Physics Curriculum Plan

Intent: Studying physics will help students to understand how the universe is structured. They will solve problems using their imagination and by developing their modelling skills. There are many areas in which this knowledge is vital to a responsible citizen, such as understanding the need for cleaner power generation through technologies like nuclear fusion. With Triple award Physics, students will be introduced to more advanced mathematical and logical modelling and explore further topics such as moments, electro-magnetic induction and Astrophysics.

Year	What will students learn?	Rationale	How will students be assessed?	Real world (disciplinary knowledge / careers / local area)
7	Phase 1 – Space, Waves and Sound Phase 2 – Energy and Energy resources	In Y7, we aim to teach the basic skills of scientific enquiry, lateral thinking, logical/mathematic modelling and practical skills whilst providing an engaging context where students can use their imagination and engage fully. To this end, we chose space for its highly engaging context as the introductory physics topic followed by Waves and Sound which provides opportunities for modelling and practical activities. After this, we have chosen energy as this is a fundamental part of all physics learning in the future. Once this key concept is covered, we continue along to the current social context of Energy resources. Our reasoning behind this is that it shows how the student's learning can be used in a wider (and arguably important) context in their own lives.	Students will sit a summative test at the end of each phase. This will also be used in formative assessment and, where appropriate, to regroup the student into a group better suited to their needs. These assessments are provided by the "Activate" education group, which also write the textbooks we use in lessons.	*Y7 is an important year in physics where we build important understanding of application of key skills and foster a love of physics which will hopefully last for the rest of the student's school career. Specific skills include;* Plotting and interpretation of simple bar charts (planet vs temperature, hearing ranges of different animals) Plotting of bar charts from experimental data (how much a specific burned food heats up a water source) Use of plotted bar charts to make conclusions (for example, which insulator is most effective in keeping water warm) Use of simple data to make conclusions (e.g., from a list of planet temperatures, which is the hottest planet?)

				Interpretation of data to make conclusions (e.g., time of day at a certain point of the year to decide if a person is north or south of the equator) Use of units to represent magnitudes (for example energy is measured in joules) Use of simple prefix conversions (1KJ = 1000J). Use of alternative units of energy (kWH) ***All of this has links to real-world careers such as astrophysics research, engineering and data analysis. There are also real-world links to the energy crisis and environmental concerns with electricity generation techniques***
8	Phase 1 – Forces, Motion and Pressure Phase 2 – Light, Electricity and Magnetism	In Y8, we continue with the development of logical/mathematical modelling in preparation for the KS4 course. For this reason, we have chosen to start with Force, Motion and Pressure. This gives us an opportunity to explore mathematical modelling and how to most effectively assign, use and solve basic physics formulae. This is also a more "physical" context and therefore easier for students to picture and model logically, allowing us to build these skills		*Disciplinary knowledge in Y8 builds on the skills outlined above, but develops this further by adding;* Plotting of line graphs based on experimental data Ability to choose axis scales based on given data Use of lines of best fit to show the relation of data (NOT dot to dot) Interpretation of data from line graphs to make conclusions (NOT calculation of gradients yet)

		After this, we move to more advanced modelling with Light, Electricity and Magnetism. As these contexts are entirely dependent on logical modelling (they can't be "seen" and can be challenging to imagine), this gives us an opportunity to describe how observations, experimentation and repeated changes shape how we model these concepts and how models are continually adapted and revised based on improved results and understanding.		Interpretation and analysis of line graphs (specifically graphs of motion) (this includes use of "dot to dot – the only time we use this inn physics), determination of gradients and calculation of areas under the line of data Plotting and interpretation of graphs from given data Ability to choose axis scales based on given data Identification and use of correct graph types (bar or line) based on variable type of the independent variable Making conclusions from given data and graphs Use of units to represent magnitudes (for example, force is measured in newtons) Description of relationships between variables (force is directly proportional to extension) Calculation of changes in a single variable (extension = change in length) Substitution and calculation from simple equations (w=mg, s=d/t, P=F/A, calculation of moments) – INTRODUCTION OF GUESS METHOD

