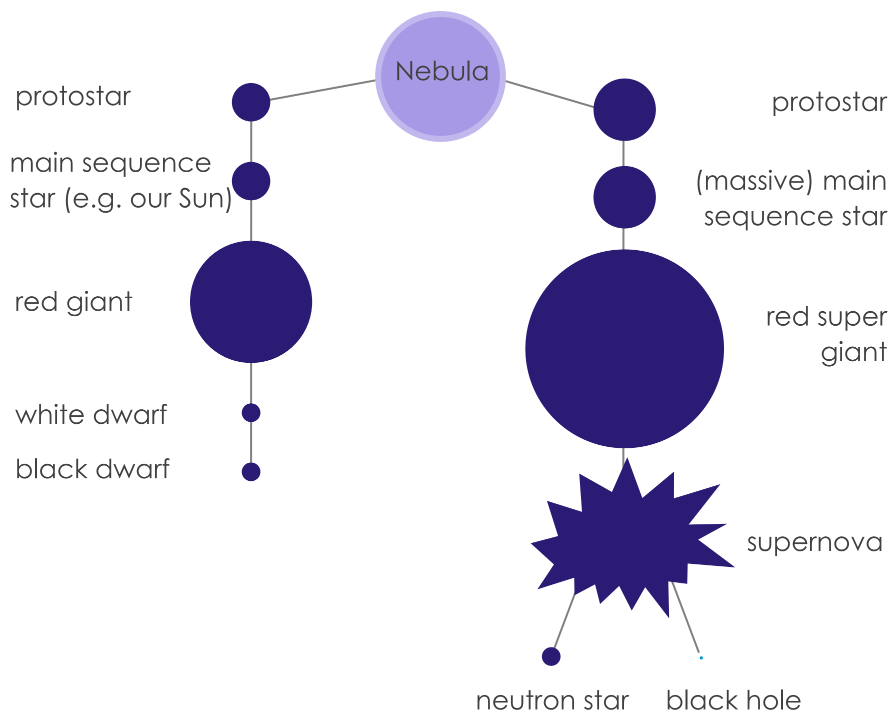
	Permanent and induced magnetism, magnetic force and fields	R	A	G
	Describe the attraction and repulsion between unlike and like poles of permanent magnets respectively. The magnetic force (a non-contact force) is strongest at the poles.			
	Describe the difference between permanent and induced magnets. ▪ a permanent magnet produces its own magnetic field ▪ an induced magnet is a material that becomes a magnet when it is placed in a magnetic field. This induced magnetism always causes a force of attraction. The induced magnet loses its magnetism once it is removed from the magnetic field causing it.			
	Recall that a magnetic field is the region around a magnet where a force acts on another magnet or magnetic material (including iron, steel, cobalt and nickel). This magnetic force is always attractive.			
	Recall that the strength of the magnetic field depends on the distance from the magnet (it is strongest at the poles) and its direction is given by the force experienced by a north pole placed at that point. A magnetic field line is directed from the north pole to the south pole of a magnet.			
	Describe how to plot the magnetic field pattern using a compass.			
	Draw the magnetic field pattern around a bar magnet, showing how the strength and direction change.  			

		R	A	G
	Explain how the behaviour of a magnetic compass (containing a small bar magnet) is related to evidence that the Earth's core must be magnetic since the compass aligns itself to the Earth's magnetic field.			
	The motor effect	**R**	**A**	**G**
	Recall that when a current flows through a conducting wire, a magnetic field is produced. The strength depends on the size of the current and distance from the wire. Shaping the wire to form a solenoid (coil) increases the strength of the magnetic field. This field is strong and uniform inside the solenoid while similar in shape to the field around a bar magnet on the outside. Adding an iron core increases the strength of the field still further and this (a solenoid with an iron core) is called an electromagnet.			
	Describe how the magnetic field around wire carrying a current can be demonstrated.			
	Draw the magnetic field around a straight current carrying wire and for a solenoid.   			
	Explain how a solenoid increases the magnetic effect of the current.			
P	Interpret diagrams of electromagnetic devices in order to explain how they work.			
H	**Recall that when a conductor carrying a current is placed in a magnetic field, the magnet producing a field and the conductor exert a force on each other causing relative motion. This is known as the motor effect.**			
H	**Show that Fleming's left-hand rule represents the relative orientation of the force, the conventional current in the conductor and the direction of the magnetic field.**			
H	**Recall the factors that affect the size of the force on the conductor.**			

H	**For a conductor at right angles to a magnetic field carrying a current, use the equation:** **force = magnetic flux density x current x length** $F = B\,I\,l$			
H	**Explain how the force on a conductor in a magnetic field causes the rotation of a coil in an electric motor.**			
H	**Explain how moving-coil loudspeakers and headphones work using the motor effect to convert variations in electrical current into pressure variations in sound waves.**			
Induced potential, transformers and the National Grid		R	A	G
P H	**Explain the generator effect.** **If a conductor moves relative to a magnetic field, or if the magnetic field changes around a conductor, then a potential difference is induced across the ends of the conductor. A current will flow if this is part of a complete circuit.**			
P H	**Recall that this induced current creates a magnetic field that opposes the original change that caused it, either the movement of the conductor or the change in magnetic field.**			
P H	**Recall the factors that affect the size and direction of the induced potential difference or induced current.**			
P H	**Apply the principles of the generator effect in a given context.**			
P H	**Explain how the generator effect is used in an alternator to generate alternating current and in a dynamo to generate direct current.**			
P H	**Draw and interpret graphs of potential difference in the coil against time.** 			
P H	**Explain how a moving-coil microphone works as it changes the pressure variations in sound waves into a varying current in an electrical circuit.**			

