MAIDSTONE GRAMMAR SCHOOL
FOUNDED 1549

Physics Curriculum Outline 2023-2024

Year 13

Term 1

Unit Title:
Teacher1 - Further Mechanics
Teacher 2 – Radioactivity

Knowledge:
FURTHER MECHANICS
- The earlier study of mechanics is further advanced through a consideration of circular motion and simple harmonic motion (the harmonic oscillator).
- Circular motion.
- SHM.
- Resonance.

RADIOACTIVITY
- This section builds on the work of Particles and radiation to link the properties of the nucleus to the production of nuclear power through the characteristics of the nucleus, the properties of unstable nuclei, and the link between energy and mass. Students should become aware of the physics that underpins nuclear energy production and also of the impact that it can have on society.

Skills:
AO1, AO2, AO3

Term 2

Unit Title:
Teacher1 - Fields
Teacher 2 - Radioactivity

Knowledge:
FIELDS
- The concept of field is one of the great unifying ideas in physics. The ideas of gravitation, electrostatics and magnetic field theory are developed within the topic to emphasise this unification. Many ideas from mechanics and electricity from earlier in the course support this and are further developed. Practical applications considered include planetary and satellite orbits, capacitance and capacitors, their charge and discharge through resistors, and electromagnetic induction. These topics have considerable impact on modern society.

Skills:
AO1, AO2, AO3

Term 3

Unit Title:
Teacher1 - Fields
Teacher 2 - Thermal Gases

Knowledge:
THERMAL PHYSICS
- A further section allows the thermal properties of materials, internal energy, density, the properties and nature of ideal gases, and the molecular kinetic theory to be studied in depth.

Skills:
AO1, AO2, AO3

Term 4

Unit Title:
Teacher1 - Magnetism
Teacher 2 – OPTION: Turning Points in Physics

Knowledge:
OPTION:
- Turning Points in Physics. This option is intended to enable key concepts and developments in physics to be studied in greater depth than in the core content. Students will be able to appreciate, from historical and conceptual viewpoints, the significance of major paradigm shifts for the subject in the perspectives of experimentation and understanding. Many present-day technological industries are the consequence of these key developments and the topics in the option illustrate how unforeseen technologies can develop from new discoveries
  - Discovery of the electron
  - Nature of light
  - Special Relativity

Skills:
AO1, AO2, AO3

Term 5

Unit Title:
Teacher1 - Capacitors
Teacher 2 - OPTION: Turning Points in Physics

Knowledge:
CAPACITORS
- Definition of capacitance
- Energy stored
- Charging and discharging
- Practical applications

Skills:
AO1, AO2, AO3

Year 12

Term 1

Unit Title:
Teacher 1- Mechanics
Teacher 2 - Fundamental Particles

Knowledge:
MECHANICS

Term 2

Term 3

Unit Title:
Teacher 1- Materials
Teacher 2 -
Quantum phenomena

Knowledge:
MATERIALS

Term 4

Unit Title:
Teacher 1- Waves
Teacher 2 - Electricity

Knowledge:
WAVES

Term 5

Term 6

Unit Title:
Teacher 1- Revision
Teacher 2 - Revision

Knowledge:
Review of all AS topics. Use of past papers and revision

	• Measurements and their errors. Content in this section is a continuing study for a student of physics. A working knowledge of the specified fundamental (base) units of measurement is vital. Likewise, practical work in the subject needs to be underpinned by an awareness of the nature of measurement errors and of their numerical treatment. The ability to carry through reasonable estimations is a skill that is required throughout the course and beyond. • Mechanics. Vectors and their treatment are introduced followed by development of the student's knowledge and • understanding of forces, energy and momentum. FUNDAMENTAL PARTICLES • This section introduces students both to the fundamental properties of matter, and to electromagnetic radiation and quantum phenomena. Teachers may wish to begin with this topic to provide a new interest and knowledge dimension beyond GCSE. Through a study of these topics, students become aware of the way ideas develop and evolve in physics. They will appreciate the importance of international collaboration in the development of new experiments and theories in this area of fundamental research. **Skills**: AO1, AO2, AO3	The section continues with a study of materials considered in terms of their bulk properties and tensile strength. QUANTUM • Electromagnetic radiation and quantum phenomena. • The photoelectric effect. • Collisions of electrons with atoms. • Energy levels and photon emission. • Wave-particle duality. **Skills**: AO1, AO2, AO3	• GCSE studies of wave phenomena are extended through a development of knowledge of the characteristics, properties, and applications of travelling waves and stationary waves. Topics treated include refraction, diffraction, superposition and interference. • Progressive and stationary waves. • Principle of superposition of waves and formation of stationary waves. • Refraction, diffraction and interference ELECTRICITY • This section builds on and develops earlier study of these phenomena from GCSE. It provides opportunities for the development of practical skills at an early stage in the course and lays the groundwork for later study of the many electrical applications that are important to society. • Current electricity including circuits, resistivity, potential dividers, EMF and internal resistance. **Skills** AO1, AO2, AO3:	documents. Self-study sections to be completed and acknowledged. Any outstanding practicals must be completed before the end of the term. **Skills**: AO1, AO2, AO3:

	Term 1	Term 2	Term 3	Term 4	Term 5
Year 11	**Unit Title**: Electro Magnetism **Knowledge**: • Electromagnetic Effects. • Permanent and Induced Magnetism. • Magnetic Forces and Fields. • Electromagnetism. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Motors **Knowledge**: • Motor Effect. • Magnetic Field. • Fleming's Left-hand Rule. • Building a Motor. • Loudspeakers • Induction. • Generator Effect. • Microphones. • Transformers. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Space **Knowledge**: • Dark Matter • The Solar System & Satellites. • Life Cycle of a Star. • Orbital Motion. • Red-shift. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Revision and Practice **Knowledge**: • A review of the whole course. Focus on grouping topics as per paper 1 and paper 2. Past papers and revision documents available as seen fit. • Opportunity to revisit any practicals that have been missed due to disruption. • Revision of equations. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	

	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Year 10	**Unit Title**: Atomic Model & Radioactivity. **Knowledge**: • Ionising radiation. • Radioactivity. • Structure of the Atom. • Mass number, atomic number and isotopes.	**Unit Title**: Radioactivity. **Knowledge**: • Radioactive decay and nuclear radiation. • Nuclear equations. • Half-lives and the random nature of radioactive decay. • Radioactive contamination.	**Unit Title**: Forces & Motion. **Knowledge**: • Forces and their interactions. • Scalar and vector quantities. • Contact and non-contact forces. • Weight, mass & gravity. • Resultant forces.	**Unit Title**: Forces & Motion. **Knowledge**: • Moments, levers and gears. • Motion graphs. • Equations of motion inc. SUVAT. • Newton's Laws of Motion. • Braking distances.	**Unit Title**: Waves & EM Spectrum. **Knowledge**: • Wave behaviour • Electromagnetic waves. • Transverse and longitudinal waves. • Properties of waves. • Reflection and refraction.	**Unit Title**: Waves & EM Spectrum. **Knowledge**: • Electromagnetic spectrum. • Radio, microwave, infrared, visible light (red to violet), ultraviolet, X-rays and gamma rays. • Properties and uses.

	• The development of the model of the atom – Thomson, Rutherford, Chadwick, Bohr (complimenting Chemistry course content). • Radioactive decay and nuclear radiation. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	• Hazards and uses of radioactive emissions and of background radiation. • Uses of nuclear radiation. • Nuclear fission and fusion. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	• Work Done and energy transfers. • Elasticity. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	• Momentum. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	• Sound and ultrasound. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	• Lenses. • Black body radiation. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.
	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Year 9	**Unit Title**: Energy Transfers & Energy Resources **Knowledge**: • The concept of energy. • Understanding chemical reactions and biological systems. • Limits to the use of fossil fuels and global warming. • Identify ways to reduce our energy usage. • Energy changes in a system, and the ways energy is stored before and after such changes. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Energy Changes in Systems. **Knowledge**: • Energy transfers in a closed system. • Dissipated energy. • Reducing unwanted energy transfers, for example through lubrication and the use of thermal insulation. • National and global energy resources. • The uses of energy resources include: transport, electricity generation and heating. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: DC Electricity & Static & AC Electricity **Knowledge**: • Electric charge. • Understanding the difference in the microstructure of conductors, semiconductors and insulators. • Design components and build electric circuits. • Standard circuit diagram symbols. • Electrical charge and current. • Current, resistance and potential difference. • Resistors. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Direct and Alternating Potential Difference. **Knowledge**: • Mains electricity. • Difference between direct and alternating potential difference. • Electrical Power. • Static Electricity. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Particle Model of Matter. **Knowledge**: • The Particle Model. • Changes of state and the particle model. • Internal energy. • Latent heat. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.	**Unit Title**: Particle Model of Matter. **Knowledge**: • Particle model and pressure. • Transfer of energy by a force. **Skills**: M1, M2, M3, M4, M5. AT 1, AT 2, AT 3, AT 4, AT 5, AT 6, AT 7, AT 8.
	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Year 8	**Unit Title**: Forces – P1 – Contact Forces and Pressure. **Knowledge**: • When the resultant force on an object is zero, it is in equilibrium and does not move, or remains at constant speed in a straight line. • One effect of a force is to change an object's form, causing it to be stretched or compressed. In some materials, the change is proportional to the force applied. • Pressure acts in a fluid in all directions. It increases with depth due to the increased weight of fluid, and results in an upthrust. Objects sink or float depending on whether the weight of the object is bigger or smaller than the upthrust. • Different stresses on a solid object can be used to explain observations where objects scratch, sink into or break surfaces.		**Unit Title**: Electromagnets – P2 – Magnetism and Electromagnets **Knowledge**: • An electromagnet uses the principle that a current through a wire causes a magnetic field. Its strength depends on the current, the core and the number of coils in the solenoid. • Magnetic materials, electromagnets and the Earth create magnetic fields which can be described by drawing field lines to show the strength and	**Unit Title**: Energy – P3 – Heating and Cooling & Work **Knowledge**: • The thermal energy of an object depends upon its mass and temperature and what it's made of. When there is a temperature difference, energy transfers from the hotter to the cooler object. • Thermal energy is transferred through different pathways, by particles in conduction and convection, and by radiation.	**Unit Title**: Energy – P3 – Heating and Cooling & Work **Knowledge**: • The thermal energy of an object depends upon its mass and temperature and what it's made of. When there is a temperature difference, energy transfers from the hotter to the cooler object. • Thermal energy is transferred through different pathways, by particles in conduction and convection, and by radiation.	**Unit Title**: Waves – P4 – Wave Effects and Wave Properties. **Knowledge**: • When a wave travels through a substance, particles move to and fro. Energy is transferred in the direction of movement of the wave. Waves of higher amplitude or higher frequency transfer more energy. • A physical model of a transverse wave demonstrates it moves from place to place, while the material it travels through does not, and