				Use of negative numbers in the context of force directions to calculate resultant forces and moment direction Introduction to use of standard form for larger and smaller numbers Calculation of mean averages of data Identification of patterns from given data to determine relationships between variables Definition and identification of independent, dependent and control variables as well as "fair tests" ***All of this has links to real-world careers such as Mechanical/electrical engineering, especially paving the way into an understanding of hydraulic systems. There are also real-world links to the national grid which further links into the world energy crisis and how to transfer electricity efficiently***
9		In Y9, students now have a stronger grasp on modelling and scientific method then they had when they started learning science. For this reason, we revisit the most fundamental key concept of physics – Energy. This time, however, we can use and further develop the logical and		*Year 9 is an especially important year in physics as it is here we secure the skills learned in KS3 and further develop the skill to a point where the rest of the course can be accessed effectively. Specific skills include;* Use of given graphs to make conclusions about data

	Topic 1 – Energy Topic 3 – Particles Topic 4 – Atomics Separate Science only – Topic 8 (Space)	mathematical modelling skills students have developed over KS3 to better understand and explore this key concept. As before, we then demonstrate how scientific understanding can be applied to real-world social issues by discussing Energy resources and their effect on the environment. Similar to the beginning of Y8, we feel strongly that a firm grasp of basic formulaic manipulation and mathematic modeling is essential for the rest of the course. As the Energy topic contains the majority of the mathematic work for this academic year, we have an excellent opportunity to build these basic key skills to a high level, in turn making the rest of the course easier to access. The remaining topics of Atomics, Particles and (for triple award only) Space allow us to explore logical modelling with “physical” contexts which is easier to imagine and understand, allowing us opportunity to develop these vital modelling and logical deduction skills	There is a 40- mark end of topic assessment for each topic designed to assess key knowledge and skills in an exam context. Papers are made using past exam papers and are used to influence future development of said skills and assess any gaps in key knowledge At two points of the year, students will sit a summative assessment which will allow us to give current attainment grades and explore avenues to improve further.	Use of experimental data to plot appropriate graphs (bar or line) based on independent variable type Ability to choose axis scales based on given data Lines of best fit plotted on-line graphs Conclusions and comparisons made from graphical data interpretation of sketch graphs to identify relationships of data without values Use of sketch graphs/plotted line graphs to describe behavior of particle models (temp vs energy for state changes) Identification of exponential decay for a large population of random events Plotting of significant datum on line graphs Ability to choose axis scales based on given data Use of curved lines of best fit to represent data Determination of ‘half-life” from plotted line graph data

				Identification of correct formulae based on given variables and requested answers Substitution and use of three-variable simple formulae to calculate variables (GUESS structure to be used) Substitution and use of more complex formulae (involving squares/square roots and 4 variable expressions) to solve problems (GUESS structure to be used) Rearrangement of substituted variables in a formula Calculation and appreciation of ratios/percentages (efficiency) Use of units to represent magnitudes (for example energy is measured in joules) Use of simple prefix conversions (1KJ = 1000J) Use of alternative units of energy (kWH) Identification and use of relationships between variables to solve problems

				Use of formulae to describe relationships between data Identification and use of patterns in data to make predictions/conclusions Calculation of volume of a simple object from recorded and given values Identification of correct formulae based on given variables and requested answers Substitution and use of three-variable simple formulae to calculate variables (GUESS structure to be used) Conversion between simple units (g to kg, m to cm) Substitution and use of more complex formulae (involving squares/square roots and 4 variable expressions) to solve problems (GUESS structure to be used) Combinations of multiple formulae to solve one problem (specifically, use of two separate

				formulae to produce two values, which together are used to solve problems) HT only – use of an expression with no given value of constant to describe relationships Appreciation of “random” events and how a large number of random events can follow a pattern Use of more specific units to represent values (e.g., “becquerels” for activity, “sieverts” for exposure) Ability to appreciate the use of standard form for extremely small values Ability to use “relative” measurements for mass and charge of a particle Appreciation for charge and mass conservation in atomic formulae Writing and balancing of atomic/nuclear formulae

				Expressions of net decline in emission after a set value of half-lives Use of half-life of a substance to identify number of half-lives elapsed and, therefore, the age of a material Identification and correction of data based on systematic error (background radiation) Use of given relationships to describe interactions between variables (orbits) ***Energy is a fundamental topic in physics and will underpin a student's understanding of physics as a whole. Specific real-world links include an understanding of the national grid and energy generation (building on what was discussed in KS3) and further applications in engineering and any career that includes the application of logic and applied mathematics. This scheme of work also allows students to gain an understanding of radiation and it's safe handling, which has real-world applications to the growing use of nuclear power and the growing use of radioactive materials in society.***
10		In Y10, we then move to more challenging modelling but with the advanced logic and		*In Y10, students are trained to develop not only key knowledge and skills, but also the ability to*

