Science – Physics

INTENT- KS3

We create a positive and safe learning environment, where students feel confident to explore ideas surrounding science. KS3 is about students finding their feet, learning the foundations and skills that are required by excellent scientists. In Year 7 we start learning about cells, atoms and forces, the essential building blocks for building the knowledge in our science curriculum. Science is a hierarchical subject, where success in each of the three specialisms is reliant on mastery of all that sits below. The principal focus of science teaching in KS3 is to develop a deeper understanding of a range of scientific ideas in the subject disciplines of Biology, Chemistry and Physics. Pupils should begin to see the connections between these subject areas and become aware of some of the big ideas underpinning scientific knowledge and understanding.
Our intent is to ensure that students have a developed understanding of the World and Universe they live in, allowing them to be successful in any route they choose; providing opportunity for academic or personal success within the Sciences, or wider career network. We are inclusive with all our students within the KS3 curriculum, learning essential practical and teamwork skills, encouraging students to develop scientific enquiry skills to explore the world around them.

SKILLS AND KNOWLEDGE

	Students will develop their KNOWLEDGE of	Students will develop their SKILLS in
7	**Forces:** forces as pushes or pulls; using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces; moment; forces: deforming objects; stretching and squashing – springs; friction between surfaces; resistance to motion of air and water; forces measured in newtons, measurements of stretch or compression as force is changed; force-extension linear relation; Hooke's Law; work done and energy changes on deformation; non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets. **Balanced forces:** opposing forces and equilibrium; weight held by stretched spring or supported on a compressed surface; Forces and motion; forces needed stop or start moving, or change speed or direction. **Observed waves:** waves on water which travel through water with transverse motion; these can be reflected, add or cancel – superposition. **Sound waves:** frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound; sound needs a medium to travel, the speed of sound in air, water, solids; sound produced by vibrations of objects, in loud speakers, detected by their effects on microphone diaphragm and the ear drum; sound waves are longitudinal; auditory range of humans and animals. **Light waves:** similarities and differences between light waves and waves; light waves travelling through a vacuum; speed of light; the transmission of light through materials: absorption, diffuse scattering and specular reflection; use of ray model to explain imaging in mirrors, pinhole camera, refraction of light and action of convex lens in focusing; the human eye; light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras; colours and the different frequencies of light, white light and prisms; differential colour effects in absorption and diffuse reflection. **Space physics:** gravity force, weight = mass x gravitational field strength (g), on Earth g=10 N/kg, different on other planets and stars; gravity forces between Earth and Moon, and between Earth and Sun; our Sun as a star, other stars in our galaxy, other galaxies; the seasons and the Earth's tilt, day length at different times of year, in different hemispheres; the light year as a unit of astronomical distance.	**Scientific attitudes**: pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility; understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review; evaluate risks. **Experimental skills and investigations**: ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience; make predictions using scientific knowledge and understanding; select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate; use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety; make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements; apply sampling techniques. **Analysis and evaluation:** apply mathematical concepts and calculate results; present observations and data using appropriate methods, including tables and graphs; interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions; present reasoned explanations, including explaining data in relation to predictions and hypotheses ; evaluate data, showing awareness of potential sources of random and systematic error; identify further questions arising from their results. **Measurement:** understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature; use and derive simple equations and carry out appropriate calculations; undertake basic data analysis including simple statistical techniques

