Teaching of KS5 Physics

The Ecclesbourne school teach the AQA specification of Physics at A level.

The specification is designed to help inspire students, nurture a passion for Physics and lay the groundwork for further study in science or engineering.

The content has been specifically designed with the AQA GCSE specification in mind to make sure that there is a seamless progression between qualifications.

This specification provides numerous opportunities to use practical experiences to link theory to reality and equip students with the essential practical skills they need.

The course allows for a choice of starting points. At Ecclesbourne we build on the familiar, starting with mechanics and electricity before introducing fresh topics including particle physics topics to create interest and a new dimension to their knowledge.

Year 12 content follows the first year of the A level and AS content. This allows assessment against this standard at the end of the year. The topic Measurements and their errors is taught throughout the course as practical work is undertaken.

The Ecclesbourne school use the resources of Oxford University Press and its Kerboodle system. The includes the Oxford University Press student text book AQA Physics A level 2nd Edition by Jim Breithaupt together with substantive additional resources.

The teaching order is detailed in Table 1.

Year 12

Year	Term	Section	Chapter	
12	2-3	3.2 Particles and Radiation	1. Matter and radiation 2. Quarks and leptons 3. Quantum phenomena	*This section is about the fundamental properties of matter, radiation, and energy. Students will learn about experimental evidence and theoretical ideas in particle physics, including the concepts of quarks and leptons, and matter and antimatter. They will study quantum theory, including the concepts of atomic energy levels and wave–particle duality. Throughout this section, students will gain awareness of the ongoing development of new ideas in physics. This is likely to be a particularly exciting area of physics for many students, who may have heard and read about particle physics and quantum physics and looked forward to studying them.*

12	2	3.3 Waves and optics	4. Waves 5. Optics	*In this section students will learn about waves and their behaviours, including refraction, diffraction, stationary waves, and interference. The section comprises two chapters: Chapter 4 Waves focuses on general wave properties in broad detail, and also stationary waves; whilst Chapter 5 Optics involves a more detailed analysis of refraction, diffraction, and interference, and demands more advanced mathematical skills.* *This section includes many opportunities for experiments, and students can start to work on their general practical skills such as planning experiments, analysing uncertainties, and using different types of apparatus such as oscilloscopes and lasers. Required mathematical skills include algebra, geometry, and data handling.* This section builds on Key Stage 4 studies of waves.
12	1	3.4 Mechanics and materials	6. Forces in equilibrium 7. On the move 8. Newton's laws of motion 9. Force and momentum 10. Work, energy, and power 11. Materials	*This section builds on Key Stage 4 studies of motion, force, and energy to develop students' understanding of the principles and applications of mechanics and materials. Students will learn to use vectors to represent physical quantities and to analyse forces and moments for objects in equilibrium. They will model motion with constant acceleration, including free fall and projectile motion. They will study Newton's laws of motion and apply them to situations such as rocket launches, skydiving, and vehicle impacts. Students will extend their understanding of Newton's laws to incorporate momentum, and apply the concepts of momentum and impulse to collisions and explosions. They will connect force and energy via the concept of work done, use the principle of conservation of energy, and calculate power and efficiency. Finally, they will analyse the deformation of materials under tension and compression.* *This section is rich in opportunities for students to develop their practical skills, by measuring and analysing forces in equilibrium, moments, objects in motion, collisions, and materials under stress. Many of the practical activities involve plotting and analysing graphs and estimating uncertainties. Most of the other mathematical skills required for the AS and A Levels will be practised in this section, including various aspects of trigonometry, geometry, and algebra.* This section builds on Key Stage 4 studies of forces.
12	1	3.4 Electricity	12. Electric current 13. DC circuits	*This section is about the key variables involved in the analysis of direct current circuits, and about some of the components used in such circuits, including resistors, lamps, diodes, and thermistors. Students will apply current and potential difference rules to analyse circuits involving multiple resistances and cells, including cells with internal resistance.*

				The section includes many opportunities for experiments on components and circuits: it includes investigations of I–V characteristics, resistance combinations, resistivity, internal resistance, combinations of Electromotive force (emf), and potential dividers. Students will need to build circuits correctly using circuit diagrams, use electrical equipment safely, and obtain measurements with digital meters. The mathematical techniques applied include using standard form, calculating means, manipulating fractions, and plotting and interpreting graphs. This section builds on Key Stage 4 studies of electricity.
12		3.1 Measurements and their errors	14. Practical work in physics 15. Practical assessment 16. More on mathematical skills	*These topics are taught throughout the course as practical work is undertaken.*