	Topic 5 – Forces Topic 2 - Electricity in circuits	mathematical skill built in Y9. The Forces topic allows our students to build upon what they have learned in Y8 Forces and use the mode advanced mathematic and logical deduction skills they have gained in Y9 to gain a real understanding of Newtonian motion, which is a key part of physics moving forward. This is then followed by the electricity topic, which will really challenge our students and allow both us and the students themselves to make decisions as to future pursuit of physics and tiers of entry for examinations, as the level of logical and mathematical ability becomes significant.	There is a 40- mark end of topic assessment for each topic designed to assess key knowledge and skills in an exam context. Papers are made using past exam papers and are used to influence future development of said skills and assess any gaps in key knowledge At two points of the year, students will sit a summative assessment which will allow us to give current attainment grades and explore avenues to improve further. One of these assessments will be in a similar format to the GCSE assessment to allow students the opportunity to practice sitting a paper in those conditions.	*apply and visualize more complex and challenging models to explain observations. These skills include;* Plotting of line graphs from given and recorded data Ability to choose axis scales based on given data Analysis of graphs including gradients and area under calculations Appreciation of how changes in axis values can affect variables given by gradients Linking of graphical analysis to formulae, relationships and conclusions Description of observations from graphical data (motion from a v vs t graph) Ability to produce sketch graphs based on expected relationships Ability to identify components based on sketch graphs/line of best fit on plotted data

				Ability to plot line graphs with both positive and negative axis with lines of best fit that can be either curves, straight or a combination of both Ability to form conclusions based on graphical data Ability to explain trends in data using modelling Ability to read and interoperate graphs with variable axis scales (for example, an oscilloscope) Ability to identify values on said graphs Definition and appreciation of vectors vs scalars Ability to attribute negative values to scalars based on direction Ability to use vector diagrams to determine resultant vectors Calculations of mean averages to reduce random error Substitution of similar terms into multiple formula based on context (e.g., Ek = Eg for a falling object, W = E for an object braking)

				Memorization and correct selection of formulae to solve specific problems Use of multiple formulae for more complex problems (specifically using a formulae to work out a value that is not specified, which is then substituted into a second expression to calculate a specified value). Use of energy and momentum conservation to calculate changes in a system Use of relationships to predict changes in a given variable (for example, resistance vs length of a wire) Use of multiple simple formulae to calculate given values (specifically the use of one expression to determine an unspecified value which is then used in a second expression to determine a specified value) Memorization and use of a significant number of simple formulae, in addition to the ability to pick correct formulae to solve a given problem Memorization and use of a range of units

				Ability to see patterns in recorded data and use said relationships to produce general relationships and predict readings Ability to use formulae to describe relationships between variables and use said relationships to describe uses of devices, for example transformers Ability to use more complex formulae to solve problems Ability to use and exploit ratios to determine changes in a given value Appreciation of vector direction in calculations and in descriptions Appreciation (but NOT calculation) of two-dimensional vectors Ability to link rates of change to magnitude of a single variable Use of multiple simple formulae to calculate given values (specifically the use of one expression to determine an unspecified value

				which is then used in a second expression to determine a specified value) Memorization and use of a significant number of simple formulae, in addition to the ability to pick correct formulae to solve a given problem Memorization and use of a range of units ***The Forces topic contains valuable logic and problems solving skills which are of high value to any career both inside and outside of STEM careers.*** ***The Electricity topic has a range of real-world careers to link to, with notable examples including electrical engineering and domestic electricity.***
11	Topic 6 – Waves Topic 7 - Electromagnetism	The waves topic will explore our student's ability to use modelling to explain relationships that are not readily seen as well as use numbers much larger and smaller than they have ever used before in calculation. Electromagnetic interaction is amongst the most challenging context to imagine and logically model as it requires an understanding of interaction between two	There is a 40- mark end of topic assessment at the end of each topic designed to assess key knowledge and skills in an exam context. Papers are made using past exam papers and are used to influence future development of said skills and assess any gaps in key knowledge	*Y11 is a year where we develop application of the skills learned throughout KS4 and coach students in revision and exam techniques to get the most accurate reflection of student ability in the GCSEs in addition to the best possible start for students wanting to do physics at A-level. Specific skills include;* Ability to produce sketch graphs based on expected relationships

		fields that cannot be directly seen. This allows us to really stretch students in the skills built up to this point as well as stretch their abilities to apply their learning to unfamiliar contexts.	At two points of the year, students will sit a summative assessment which will allow us to give current attainment grades and explore avenues to improve further. These will be structured in a similar way to the GCSE assessment to allow students the opportunity to practice the exam and revise previous knowledge.	Ability to identify components based on sketch graphs/line of best fit on plotted data Ability to plot line graphs with both positive and negative axis with lines of best fit that can be either curves, straight or a combination of both Ability to form conclusions based on graphical data Ability to explain trends in data using modelling Ability to read and interoperate graphs with variable axis scales (for example, an oscilloscope) Ability to use more complex formulae to solve problems Ability to use and exploit ratios to determine changes in a given value Appreciation of vector direction in calculations and in descriptions Ability to link rates of change to magnitude of a single variable