	Students will develop their KNOWLEDGE of	Students will develop their SKILLS in
8	**Current electricity:** electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge; potential difference, measured in volts, battery and bulb ratings; resistance, measured in ohms, as the ratio of potential difference (p.d.) to current; differences in resistance between conducting and insulating components. **Static electricity:** separation of positive or negative charges when objects are rubbed together: transfer of electrons, forces between charged objects; the idea of electric field, forces acting across the space between objects not in contact. **Magnetism:** magnetic poles, attraction and repulsion; magnetic fields by plotting with compass, representation by field lines; Earth's magnetism, compass and navigation; the magnetic effect of a current, electromagnets, D.C. motors (principles only). **Physical changes:** conservation of material and of mass, and reversibility, in melting, freezing, evaporation, sublimation, condensation, dissolving; similarities and differences, including density differences, between solids, liquids and gases; Brownian motion in gases; diffusion in liquids and gases driven by differences in concentration; the difference between chemical and physical changes. **Particle model:** differences in arrangements, in motion and in closeness of particles explaining changes of state, shape and density, the anomaly of ice-water transition; atoms and molecules as particles. **Energy in matter:** changes with temperature in motion and spacing of particles; internal energy stored in materials. **Energy and waves:** pressure waves transferring energy; use for cleaning and physiotherapy by ultra-sound; waves transferring information for conversion to electrical signals by microphone. **Energy:** Calculation of fuel uses and costs in the domestic context; comparing energy values of different foods (kJ); comparing power ratings of appliances in watts (W, kW); comparing amounts of energy transferred (J, kJ, kW hour); domestic fuel bills, fuel use and costs; fuels and energy resources. **Energy changes and transfers:** simple machines give bigger force but at the expense of smaller movement: product of force and displacement unchanged; heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: use of insulators; processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels. **Changes in systems:** energy as a quantity that can be quantified and calculated; the total energy has the same value before and after a change; comparing the starting with the final conditions of a system and describing increases and decreases in the amounts of energy associated with movements, temperatures, changes in positions in a field, in elastic distortions and in chemical compositions; using physical processes and mechanisms, rather than energy, to explain the intermediate steps that bring about such changes. **Describing motion:** speed and the relationship between average speed, distance and time (speed = distance ÷ time); the representation of a journey on a distance-time graph; relative motion. **Pressure in fluids:** atmospheric pressure, decreases with increase of height as weight of air above decreases with height; pressure in liquids, increasing with depth; upthrust effects, floating and sinking; pressure measured by ratio of force over area – acting normal to any surface.	**Scientific attitudes**: pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility; understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review; evaluate risks. **Experimental skills and investigations**: ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience; make predictions using scientific knowledge and understanding; select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate; use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety; make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements; apply sampling techniques. **Analysis and evaluation:** apply mathematical concepts and calculate results; present observations and data using appropriate methods, including tables and graphs; interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions; present reasoned explanations, including explaining data in relation to predictions and hypotheses ; evaluate data, showing awareness of potential sources of random and systematic error; identify further questions arising from their results. **Measurement:** understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature; use and derive simple equations and carry out appropriate calculations; undertake basic data analysis including simple statistical techniques

SKILLS AND KNOWLEDGE

	Students will develop their KNOWLEDGE of	Students will develop their SKILLS in
9	**Energy:** energy changes in a system involving heating, doing work using forces, or doing work using an electric current; calculating the stored energies and energy changes involved; power as the rate of transfer of energy; conservation of energy in a closed system; dissipation; calculating energy efficiency for any energy transfers; renewable and non-renewable energy sources used on Earth; changes in how these are used. **Electricity:** measuring resistance using p.d. and current measurements; exploring current, resistance and voltage relationships for different circuit elements, including their graphical representations; quantity of charge flowing as the product of current and time; drawing circuit diagrams; exploring equivalent resistance for resistors in series; domestic a.c. supply; live, neutral and earth mains wires; safety measures; power transfer related to p.d. and current, or current and resistance.	**Scientific attitudes**: pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility; understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review; evaluate risks. **Experimental skills and investigations**: ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience; make predictions using scientific knowledge and understanding; select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate; use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety; make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements; apply sampling techniques. **Analysis and evaluation:** apply mathematical concepts and calculate results; present observations and data using appropriate methods, including tables and graphs; interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions; present reasoned explanations, including explaining data in relation to predictions and hypotheses ; evaluate data, showing awareness of potential sources of random and systematic error; identify further questions arising from their results. **Measurement:** understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature; use and derive simple equations and carry out appropriate calculations; undertake basic data analysis including simple statistical techniques

INTENT- KS4

Our KS4 curriculum builds on the strong foundations that students have set up themselves in KS3. Teaching the sciences in KS4 continues with the process of building upon and deepening scientific knowledge and the understanding of ideas developed in earlier key stages in the subject disciplines of biology, chemistry and physics. For some students, studying the sciences in key stage 4 provides the platform for more advanced studies, establishing the basis for a wide range of careers. For others, it will be their last formal study of subjects that provide the foundations for understanding the natural world and will enhance their lives in an increasingly technological society.
Science is changing our lives and is vital to the world's future that all students should be taught essential aspects of the knowledge, methods, processes and uses of science. They should be helped to appreciate the achievements of science in showing how science has evolved with time. The sciences taught are linked to different careers in the scientific world. We are inclusive of all students providing triple science for all and differentiating these disciplines to allow all to succeed, this includes the addition of entry level certificate.