P H	**Recall that a basic transformer is constructed of an iron core with a primary and secondary coil of wire wound onto it.** [Knowledge of laminations and eddy currents in the core is not required]			
P H	**Explain how the alternating current in one coil induces an alternating current in the secondary coil.**			
P H	**Apply the equation:** $\frac{\text{potential difference across the primary coil}}{\text{potential difference across the secondary coil}} = \frac{\text{number of turns in primary}}{\text{number of turns in secondary}}$ $V_p / V_s = n_p / n_s$			
P H	**Explain how the ratio of the potential differences depends on the ratio of the number of turns of each coil.**			
P H	**Recall that in a:** ▪ **step-up transformer $V_s > V_p$** ▪ **step-down transformer $V_s < V_p$**			
P H	**For a 100% efficient transformer use the equation:** potential difference across primary coil x current in primary coil = potential difference across secondary coil x current in secondary coil $V_p I_p = V_s I_s$			
P H	**Apply the transformer equations and relate these to the advantages of power transmission at very high potential differences.**			

Space Physics

	The solar system, orbital motion and satellites	R	A	G
P	Recall that our solar system is part of the Milky Way galaxy. It contains one star with eight planets and many dwarf planets orbiting it. There are also natural satellites and moons that orbit planets.			
P	Explain the formation of a star: ▪ dust and gas in a nebula are pulled together by gravitational attraction until nuclear fusion reactions start ▪ the star eventually enters a stable phase when the gravitational collapse of the star is in equilibrium with the expansion of the star due to fusion energy			
P	Describe the life cycle of a star the size of our Sun and one which is much more massive than our Sun. 			
P	Explain how fusion leads to the formation of new elements in stars, and that all elements heavier than iron are produced in a supernova which then distributes these elements throughout the universe.			
P	Describe the similarities and differences between planets, their moons and artificial satellites.			
P	Recall that gravity provides the force that allows planets and satellites to maintain their circular orbits.			

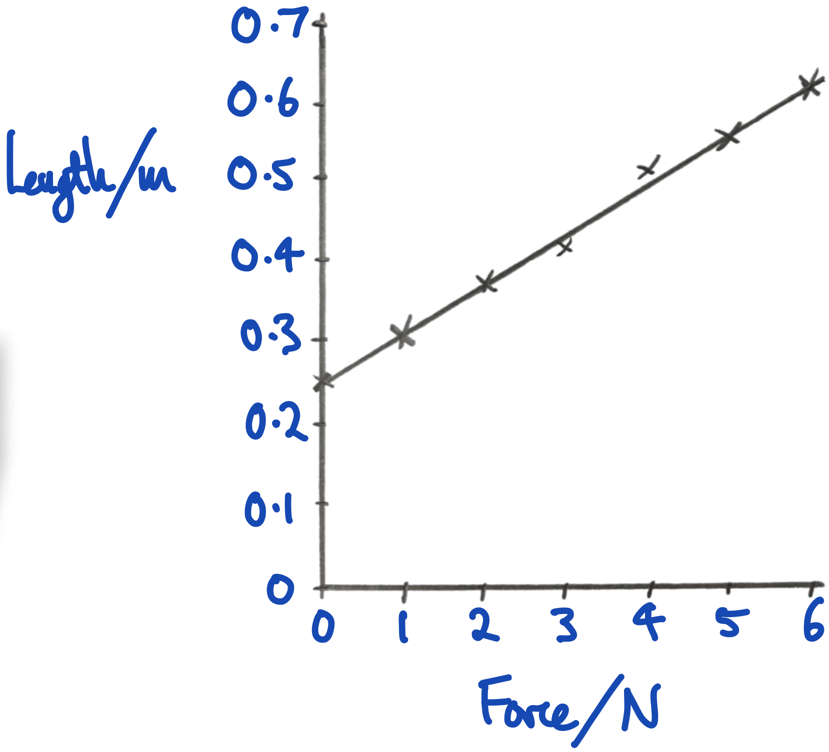
P H	**Explain qualitatively how the force of gravity can lead to changing velocity but an unchanged speed.**			
P H	**Explain qualitatively that for a stable orbit, the radius must change if the speed changes.**			
P	Explain that red-shift provides evidence for the Big Bang: ▪ red-shift is the observed increase in the wavelength of light from distant galaxies ▪ the further away the galaxy the faster it is moving, so the greater the change in wavelength ▪ the change in each galaxies speed with increasing distance is evidence that the universe is expanding ▪ this suggests that previously the universe began from a region that was extremely hot and dense			
P	Realise that since 1998 observations of supernova have suggested that distant galaxies are receding even faster.			
P	Explain how scientists are able to arrive at theories, including the Big Bang, using observations.			
P	Realise that there is still a lot about the universe that is not understood, including dark matter and dark energy.			

Working Scientifically

Alongside the Physics content that you learn during your GCSE course, there are also scientific skills that you must be able to apply to your own practical work, when analysing other people's results and to questions you may be asked.