				Use of multiple simple formulae to calculate given values (specifically the use of one expression to determine an unspecified value which is then used in a second expression to determine a specified value) Memorization and use of a significant number of simple formulae, in addition to the ability to pick correct formulae to solve a given problem Memorization and use of a range of units ***The waves topic has a specific real-world application in the uses of waves, which links well into careers in IT and communication technology. The importance of communication technology in the form of the internet and mobile/satellite communications is a real-world application of this knowledge in addition to the dangers and understanding of ionizing radiation, such as tanning beds and medical imaging.***
12	**Topic 1 – Working as a Physicist** **Topic 2 – Mechanics** **Topic 3 – Electric Circuits**	**The order of topics in KS5 follows the order given in the Pearson Edexcel Specification – our examining body. We have chosen to follow this structure as the development of mathematic and logical thinking skills given by this order allows us to better support our students, especially**	Students will sit Three papers at the end of the Y13 academic year;	*A-level physics is focused on the idea of mastery of physics and the ability to freely apply and combine skills and ideas to solve both real and theoretical problems. Specific skills learned include;*

	<u>Topic 4 – Materials</u> **<u>Topic 5 – Waves and the Particle Nature of Light</u>**	**those who are not doing mathematics (something we recommend but do not insist upon. Our professional staff do make some minor changes on the topic order to better fit practice examinations, revision or if certain topics work better in combination (for example, some teachers prefer to teach Nuclear Radiation immediately before Nuclear and Particle Physics as this has a shared context), however any such changes are communicated to students ahead of time and are made to better serve the teaching of the content.** **Throughout the topics, Students are also learning practical skills as outlined in Topic 1 – this is done over the period of teaching as it gives us plenty of opportunity to use specialist tools and equipment in suitable contexts.**	• Paper 1, consisting of topics 1,2,3,6,7 and 8 (1 hour 45 minutes) • Paper 2, consisting of topics 1,4,5,9,10,11,12 and 13 (1 hour 45 minutes) • Paper 3, which contains content from all topics but will be entirely in an experimental physics context. (2 hours 30 minutes) The examinations are summative and test the entirety of the course. There unfortunately is no option to "bank" a grade at As. In terms of in-school regular assessment, students sit a short formative assessment at the end of each topic. In Y12, Students will also complete a practice As Paper 1 (topics 1,2	Ability to read and interoperate graphs with variable axis scales (for example, an oscilloscope) Ability to identify values on said graphs Plotting of line graphs from given and recorded data Ability to choose axis scales based on given data Analysis of graphs including gradients and area under calculations Appreciation of how changes in axis values can affect variables given by gradients Linking of graphical analysis to formulae, relationships and conclusions Description of observations from graphical data (motion from a v vs t graph) Ability to produce sketch graphs based on expected relationships Ability to identify components based on sketch graphs/line of best fit on plotted data

			and 3 only) and Paper 2 (Topics 1,4 and 5 only) as a summative assessment as well as for formative feedback. Where possible, Students will also sit a practice paper focused on experimental context-based questions and more advanced contexts. In Y13, in addition to the end of topic tests describes previously, students also sit a practice Paper 1,2 and 3 over the year, again as both a formative and summative assessment. In addition to this, ALL student have to complete a core practical endorsement which assesses practical and analysis skills. This endorsement is based on a holistic review of 12 core practical write-ups done over Y12 and 13 (there are 15 planned core practicals in the current SOW with	Ability to plot line graphs with both positive and negative axis with lines of best fit that can be either curves, straight or a combination of both Ability to form conclusions based on graphical data Ability to explain trends in data using modelling Ability to read and interoperate graphs with variable axis scales (for example, an oscilloscope) Ability to identify values on said graphs Ability to identify values on said graphs Ability to map a n expression to Y=MX+C in order to plan an experiment to determine either M or C Ability to use more complex formulae to solve problems Ability to use and exploit ratios to determine changes in a given value Ability to use and calculate using numbers in standard form