SKILLS AND KNOWLEDGE

	Students will develop their KNOWLEDGE of	Students will develop their SKILLS in
10 & 11	**Forces:** forces and fields: electrostatic, magnetic, gravity; forces as vectors; calculating work done as force x distance; elastic and inelastic stretching; pressure in fluids acts in all directions: variation in Earth's atmosphere with height, with depth for liquids, up-thrust force **Forces and motion:** speed of sound; estimating speeds and accelerations in everyday contexts; interpreting quantitatively graphs of distance, time, and speed; acceleration caused by forces; Newton's First Law; weight and gravitational field strength; decelerations and braking distances involved on roads. **Wave motion:** amplitude, wavelength and frequency; relating velocity to frequency and wavelength; transverse and longitudinal waves; electromagnetic waves and their velocity in vacuum; waves transferring energy; wavelengths and frequencies from radio to gamma-rays; velocities differing between media: absorption, reflection, refraction effects; Production and detection, by electrical circuits, or by changes in atoms and nuclei; uses in the radio, microwave, infra-red, visible, ultra-violet, X-ray and gamma-ray regions, hazardous effects on bodily tissues. **Magnetism and electromagnetism:** Exploring the magnetic fields of permanent and induced magnets, and the Earth's magnetic field, using a compass; Magnetic effects of currents; how solenoids enhance the effect; how transformers are used in the national grid and the reasons for their use.	**The development of scientific thinking:** ways in which scientific methods and theories develop over time; using a variety of concepts and models to develop scientific explanations and understanding; appreciating the power and limitations of science and considering ethical issues which may arise; explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments; evaluating risks both in practical science and the wider societal context, including perception of risk; recognising the importance of peer review of results and of communication of results to a range of audiences. **Experimental skills and strategies:** using scientific theories and explanations to develop hypotheses; planning experiments to make observations, test hypotheses or explore phenomena; applying a knowledge of a range of techniques, apparatus, and materials to select those appropriate both for fieldwork and for experiments; carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations; recognising when to apply a knowledge of sampling techniques to ensure any samples collected are representative; making and recording observations and measurements using a range of apparatus and methods; evaluating methods and suggesting possible improvements and further investigations.

SKILLS AND KNOWLEDGE

	Students will develop their KNOWLEDGE of	Students will develop their SKILLS in
10 & 11	**The structure of matter:** relating models of arrangements and motions of the molecules in solid, liquid and gas phases to their densities; melting, evaporation, and sublimation as reversible changes; calculating energy changes involved on heating, using specific heat capacity; and those involved in changes of state, using specific latent heat; links between pressure and temperature of a gas at constant volume, related to the motion of its particles (qualitative). **Atomic structure:** nuclear model and its development in the light of changing evidence; masses and sizes of nuclei, atoms and small molecules; differences in numbers of protons and neutrons related to masses and identities of nuclei; isotope characteristics and equations to represent changes; ionisation; absorption or emission of radiation related to changes in electron orbits; radioactive nuclei; emission of alpha or beta particles, neutrons, or gamma-rays, related to changes in the nuclear mass and/or charge; radioactive materials, half-life, irradiation, contamination and their associated hazardous effects; waste disposal; nuclear fission, nuclear fusion and our Sun's energy **Space physics:** main features of the solar system	**Analysis and evaluation:** applying the cycle of collecting, presenting and analysing data, including; presenting observations and other data using appropriate methods; translating data from one form to another; carrying out and representing mathematical and statistical analysis; representing distributions of results and making estimations of uncertainty; interpreting observations and other data, including identifying patterns and trends; making inferences and drawing conclusions; presenting reasoned explanations, including relating data to hypotheses; being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error; communicating the scientific rationale for investigations, including the methods used, the findings and reasoned conclusions, using paper-based and electronic reports and presentations. **Vocabulary, units, symbols and nomenclature:** developing their use of scientific vocabulary and nomenclature; recognising the importance of scientific quantities and understanding how they are determined; using SI units and IUPAC chemical nomenclature unless inappropriate; using prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano); interconverting units; using an appropriate number of significant figures in calculations.

