love the journey

Curriculum Implementation 2023-24

Secondary

LCA Strand	Science
Subject	**Physics**
Key Stage	**Key Stage 5 (Chapter 12-13)**

What are the key concepts taught?	**Paper 1** – Particle physics, Quantum phenomena, Waves, Mechanics, Materials and Electricity **Paper 2** – Further mechanics, Thermal physics, Gravitational fields, Electric fields, Capacitors, Magnetic Fields and Radioactivity **Paper 3** – Practical skills and Astrophysics **Practical skills** – all students are entered for the CPAC practical assessment alongside their A level papers, and data analysis skills are also tested in Paper 3A.

What is the sequencing of units?	**In Chapter 12 and Year 13 the course content is divided between two teachers which allows pupils to learn two topics concurrently and build their higher level physics schema, and their understanding of the links between their substantive and disciplinary knowledge more rapidly.** **Chapter 12** – In **Chapter** 12, with one teacher we start with the particle physics and quantum phenomena topic. This gives pupils an exciting introduction to more challenging and modern physics, as well as building on their GCSE knowledge of atomic structure and scientific models of light and particles. With this teacher, we then move on to cover the electricity topic where pupils gain a much deeper understanding of the nature of electrical current, emf and resistance as well as becoming fluent in the problem solving and calculation skills required. We then move on to study the bulk properties of materials including density, elasticity and the Young modulus. With the second teacher, pupils begin the year by optimising their practical skills and develop an appreciation of the importance of taking accurate measurements, carefully recording and presenting

	data in standard formats, and learn how to qualify their data with a valid assessment of error bounds. As well as giving pupils the tools to support their practical work through the A Level course, this topic lays the foundations for achieving well in both the CPAC practical endorsement and Paper 3A in Chapter 13. We then move onto the mechanics topic where pupils study forces, acceleration, moments, energy conservation and momentum – applying their knowledge to solve increasingly complex problems. We follow mechanics by covering progressive and stationary waves and refraction before introducing the more complex topics of interference and diffraction gratings. Once Paper 1 content is completed, pupils will be given opportunities for overall revision and retrieval as well as an introduction to the first Chapter 13 topics to allow them to make more rapid progress the following year. **Chapter 13 –** In Chapter 13 we move onto more challenging physics concepts in order to prepare pupils for the A Level exams and for further study at university level. With their first teacher, the pupils will begin the Paper 2 content with the thermal physics topic which allows them to explore a more experimental and statistical approach to physics, which is in contrast to the theoretical nature of the majority of the SOW. We then cover gravitational fields which introduces pupils for the challenging concepts linking field strength, action-at-a-distance, force and potential. Pupils then move on to study radioactivity and nuclear fission which builds and extends on their GCSE learning and develops this far further into decay equations, calculations of nuclear radius and the use of $E=mc^2$. The final topic is astrophysics, which introduces new knowledge and broadens pupils understanding of our place in space, as well as linking back to the skills and disciplinary knowledge gained in many previous topics the pupils have covered during the A Level course. With the second teacher, pupils will cover further mechanics which extends their Chapter 12 learning and introduces pupils to circular and simple harmonic motion. We then move on to electric fields and the closely linked topics of capacitance and magnetic fields which really stretch pupils' ability to grasp apply abstract concepts and combine spatial awareness with mathematical reasoning. Studying these higher level fields topics at this point in the SOW is intentionally planned as pupils have already been introduced to the gravitational fields earlier in the year. Once the course content has been completed, this teacher then takes pupils through any required practicals that still need to be completed followed by intensive revision of content, mathematical and data skills and problem-solving confidence in preparation for the final exams.

How do we encourage pupils to see the links between different units and concepts?	There are continual links back to **fundamentals** in physics through each subsequent topic e.g. when learning how to calculate the closest approach of an alpha particle to a nucleus at the end of Chapter 13 pupils will need to use their knowledge of

	energy conservation, kinetic energy, electric fields and basic atomic structure. **Spiralling** of the curriculum each year is a strength of our SOW e.g. electrical fields and further mechanics in Chapter 13 revisit content from electricity and mechanics in Chapter 12. Spiralling allows pupils to thoroughly consolidate their understanding of the absolute fundamental substantive and disciplinary knowledge required in physics, and enables us to ensure there are no gaps in pupils' knowledge by the time they finish the A Level course. **Questioning** (whole class and independent work) is present in all lessons which intentionally leads pupils to see the links between topics. **Retrieval** tasks are planned to review linked content learnt previously to allow students to internalise the connections between the different topics and skills. **Cross curricular** links are explicitly made in lessons between physics topics and other science/maths/geography. Specific areas of common content with chemistry and maths e.g. the use of mole calculations in thermal and nuclear physics, and the ability to linearise exponential decay equations using ln graphs are identified by teachers so that pupils can make those links in their schema and organise their knowledge effectively.