Area	Development of scientific thinking
Scientific theories	You could be asked to give examples that show how scientific models and theories have changed over time, explain why new data led to changes in these theories and decide whether or not data supports a certain theory.
Using models	You could be asked to give ways in which a model that explains something could be tested by observation or experiment.
Power and limitations of science	You could be asked to explain why data is needed to answer scientific questions and why this data may be uncertain or incomplete. You should also be able to outline a simple ethical argument about new technology.
Scientific applications	You could be asked to describe and explain examples of the technological applications of science, and evaluate methods used to tackle problems created by the human impact on the environment.
Risks	You could be asked to give examples of hazards associated with science based technologies, and suggest reasons why the perceived risk is often different to the measured risk.
Peer review	You could be asked to explain that the process of peer review helps to detect false claims, while media reports of scientific developments which are not peer reviewed are often oversimplified, inaccurate or biased.
Area	**Experimental skills**
Hypotheses	You could be asked to suggest a hypothesis to explain data or observations.
Experiments	You could be asked to describe practical procedures, identify independent, dependent and control variables and explain why the procedure is well designed for that purpose.
Selection	You could be asked to suggest and explain why a particular instrument or technique is suitable for a particular purpose.
Health and safety	You could be asked to identify the main hazards in an experiment and suggest ways of reducing risk.
Sampling	You could be asked to suggest and describe a suitable sampling technique in a given context.
Measurements	You could be asked to read measurements and record data appropriately.

Evaluation	You could be asked to evaluate methods used and assess whether sufficient precise measurements have been taken.
Area	**Analysis and evaluation**
Presenting observations	You could be asked to construct diagrams, tables and histograms and plot two variables from experimental data.
Translating data	You could be asked to translate between graphical and numerical data.
Mathematical analysis	You could be asked to use an appropriate number of significant figures, find the mean, change the subject of a calculation and solve it, determine slopes and intercepts of graphs and draw a tangent to a curve.
Uncertainty	You could be asked to use the range of a set of readings about the mean as a measure of uncertainty.
Interpreting data	You could be asked to use data to make predictions, describe patterns in results and draw conclusions from observations.
Explanations	You could be asked to comment on the extent to which data is consistent with the hypotheses and identify which hypothesis gives a better explanation.
Evaluating data	You could be asked to evaluate data using the following terms appropriately: ▪ **accurate** measurements are close to the true value ▪ **precise** measurements cluster together ▪ **repeatable** measurements are ones that give similar results when repeated by the same people under similar conditions ▪ **reproducible** measurements give similar results by different people with different equipment ▪ **random** error is due to results varying in unpredictable ways ▪ **systematic** errors are due to results differing from the true value by a consistent amount each time ▪ **anomalous** values could be the product of a poor measurement and should be ignored
Communication	You could be asked to present coherent and logical responses to questions on the required practicals and other practical investigations.
Area	**Scientific vocabulary**
Vocabulary	You could be asked to use appropriate scientific terminology and definitions across all topics.
Quantities and units	You could be asked to use SI units, prefixes and convert units as appropriate.



Make sure you have all the equipment you need for your lessons and exams – including a ruler for drawing straight lines of best fit.

Required Practicals

There are a number of practical experiments you should complete in school for your GCSE Physics. You must understand how to set up and use the equipment, identify variables and analyse any results you take. You will be assessed on this in your final written exams.

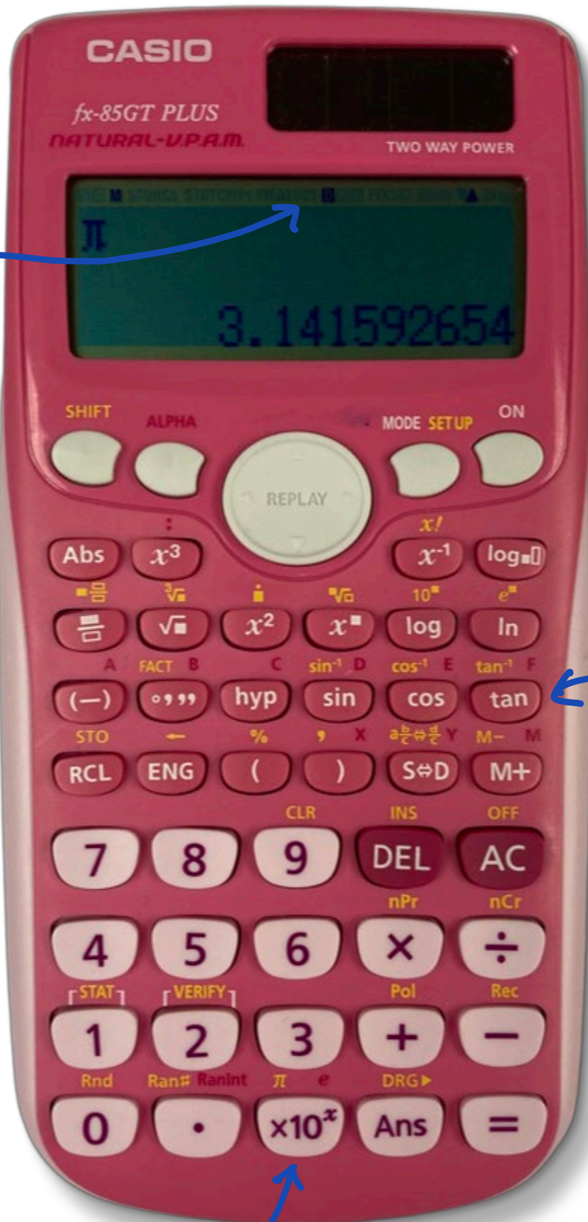
No.	Required Practical Activity	Completed
1	Determine the specific heat capacity of one or more materials	
2	Investigate the effectiveness of different materials as thermal insulators	
3	Set up circuits to investigate: ▪ The resistance of a length of wire at constant temperature ▪ Resistors in series and parallel	
4	Set up circuits to investigate the I-V characteristics of: ▪ A resistor ▪ A filament lamp ▪ A diode	
5	Make and record measurements to determine the density of: ▪ Regular objects ▪ Irregular objects ▪ Liquids	
6	Investigate the relationship between force and extension for a spring	
7	Investigate the effect on acceleration of: ▪ Varying the force for a constant mass ▪ Varying the mass for a constant force	
8	Make observations to identify the suitability of apparatus for measuring the frequency, wavelength and speed of: ▪ Waves in a ripple tank ▪ Waves in a solid	
9	Investigate the: ▪ Reflection of light by different types of surfaces ▪ Refraction of light by different substances	
10	Investigate how the amount of infrared radiation absorbed or radiated by a substance depends on the surface	