			additional (backup" opportunities available as required).	Ability to memorise, recognize and convert between prefix values from "nano" to "giga" in a calculation Calculation of two-dimensional vectors using both vector diagrams and Pythagoras/trigonometry Ability to resolve vectors into horizontal/vertical components Ability to calculate across two dimensions (SUVAT projectile motion) Ability to see patterns in recorded data and use said relationships to produce general relationships and predict readings Ability to use conservation laws and formulae to logically explain patterns in data Ability to use formulae to describe relationships between variables and use said relationships to describe uses of devices, for example transformers Calculation of random and systematic errors from data

				Calculation of uncertainties from data Ability to use more complex scientific equipment, such as micrometers, Vernier calipers and oscilloscopes ***Students sitting an A-level in physics are more likely to enter into a career of engineering, physics research and economics, and our SOW reflects the core skills that are of use in these fields. There are many real-world links to be made including a greater understanding of engineering, electrical engineering and avionics in addition to quantum physics and practical physics research such as quantum computing and wave-particle duality.***
13	**Topic 1 – Working as a Physicist** **Topic 6 – Further Mechanics** **Topic 7 – Electric and Magnetic Fields** **Topic 8 – Nuclear and Particle Physics**			*The goal in Y13 is to produce true mastery of every skill learnt so far, with students gaining a true understanding of the observable world around them. We also aim to prepare students for their entry into degree level physics Skills to achieve this include;* Ability to read and interoperate graphs with variable axis scales (for example, an oscilloscope) Ability to identify values on said graphs

	<u>Topic 9 – Thermodynamics</u> **<u>Topic 10 – Astrophysics</u>** **<u>Topic 11 – Nuclear Radiation</u>** **<u>Topic 12 – Gravitational Fields</u>** **<u>Topic 13 – Oscillations</u>**			Plotting of line graphs from given and recorded data Ability to choose axis scales based on given data Analysis of graphs including gradients and area under calculations Appreciation of how changes in axis values can affect variables given by gradients Linking of graphical analysis to formulae, relationships and conclusions Description of observations from graphical data (motion from a v vs t graph) Ability to produce sketch graphs based on expected relationships Ability to identify components based on sketch graphs/line of best fit on plotted data Ability to plot line graphs with both positive and negative axis with lines of best fit that can be either curves, straight or a combination of both Ability to form conclusions based on graphical data

				Ability to explain trends in data using modelling Ability to read and interoperate graphs with variable axis scales (for example, an oscilloscope) Ability to identify values on said graphs Ability to identify values on said graphs Ability to map a n expression to Y=MX+C in order to plan an experiment to determine either M or C Ability to work on logarithmic scales and use log-linear graphs to analyse exponential patterns Ability to work with a combination of logarithmic and linear scales on a sketch graph Ability to use more complex formulae to solve problems Ability to use and exploit ratios to determine changes in a given value Ability to use and calculate using numbers in standard form Ability to memorise, recognize and convert between prefix values from “nano” to “giga” in a calculation

				Calculation of two-dimensional vectors using both vector diagrams and Pythagoras/trigonometry Ability to resolve vectors into horizontal/vertical components Ability to calculate across two dimensions (SUVAT projectile motion) Ability to see patterns in recorded data and use said relationships to produce general relationships and predict readings Ability to use conservation laws and formulae to logically explain patterns in data Ability to use formulae to describe relationships between variables and use said relationships to describe uses of devices, for example transformers Ability to mathematically model for large populations of random data in multiple dimensions Ability to calculate using exponentials and logarithms

				Ability to adapt to new units that better suit the scale of work (e.g., the use of elctronvolts instead of joules) Ability to convert between adapted and SI base units Ability to derive SI base units from SI units and use these to prove formulaic relationships Ability to integrate and differentiate simple expressions Ability to use circular modelling to apply expressions to either simple harmonic or sinusoidal motion Calculation of random and systematic errors from data Calculation of uncertainties from data Ability to use more complex scientific equipment, such as micrometers, Vernier calipers and oscilloscopes *At this point, we are discussing real world research and applications/discoveries in advanced power generation (nuclear fusion and fission, antimatter and the morals of nuclear*

				weaponry/application of physics for conflict) and discoveries astrophysics (such as more advances astrophysics measuring and new discoveries of the universe). Students are ideally well situated to apply which knowledge to any engineering-based career and the analytical and logic skills to virtually any career.