CURRICULUM LESSONS ALLOCATED OVER THE 2 WEEK TIMETABLE

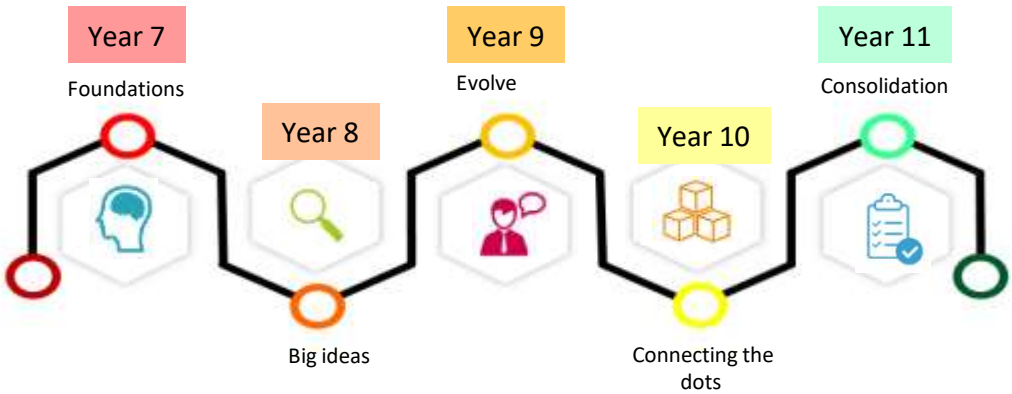
Year 7	Year 8	Year 9	Year 10	Year 11
2 hours	2 hours	3 hours	4 hours	4 hours

OVERVIEW

Qualification gained by the end of year 11: GCSE in Physics

Whole school vision links developed in this subject	After school destinations linked to this subject	
• Allowing student to be encouraged in their learning by providing a safe learning environment so they can be ambitious and achieve above and beyond • British values through mutual respect • Inclusive for all- same setting but differentiated work. • Supporting local providers	A' Level Physics Astronomer Clinical scientist Medical physics Geophysicist Higher education lecturer Meteorologist Nanotechnologist Sound engineer	Radiation protection practitioner Research scientist (physical sciences) Secondary school teacher Technical author

Science CURRICULUM THEMES



Cross Curriculum links in science

- Geography- rock cycle,
- Maths- calculations, graphs
- History- history of periodic table/ atom
- PE- anatomy & lifestyle
- English- literacy
- CA- field science

Year 7- Physics Curriculum

CUMBRIA FUTURES FEDERATION

Curriculum theme: ***Foundations***

In Year 7, students lay the foundations to their knowledge, cementing previous knowledge from KS2 and adding more knowledge and skills to their mind-sets.

KS2 recap

Students are given a baseline test to assess their entry level to KS3. Our first chapter is to introduce science 1 skills, so students learn about variables, predicting, planning obtaining results, analyzing concluding and evaluating. These are all the fundamental skills needed for experiments.

1. P1.1 Forces

In this chapter students learn the foundations of physics and are introduced to forces and force diagrams. They learn about interactive force pairs and Hooke's law.

2. P1.2 Sound

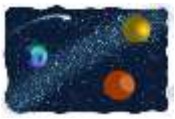
This chapter looks at how sounds are made and the different features of sound and sound waves.

3. P1.3 Light

This chapter introduces the concept of light and looks at simple behaviours of light like reflection and refraction.

4. P1.4 Space

In this chapter Students look at the structure of the solar system, phases of the moon, the seasons and the night sky.



Progressing into year 8

Students will complete an end of year assessment during exam week.

Year 8- Physics Curriculum

CUMBRIA FUTURES FEDERATION

Curriculum theme: ***Evolve***

In Year 9, students start to bring together knowledge and skills to create a bigger picture of the world of science. They begin to understand how all three disciplines link together as well as linking to the outside world.

Year 7 recap

Students again complete a short chapter about science 1 skills. students recap knowledge about variables, predicting, planning obtaining results, analyzing concluding and evaluating. These are all the fundamental skills needed for experiments.

1. P2.1 Electricity and magnesium

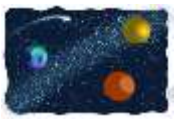
This module looks at conductors and insulators and basic series and parallel circuits. The students then move on to study magnetism and electromagnets.

2. P2.2 Energy

In this module students learn the foundations of physics and introduces the energy store model and the mechanisms of transfer between different energy stores.

3. P2.3 Motion and pressure

In this chapter students learn about pressure in solids, liquids and gases. They also learn to calculate speed and interpret distance-time graphs.



Progressing into Year 9

Students will complete an end of year assessment during exam week.

Year 9- Physics Curriculum

CUMBRIA FUTURES FEDERATION

Curriculum theme: ***Explain***

In Year 9 students will begin to explain theories of other scientists as well as their own theories and predictions. They will use knowledge from previous years to build on already founded concepts and knowledge to justify their ideas and theories..

Year 8 recap

Students begin their GCSE course in Year 9. They start by returning to the topic of energy covered in the Year 8 energy chapter. Building on their prior learning and knowledge from Year 8.

1. P1 conservation and dissipation of energy

In this chapter students review and build on their knowledge from the Year 8 energy chapter. They build on their knowledge of energy store, model, sand and the mechanisms of transfer between different energy stores. They learn to calculate different energy values like kinetic energy and gravitational potential.