Head over to GCSEPhysicsOnline.com/**aqa-practicals** to find the AQA required practical videos.

Each one includes the equipment, hazards and safety information, downloadable results tables, sample data and an analysis of the results.

Make sure you're really familiar with the calculator you will be using in your exams!

degrees

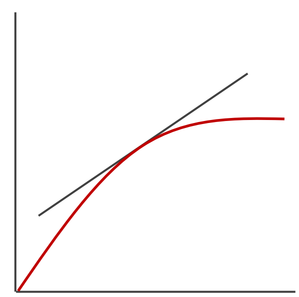


sin, cos and tan

standard form or pi

Maths for GCSE Physics

Alongside the work you are already completing for your GCSE Maths, there are a number of skills that are used throughout GCSE Physics that you must be familiar with.

Topic	You must be able to:
Numbers	▪ Use numbers in decimal and standard form ($x10^n$)
Data	▪ Use an appropriate number of significant figures ▪ Understand mean, mode and median ▪ Find the mean of a series of numbers
Equations	▪ Use the symbols: = Equals $\sim$ Approximately equal to $\propto$ Proportional $<$ Less than $<<$ Much less than $>$ Greater than $>>$ Much greater than ▪ Rearrange equations and use them to solve numerical problems
Graphs	  ▪ Understand that $y = mx + c$ represents a linear relationship ▪ Work out the slope (gradient) and intercept from a graph ▪ Use a tangent to a curve to work out the gradient ▪ Calculate the area below a line and realise what this represents
Shapes	▪ Calculate areas of rectangles and triangles ▪ Calculate the volume and surface area of a cube

The maths you need for physics is all covered in your GCSE Maths lessons. The more questions you attempt the more you will improve your mathematical skills, especially rearranging equations and performing calculations.

Quantities and Units

You should be able to recognise and recall all of these quantities, units and their symbols.

Quantity	Symbol	Unit	Symbol
Acceleration	a	metres per second squared	m/s^2
Activity	A	becquerel	Bq
Area	A	metres squared	m^2
Change in	Δ *(delta)*	-	-
Charge	Q	coulombs	C
Current	I	amps	A
Density	ρ *(rho)*	kilograms per cubic metre	kg/m^3
Distance or displacement	s	metres	m
Efficiency	-	percentage	%
Elastic potential energy	E_e	joules	J
Energy	E	joules	J
Extension	e	metres	m
Final velocity	v	metres per second	m/s
Force (resultant force)	F	newtons	N
Frequency	f	hertz	Hz
Gravitational field strength	g	newtons per kilogram	N/kg
Gravitational potential energy	E_p	joules	J
Height	h	metres	m
Initial velocity	u	metres per second	m/s
Kinetic energy	E_k	joules	J
Magnetic flux density	B	tesla	T
Magnification	M	-	-
Mass	m	kilograms	kg
Moment	M	newton metres	Nm

Momentum	p	kilogram metres per second squared	kg m/s²
Number of turns	n	-	-
Potential difference	V	volts	V
Power	P	watts	W
Pressure	p	pascals	Pa
Radiation dose	-	sieverts	Sv
Resistance	R	ohms	Ω *(omega)*
Specific heat capacity	c	joules per kilogram per degree Celcius	J/kg °C
Specific latent heat	L	joules per kilogram	J/kg
Speed	v	metres per second	m/s
Spring constant	k	newtons per metre	N/m
Temperature	θ *(theta)*	degrees Celsius	°C
Thermal energy	E	joules	J
Time	t	seconds	s
Velocity	v	metres per second	m/s
Volume	V	metres cubed	m³
Wave speed	v	metres per second	m/s
Wavelength	λ *(lambda)*	metres	m
Weight	W	kilograms	kg
Work done	W	joules	J

An equation with quantities written in words and symbols.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

m

These are the units these quantities are measured in.