What are the planned opportunities for adaptive teaching, including for SEND, the more and able and disadvantaged pupils?	It is well documented that physics can be difficult to access for disadvantaged and vulnerable pupils across the country. Our curriculum aims to go against that trend with the use of positive, adaptive teaching throughout the key stages including at KS5. All of our teachers provide formal and informal interventions for pupils where needed, both inside and outside of timetabled lessons. Teachers ensure they are familiar with individual pupil profiles and plan and adapt their teaching accordingly taking these into account. Stretch and challenge for the most able students is planned with the use of extended research tasks, preparation for Oxbridge entrance exams, and we also regularly enter students in the Physics Olympiad in Chapter12.

What are the planned opportunities for retrieval and reflection by pupils?	Planned, targeted **retrieval starters** which return to previously learnt content at regular intervals with increasing levels of challenge, as well as **cumulative assessment** in both low stakes assessments and PP exams throughout the year. **Pre- and post-assessment** lessons are planned carefully to ensure a breadth of content is revised beforehand, and that pupils have the opportunity to reflect on their outcomes. At this level, pupils are often given extended review tasks to complete independently in their own study time to improve their progress on their individual areas for development.

	As the course progresses, pupils are also encouraged to apply their knowledge beyond the AQA specification which stretches their thinking skills and also allows them to retrieve information but apply it to unfamiliar contexts and different styles of question e.g. questions from other exam boards, ENGAA papers, challenging textbooks e.g. practice in physics.

What are the opportunities for feed forward by the teacher post assessment outcomes?	Lessons set aside for **assessment review** and targeted questions based of students' individual errors and misconceptions. Students **reflect** on their assessment performance and set their own targets for their progress. Smaller **low-stakes assessment for learning** and mini-tests used frequently by class teachers to allow rapid feedback and feed forward to avoid misconceptions being embedded. Teachers act on errors and misconceptions demonstrated in assessments and in class and **adapt content of future lessons** to review skills and knowledge as needed.

What are the planned opportunities for developing Reading?	**Reading lists** relevant to KS5 are shared with pupils, which include journals and articles as well as books, as well as suggestions shared with school library for new book purchases. Challenging questions are used for independent work which include large extracts of technical and scientific writing, particularly in the nuclear physics and magnetic fields topics in Chapter 13. Where relevant teachers use **reading comprehension** activities and homework **research tasks** to develop pupils' ability to read and understand complex non-fiction texts – this includes researching alternative methods for required practicals and real-life applications of physics. Pupils are also taught how to reference articles and websites.

What are the planned opportunities for developing literacy, numeracy, oracy and SMSC?	**Literacy –** Each key concept of the curriculum has topics which allow for knowledge of tier 2 and 3 vocabulary and literacy skills to be embedded in lessons throughout the course. Extended writing is planned within lessons, homework research tasks and assessments e.g. students will be able to write cogently on the various features of optical fibres, evaluate the hazards present in obtaining power from nuclear fission and write structured conclusions drawn from experimental data. **Numeracy –** Developing students who are confident in the application of numeracy to physics problems is the absolute foundation of our curriculum with fundamental algebra, calculation, ratio, geometry and estimation skills being essential to the success of our pupils at A Level. We aim to give our pupils the confidence to know when a problem requires a quick estimate, the use of mental arithmetic combined with key knowledge, or careful substitution of exact values. Mathematical skills are explicitly planned in the resources for each lesson and highlighted by teachers in every lesson.

	Oracy – Paired and group discussions to assist students to build their physics schema and articulate answers are present in many physics lessons. When carrying out required practicals, pupils must learn to carefully attend to verbal instructions and communicate effectively with their peers in order to succeed. **SMSC –** Links to the role of science in society and industry, discussion of STEM degrees and career paths and the representation of female and ethnically diverse scientists are present throughout the course. Exploration of the key turning points in the history of physics e.g. the arguments between the supporters of the particle and wave models of light and the dual model we now use is planned within the SOW. Our physics curriculum also aims to develop a proper understanding of hazards and risks where good scientific understanding will support pupils to make informed decisions e.g. car and road safety features, radiation safety and the use of lasers are just a few examples of how we achieve this within our curriculum.