2. P2 Energy transfer by heating

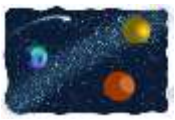
In this chapter students build further on their knowledge from the Year 8 energy chapter, by looking at heat energy transfer and applying it to heating and insulating of buildings a. This chapter also introduces the concept of specific heat capacity.

3. P3 Energy Resources

In this module students build on their knowledge from the Year 8 energy chapter by learning about how electricity is produced via renewable and non-renewable energy resources, as well as evaluating these different methods of meeting the nation's energy demands

4. P4 Electrical Circuits

In this chapter students review and build on their knowledge from the Year 8 electricity and magnetism chapter by describing static electricity before describing electrical fields and investigating the relationship between current, potential difference and resistance in different components.



Progressing into Year 10

Students will complete an end of year assessment created by the AQA exam board and aimed at assessing students' knowledge of the Year 9 chapters. Students will be graded in line with GCSE grades 1-9.

Year 10- Physics Curriculum

CUMBRIA FUTURES FEDERATION

Curriculum theme: ***Connecting the dots***

In Year 10, knowledge is linked together in students' minds as it is this linking, or construction, that creates understanding. This linking takes time and requires students to engage in practice and a degree of struggle, to promote reorganisation of ideas, that will ultimately lead to a personal understanding.

Year 9 recap

Transition tests

1. P6 Molecules and energy

In this chapter students review and build on their knowledge from the Y8 chapter s Matter and pressure and motion. They are introduced to the concept of internal energy and specific latent heat, alongside describing the relationships between gas pressure and temperature from the

2. P7 Radioactivity

In this chapter students are introduced to nuclear radiation by describing the different types of nuclear radiation and calculating half-life.

3. P8 Forces in balance

In this chapter students review and build on their knowledge from the Year 7 forces and Year 8 motion and pressure chapters, by introducing vectors and resolving forces.

4. P9 Motion

In this Chapter students review and further improve their knowledge from the Year 7 forces and Year 8 motion and pressure chapters by calculating velocity and acceleration and analysing motion graphs.

5. P10 Forces and Motion

In this chapter students review and build on their knowledge from the Year 7 forces and Year 8 motion and pressure chapters by calculating velocity and acceleration and analysing motion graphs including velocity-time graphs.

Progressing into Year 11

Students will complete an end of year assessment which will be a previous Paper 1 from the AQA exam board and aimed at assessing students' knowledge of the Year 9/10 chapters. Students will be graded in line with GCSE grades 1-9.

Year 11- Physics Curriculum

CUMBRIA FUTURES FEDERATION

Curriculum theme: ***Consolidation***

In Year 11, students start to consolidate their knowledge in preparation for exams and putting their knowledge and skills to the test.

Year 10 Recap

Students will move onto the new chapters in the GCSE course. There will be an assessment during assessment week to aid our development and focus for revision sessions.

1. P10 Forces and motion

In this chapter students further build on their knowledge from the Year 7 forces and Year 8 motion and pressure chapters, by describing the effect of forces acting on a falling body, during braking and introducing the concept of momentum. This module then extends to study the conservation of momentum in car safety.

2. P11 Forces and pressure

In this module students extend on their knowledge from the Year 8 chapters – matter, motion and pressure by further extending their knowledge of pressure on liquids and gases.

3. P12 Wave Properties

In this chapter students review and build on their knowledge from the Year 7 light and sound chapters by looking at the nature and behaviour of waves.

4. P13 EM waves

In this chapter students review and build on their knowledge from the Year 7 Light and space chapters by describing the electromagnetic spectrum and its uses

5. P14 Light

In this chapter students review and build on their knowledge from Year 7 light chapter. Students extend their knowledge to different types of lenses and their uses.

6. P15 Electromagnetism

In this module students review and build on their knowledge from the Year 8 chapter electricity and magnetism, extending their prior knowledge to understanding and explaining the motor effect.

7. P16 Space

In this chapter students review and build on their knowledge from the Year 7 Light and space chapters by describing the origin and future of the universe and the evidence supporting it.

Exams

Students will sit 2 exams per science. Paper 1 in physics covers P1 to P7 and paper 2 covers P8 to P16. Each paper is 1 hour and 15 minutes.

Potential destinations

A'level physics, Astronomer, Clinical scientist, medical physics, Geophysicist, Higher education lecturer, Meteorologist, Nanotechnologist, Radiation protection practitioner, Research scientist (physical sciences), Secondary school teacher, Sound engineer, Technical author