$$v = \frac{s}{t}$$

m/s

s

Equations

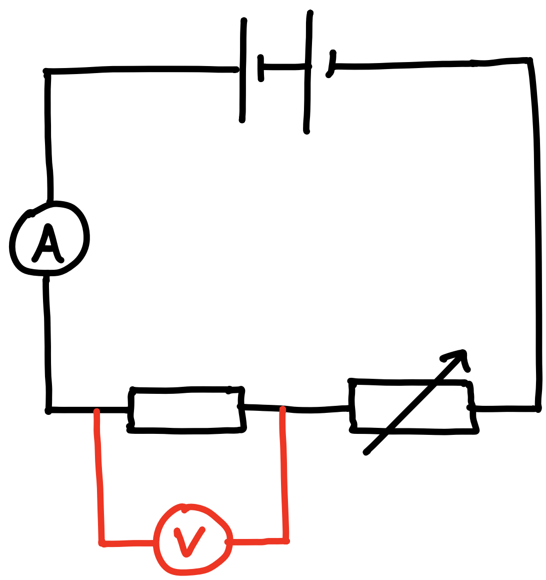
Only a few equations will be given to you in the exam on the Physics Equation Sheet. You must be able to remember the rest of these equations.

	Equation	Symbol
	kinetic energy = ½ x mass x speed^2	$E_k = \frac{1}{2} m v^2$
	elastic potential energy = ½ x spring constant x extension^2	$E_e = \frac{1}{2} k e^2$
	gravitational potential energy = mass x gravitational field strength x height	$E_p = m g h$
	change in thermal energy = mass x specific heat capacity x change in temperature	$\Delta E = m c \Delta\theta$
	power = energy transferred / time	$P = E / t$
	power = work done / time	$P = W / t$
	efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	-
	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	-
	charge = current x time	$Q = I t$
	potential difference = current x resistance	$V = I R$
	resistors in series: total resistance = sum of individual resistances	$R_{Total} = R_1 + R_2$
	power = potential difference x current	$P = V I$
	power = current^2 x resistance	$P = I^2 R$
	energy transferred = power x time	$E = P t$
	energy transferred = charge x potential difference	$E = Q V$
	density = mass / volume	$\rho = m / V$
	energy for a change of state = mass x specific latent heat	$E = m L$

You should try and learn all of these off by heart.

	For a fixed mass of gas at constant temperature: pressure x volume = constant	$p\ V = constant$
	weight = mass x gravitational field strength	$W = m\ g$
	work done = force x distance (moved along the line of action of the force)	$W = F\ s$
	force = spring constant x extension	$F = k\ e$
	moment of a force = force x distance (perpendicular from the pivot to the line of action of the force)	$M = F\ d$
	pressure = force normal to a surface / area	$p = F\ /\ A$
Higher	**pressure = height x density of liquid x gravitational field strength**	$\boldsymbol{p = h\ \rho\ g}$
	distance travelled = speed x time	$s = v\ t$
	acceleration = change in velocity / time taken	$a = \Delta v\ /\ t$
	final velocity^2 – initial velocity^2 = 2 x acceleration x distance	$v^2 - u^2 = 2\ a\ s$
	resultant force = mass x acceleration	$F = m\ a$
Higher	**momentum = mass x velocity**	$\boldsymbol{p = m\ v}$
Higher	**force = change of momentum / time taken**	$\boldsymbol{F = m\ \Delta v\ /\ \Delta t}$
	period = 1 / frequency	$T = 1\ /\ f$
	wave speed = frequency x wavelength	$v = f\ \lambda$
	magnification = image height / object height	-
Higher	**For a conductor at right angles to a magnetic field carrying a current:** **force = magnetic flux density x current x length**	$\boldsymbol{F = B\ I\ l}$
Higher	$\dfrac{\textbf{potential difference across the primary coil}}{\textbf{potential difference across the secondary coil}} = \dfrac{\textbf{number of turns in primary}}{\textbf{number of turns in secondary}}$	$\boldsymbol{V_p\ /\ V_s = n_p\ /\ n_s}$
Higher	**potential difference across primary coil x current in primary coil = potential difference across secondary coil x current in secondary coil**	$\boldsymbol{V_p\ I_p = V_s\ I_s}$

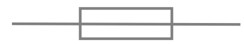
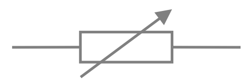
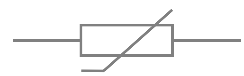
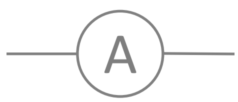
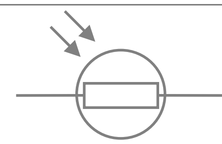
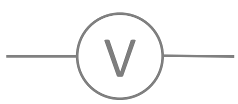
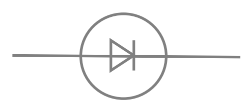
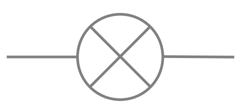
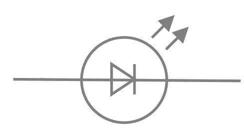
Don't forget than **ammeter** always goes in **series** to measure the current through a component...



... and a **voltmeter** is connected in **parallel** to measure the potential difference across a component.

Common Circuit Symbols

You must remember these circuit symbols and be able to draw them correctly in circuits.

Component	Symbol	Component	Symbol
Open Switch		Resistor	
Closed Switch		Fuse	
Cell		Variable resistor	
Battery		Thermistor	
Ammeter		Light dependent resistor (LDR)	
Voltmeter		Diode	
Filament lamp		Light emitting diode (LED)	

Definitions

These are the key words that you must know the meaning of.