Year 13

13	1	3.6 Further mechanics and thermal physics	17. Motion in a circle 18. Simple harmonic motion 19. Thermal physics 20. Gases	*This section consists of two main areas: further mechanics and thermal physics. Both areas depend on a good understanding of A level physics year one studies on force and energy. Further mechanics develops the A level year one link between force and acceleration in the context of objects in circular motion at constant speed and objects oscillating in simple harmonic motion. By studying the further mechanics topics in this section students establish a solid basis for further studies in both physics and engineering.* *Thermal physics is the study of thermal properties of materials including the relationships between energy, temperature and the physical state of a substance. Students learn to explain the physical properties of an ideal gas by applying the kinetic theory of matter and the laws of mechanics to a simple molecular model of a gas. This model is a classic example of the successful use of a theory to explain a law founded on experimental observations.* This topic builds on A level physics year one studies on force and energy.
13	1	3.7 Fields	21. Gravitational fields 22. Electric fields 23. Capacitors 24. Magnetic fields 25. Electromagnetic induction	*This section extends students' A level physics year one studies on mechanics, electricity and energy. They deepen their understanding of the gravitational force, the electrostatic force between charged objects, and the forces that magnetic fields exert on current carrying conductors and moving charges. In studies of exchange particles in section one of A level year one students will have gained some appreciation of the actions of these forces. In this section they deepen their understanding of the differences and similarities between gravitational electric and magnetic fields and the effects they have on objects. Both Newton's law of gravitation and its application to satellite motion and coulomb's law of force between charged objects are considered in depth. The study of electric and magnetic fields applies to knowledge and understanding to a range of applications and devices. These include the capacitor which is commonly used in radio circuits and timing circuits and alternating current generators and Transformers which are used to generate and supply electricity in our home.* This topic builds on A level physics year one studies on mechanics, electricity and energy.
13	1	3.8 Nuclear physics	26. Radioactivity 27. Nuclear energy	*In this section students extend A level physics year one studies on the structure of the atom and mechanics. Students look in depth at the random nature of radioactive decay.* *They discuss the relative hazards to humans of exposure and the safe handling and storage of radioactive sources.*

				Students also study nuclear instability in relation to stable nuclei plotted on an N-Z graph. They consider the evidence from gamma radiation studies for nuclear excited states and study the use of gamma radiation from these states. Students then move on to calculate the density of the nucleus from experimental measurements. Finally, they consider why energy is released in nuclear fission and fusion, how to calculate the energy released in such changes, how the release of fission energy is controlled in a thermal nuclear reactor and how safety is ensured in the operation of nuclear reactors and in the storage of nuclear waste. This section builds on level physics year one studies on the structure of the atom and mechanics.
13	2	3.9 Astrophysics	28. Telescopes Stars Cosmology	*In this option students apply fundamental physics principles to the astronomical observations and measurements of objects in space. The option starts by considering the optical principles of telescopes used by astronomers and how they are designed. Students learn how refracting and reflecting telescopes are designed and what is meant by terms such as magnifying power and resolving power.* *In chapter 2 students discover how accurate observations and measurements have been used to develop our current astronomical knowledge about stars and galaxies. They learn what is meant by the absolute magnitude of a star and how the temperature, radius and other properties of stars have been determined. Students discover how astronomers classify stars according to their absolute magnitude and temperature and how different classes of stars form, evolve and die.* *In the final chapter students learn about how astronomers such as Edwin Hubble deduced from their observations that the distant galaxies are moving away from each other and why astronomers now believe the expansion of the universe is accelerating. The cause of this acceleration remains unclear at present and astronomers think a mysterious form of energy known as dark energy is at work.* This section builds on the KS4 topics of Space and Optics (part of the section on Waves).
	3	3.1 Measurements and their errors	29. Practical work 30. Mathematical skills	*Time is taken to consolidate learning throughout the course on this topic and to prepare students for the AQA A Level Physics Paper 3 assessment.*

Note Chapter numbers refer to textbook AQA A Level Physics 2nd Edition Oxford University Press