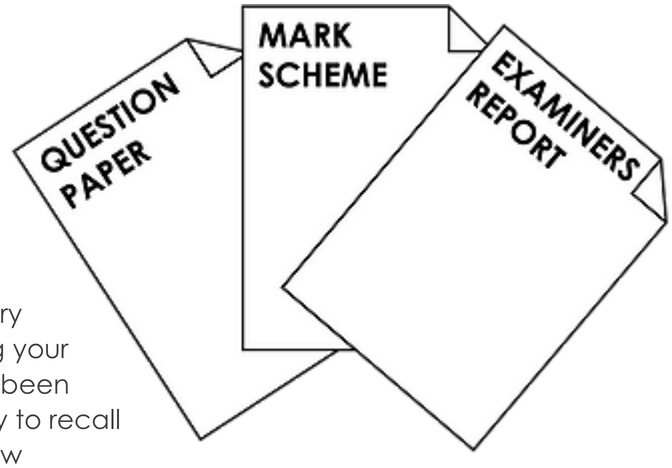
Term	Definition
Power	Power is defined as the rate at which energy is transferred or at which work is done
Current	Electric current is the rate of flow of electric charge
Ohmic conductor	The current through an ohmic conductor at constant temperature is directly proportional to the potential difference across it
National Grid	The National Grid is a system of cables and transformers linking power stations to consumers
Internal energy	Internal energy is the total kinetic and potential energy of all the particles that make up a system
Specific heat capacity	The specific heat capacity of a substance is the amount of energy required to raise the temperature of one kilogram of the substance by one degree Celsius
Specific latent heat	The specific latent heat of a substance is the amount of energy required to change the state of one kilogram of the substance with no change in temperature
Activity	Activity is the rate at which a source of unstable nuclei decays
Count-rate	Count-rate is the number of decays recorded each second by a detector
Half-life	The half-life of a radioactive isotope is the time it takes for the number of nuclei of the isotope in a sample to halve or The time it takes for the count-rate, or activity, from a sample containing the radioactive isotope to fall to half its initial level
Contamination	Contamination is the unwanted presence of material containing radioactive atoms on other material
Irradiation	Irradiation is the process of exposing an object to nuclear radiation
Fission	Nuclear fission is the splitting of a large and unstable nucleus
Fusion	Nuclear fusion is the joining of two light nuclei to form a heavier nucleus
Joule	One joule of work is done when a force of one newton causes a displacement of one metre

Term	Definition
Moment	The turning effect of a force is called the moment of a force and is equal to the force multiplied by the perpendicular distance from the pivot to the line of action of the force
Displacement	Displacement includes both the distance an object moves and the direction it moves from its start point
Velocity	The velocity of an object is its speed in a given direction
Newton's First Law	If the resultant force acting on an object is zero and the object is: ▪ stationary, the object remains stationary ▪ moving, the object continues to move at the same velocity
Newton's Second Law	The acceleration of an object is proportional to the resultant force acting on the object and inversely proportional to the mass of the object
Newton's Third Law	Whenever two objects interact, the forces they exert on each other are equal and opposite
Stopping distance	The stopping distance of a vehicle is the sum of the distances the vehicle travels during the driver's reaction time (thinking distance) and the distance it travels under the braking force (braking distance)
Momentum	**Momentum is defined as mass times velocity**
Conservation of momentum	**In a closed system, the total momentum before an event is equal to the total momentum after the event**
Amplitude	The amplitude of a wave is defined as the maximum displacement of a point on a wave away from its undisturbed position
Wavelength	The wavelength of a wave is the distance from a point on one wave to the equivalent position on the adjacent wave
Frequency	The frequency of a wave is the number of waves passing a point each second

Make your own flashcards to help you learn all these definitions off by heart – they are easy marks in an exam.

Exam Preparation

Past Papers



Ultimately, you're going to be judged on your ability to answer questions about physics. The way to get good at this is to attempt as many exam questions about physics as possible. Simple!

Well, actually, it is not that simple. It can be a very daunting experience when you first start working your way through past papers. These questions have been written by a team of experts to assess your ability to recall knowledge and apply your understanding to new situations and scenarios. They have detailed mark schemes (written for examiners and teachers to mark your work), grade boundaries based on real data and examiners reports that summarise how students actually responded when they sat these exams.

My suggestion is that you need to complete as many past exam papers as possible in the following way:

- If you have the opportunity, print it out so you're writing on the actual paper. If this is not possible then write on blank paper using the same amount of space as the real exam while viewing the paper on a computer.
- Complete the whole paper under exam conditions – working in silence with no distractions (like your phone or music) and don't refer to your notes or textbooks.
- Mark your paper using the mark scheme – if you're not sure about your answer mark it incorrect rather than giving yourself the benefit of the doubt.
- Write down any corrections in another colour pen.
- Read through the examiner report – this is what can give you the edge over other candidates as a few extra marks can take you to the next grade. Use this to add any more notes to your paper to supplement your answers.
- If you still feel unsure about a particular question and the answer you've written, don't ignore it, but address it as soon as possible with your teacher.

To find papers, mark schemes and examiner reports for GCSE Physics then just head over to my website.

GCSEPhysicsOnline.com/**aqa-past-papers**

Current Specification AQA Past Papers (9-1)

These will be the closest thing to the real GCSE exams that you're going to be taking – although there are only a few of these available and some may be used by your teachers for mock exams. My advice would be to save these until the end to give you a good reflection of how you are progressing.

Old Specification AQA Past Papers (A* - G)

The actual content of GCSE Physics has not changed drastically over the years, but these papers had a few differences.

The first was the structure of the exams where everyone took Paper 1 and Paper 2, with those taking Triple Science taking an additional Paper 3 that had extra topics. There were also some changes to the actual content assessed (for example, they also referred to types of energy rather than the stores of energy). This is not a big problem, provided you have a good understanding of the new topics you will be asked questions about for the current AQA course.

Edexcel, OCR A and OCR B Past Papers

In addition to AQA there are two other main exam board in England. The great thing is that all of these exams offer almost similar content to AQA as they all follow the National Curriculum. This means that if you look at the recent papers from these boards then you can access a huge amount of high-quality additional questions.

WJEC, CCEA and IGCSE Edexcel and CIE Past Papers

If you want to view even more past papers to access thousands and thousands of additional questions, other exam boards including WJEC, CCEA, Edexcel IGCSE and CIE can be used. Although these are aimed at a similar audience to you, their specifications have some differences so there may be more content that is unfamiliar. However, they are worth a look at – a question where you have to calculate the kinetic energy of a moving object is going to be fairly similar whichever paper you find it in.

Next Steps

It's now down to you to start working through as many questions to make sure you can apply your knowledge to as many new situations as possible. This will allow you to consolidate what you already know and identify your weaker areas that you must continue working on. Remember to record your progress using the topic checklists in this book.

Past Paper Tracker

Don't just randomly do questions, make a record of the past papers you complete and record your progress over the next few months.

Year	Paper	Raw Mark	Grade	Notes

Year	Paper	Raw Mark	Grade	Notes

Grade Converter

These are the grade boundaries for AQA legacy past papers and a suggested guide for converting these to a 9-1 grade.

Complete Paper 1 and 2 if you're studying Combined Trilogy.

May/June 2017

2017	Paper 1 H	
Mark /60	A*-G	9-1
51		9
42	A*	8
34	A	7
26	B	6
22		5
18	C	4
10	D	U
<10	U	U

2017	Paper 2 H	
Mark /60	A*-G	9-1
53		9
47	A*	8
36	A	7
25	B	6
20		5
15	C	4
7	D	U
<7	U	U

2017	Paper 3 H	
Mark /60	A*-G	9-1
42		9
34	A*	8
30	A	7
26	B	6
25		5
23	C	4
20	D	U
<20	U	U

2017	Paper 1 F	
Mark /60	A*-G	9-1
48		5
37	C	4
29	D	3
21	E	2
13	F	1
5	G	1
<5	U	U

2017	Paper 2 F	
Mark /60	A*-G	9-1
46		5
32	C	4
26	D	3
20	E	2
14	F	1
8	G	1
<8	U	U

2017	Paper 3 F	
Mark /60	A*-G	9-1
50		5
41	C	4
31	D	3
22	E	2
13	F	1
4	G	1
<4	U	U

If you're taking Physics (Triple Science) do Paper 3 as well.

May/June 2016

2016	Paper 1 H	
Mark /60	A*-G	9-1
53		9
46	A*	8
37	A	7
28	B	6
23		5
19	C	4
10	D	U
<10	U	U

2016	Paper 2 H	
Mark /60	A*-G	9-1
53		9
46	A*	8
37	A	7
28	B	6
23		5
19	C	4
10	D	U
<10	U	U

2016	Paper 3 H	
Mark /60	A*-G	9-1
48		9
36	A*	8
31	A	7
26	B	6
24		5
22	C	4
18	D	U
<18	U	U

2016	Paper 1 F	
Mark /60	A*-G	9-1
49		5
38	C	4
30	D	3
23	E	2
16	F	1
9	G	1
<9	U	U

2016	Paper 2 F	
Mark /60	A*-G	9-1
46		5
32	C	4
26	D	3
20	E	2
14	F	1
8	G	1
<8	U	U

2016	Paper 3 F	
Mark /60	A*-G	9-1
49		5
38	C	4
29	D	3
20	E	2
12	F	1
4	G	1
<4	U	U

May/June 2015

2015	Paper 1 H	
Mark /60	A*-G	9-1
53		9
47	A*	8
37	A	7
27	B	6
22		5
18	C	4
9	D	U
<9	U	U

2015	Paper 2 H	
Mark /60	A*-G	9-1
52		9
45	A*	8
36	A	7
27	B	6
23		5
19	C	4
11	D	U
<11	U	U

2015	Paper 3 H	
Mark /60	A*-G	9-1
52		9
44	A*	8
39	A	7
34	B	6
32		5
30	C	4
26	D	U
<26	U	U

2015	Paper 1 F	
Mark /60	A*-G	9-1
47		5
35	C	4
27	D	3
20	E	2
13	F	1
6	G	1
<6	U	U

2015	Paper 2 F	
Mark /60	A*-G	9-1
48		5
36	C	4
29	D	3
22	E	2
16	F	1
10	G	1
<10	U	U

2015	Paper 3 F	
Mark /60	A*-G	9-1
51		5
42	C	4
32	D	3
23	E	2
14	F	1
5	G	1
<5	U	U

May/June 2014

2014	Paper 1 H	
Mark /60	A*-G	9-1
51		9
43	A*	8
35	A	7
27	B	6
23		5
19	C	4
11	D	U
<11	U	U

2014	Paper 2 H	
Mark /60	A*-G	9-1
52		9
44	A*	8
36	A	7
28	B	6
24		5
20	C	4
12	D	U
<12	U	U

2014	Paper 3 H	
Mark /60	A*-G	9-1
52		9
45	A*	8
40	A	7
34	B	6
30		5
28	C	4
22	D	U
<18	U	U

2014	Paper 1 F	
Mark /60	A*-G	9-1
47		5
35	C	4
28	D	3
21	E	2
15	F	1
9	G	1
<9	U	U

2014	Paper 2 F	
Mark /60	A*-G	9-1
48		5
37	C	4
31	D	3
25	E	2
20	F	1
15	G	1
<15	U	U

2014	Paper 3 F	
Mark /60	A*-G	9-1
53		5
46	C	4
36	D	3
26	E	2
17	F	1
8	G	1
<8	U	U

May/June 2013

2013	Paper 1 H	
Mark /60	A*-G	9-1
53		9
46	A*	8
37	A	7
28	B	6
24		5
20	C	4
12	D	U
<12	U	U

2013	Paper 2 H	
Mark /60	A*-G	9-1
50		9
41	A*	8
35	A	7
29	B	6
26		5
23	C	4
17	D	U
<17	U	U

2013	Paper 3 H	
Mark /60	A*-G	9-1
50		9
41	A*	8
38	A	7
32	B	6
29		5
26	C	4
20	D	U
<20	U	U

2013	Paper 1 F	
Mark /60	A*-G	9-1
46		5
32	C	4
25	D	3
19	E	2
13	F	1
7	G	1
<7	U	U

2013	Paper 2 F	
Mark /60	A*-G	9-1
47		5
34	C	4
28	D	3
22	E	2
17	F	1
12	G	1
<12	U	U

2013	Paper 3 F	
Mark /60	A*-G	9-1
53		5
45	C	4
36	D	3
27	E	2
18	F	1
9	G	1
<9	U	U

January 2013

2013	Paper 1 H	
Mark /60	A*-G	9-1
53		9
45	A*	8
36	A	7
27	B	6
23		5
19	C	4
11	D	U
<11	U	U

2013	Paper 2 H	
Mark /60	A*-G	9-1
55		9
51	A*	8
42	A	7
32	B	6
27		5
22	C	4
12	D	U
<12	U	U

2013	Paper 1 F	
Mark /60	A*-G	9-1
47		5
35	C	4
28	D	3
21	E	2
14	F	1
7	G	1
<7	U	U

2013	Paper 2 F	
Mark /60	A*-G	9-1
47		5
35	C	4
28	D	3
21	E	2
15	F	1
9	G	1
<9	U	U

May/June 2012

2012	Paper 1 H	
Mark /60	A*-G	9-1
52		9
44	A*	8
35	A	7
26	B	6
22		5
17	C	4
8	D	U
<8	U	U

2012	Paper 2 H	
Mark /60	A*-G	9-1
50		9
41	A*	8
33	A	7
25	B	6
21		5
18	C	4
11	D	U
<11	U	U

2012	Paper 1 F	
Mark /60	A*-G	9-1
47		5
34	C	4
27	D	3
20	E	2
13	F	1
6	G	1
<6	U	U

2012	Paper 2 F	
Mark /60	A*-G	9-1
46		5
32	C	4
25	D	3
18	E	2
11	F	1
4	G	1
<4	U	U

Estimating 9-1 Grade Boundaries

Please note that these grade boundaries, although based on real AQA grade boundaries, are only a rough estimate of how they translate to the 9-1 grades.

To calculate grade boundaries for **higher** tier papers:

Grade	Calculation
9	Mark midway between full marks on the paper and A* threshold
8	Minimum mark needed for an A*
7	Minimum mark needed for an A
6	Minimum mark needed for a B
5	Mark midway between a C and B
4	Minimum mark needed for a C
U	Any mark below a grade C

To calculate grade boundaries for foundation tier papers:

Grade	Calculation
5	Mark midway between full marks on the paper and C threshold
4	Minimum mark needed for a C
3	Minimum mark needed for a D
2	Minimum mark needed for an E
1	Minimum mark needed for a G
U	Any mark below a grade G

And there's a little bit more…

Finally

Two points from me:

You can sign up for an individual **Premium Plan** at **GCSEPhysicsOnline.com** to access hundreds of additional videos and resources…

or

…ask your teacher to sign you and your whole class up to a **School Subscription** plan to access all my material at no extra cost to you.

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Keep working hard and you can make massive improvements – good luck in your exams this year!

Lewis Matheson

With thousands of subscribers on YouTube, I've been making videos to support students since 2015: including practical experiments, livestreams, worked examples and regular updates about exams.

My website, GCSEPhysicsOnline, has over five hundred videos all organised by topic so you can find anything whenever you need it. The site also includes hundreds of additional questions and worksheets to help you improve your understanding and ultimately improve your performance in any tests or exams.

I have also continued to work with many organisations to support teachers, including the Royal Academy of Engineering, Ogden Trust, Institute of Physics and STEM Learning.