	Skills: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.		direction. The stronger the magnet, and the smaller the distance from it, the greater the force a magnetic object in the field experiences. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.	• Work is done and energy transferred when a force moves an object. The bigger the force or distance, the greater the work. Machines make work easier by reducing the force needed. Levers and pulleys do this by increasing the distance moved, and wheels reduce friction. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.	• Work is done and energy transferred when a force moves an object. The bigger the force or distance, the greater the work. Machines make work easier by reducing the force needed. Levers and pulleys do this by increasing the distance moved, and wheels reduce friction. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.	describes the properties of speed, wavelength and reflection. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.
	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Year 7	**Unit Title**: Forces – P1 - Gravity and Speed **Knowledge**: • Mass and weight are different but related. Mass is a property of the object; weight depends upon mass but also on gravitational field strength. • Every object exerts a gravitational force on every other object. The force increases with mass and decreases with distance. Gravity holds planets and moons in orbit around larger bodies. • If the overall, resultant force on an object is unbalanced, its motion changes and it slows down, speeds up or changes direction. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.		**Unit Title**: Electromagnets – P2 – Current and Voltage and Resistance **Knowledge**: • Current is a movement of electrons and is the same everywhere in a series circuit. Current divides between loops in a parallel circuit, combines when loops meet, lights up bulbs and makes components work. • Around a charged object, the electric field affects other charged objects, causing them to be attracted or repelled. The field strength decreases with distance. • We can model voltage as an electrical push from the battery, or the amount of energy per unit of charge transferred through the electrical pathway. In a series circuit, voltage is shared between each component. In a parallel circuit, voltage is the same across each loop. • Components with resistance reduce the current flowing and shift energy to the surroundings. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.		**Unit Title**: Energy – P3 - Energy Costs and Energy Transfers. **Knowledge**: • We pay for our domestic electricity usage based on the amount of energy transferred. • Electricity is generated by a combination of resources which each have advantages and disadvantages. • We can describe how jobs get done using an energy model where energy is transferred from one store at the start to another at the end. • When energy is transferred, the total is conserved, but some energy is dissipated, reducing the useful energy. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise	**Unit Title**: Waves – P4 - Light and Sound **Knowledge**: • When a light ray meets a different medium, some of it is absorbed and some reflected. For a mirror, the angle of incidence equals the angle of reflection. The ray model can describe the formation of an image in a mirror and how objects appear different colours. • When light enters a denser medium, it bends towards the normal; when it enters a less dense medium it bends away from the normal. Refraction through lenses and prisms can be described using a ray diagram as a model. • Sound consists of vibrations which travel as a longitudinal wave through substances. The denser the medium, the faster sound travels. • The greater the amplitude of the waveform, the louder the sound. The greater the frequency (and therefore the shorter the

			questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.	wavelength), the higher the pitch. **Skills**: Use a range of equipment, analyse patterns, discuss limitations, draw conclusions, present data, communicate ideas, construct explanations, critique ideas/opinions, justify ideas/opinions, collect data, devise questions, plan variables, test hypothesis, estimate risks, examine consequences, review theories & interrogate sources.

Key/Legend/Notes:

KS5 Skills:
AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures.
AO2: Apply knowledge and understanding of scientific ideas, processes, techniques and procedures:
- in a theoretical context
- in a practical context
- when handling qualitative data
- when handling quantitative data.

AO3: Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to:
- make judgements and reach conclusions
- develop and refine practical design and procedures.

KS4 Skills:
M1 = Arithmetic and numerical computation.
M2 = Handling data.
M3 = Algebra.
M4 = Graphs
M5 = Geometry and trigonometry.
AT 1 = Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, volume and temperature. Use of such measurements to determine densities of solid and liquid objects (links to A-level AT a and b).
AT 2 = Use of appropriate apparatus to measure and observe the effects of forces including the extension of springs (links to A-level AT a).
AT 3 = Use of appropriate apparatus and techniques for measuring motion, including determination of speed and rate of change of speed (acceleration/deceleration) (links to A-level AT a, b and d).
AT 4 = Making observations of waves in fluids and solids to identify the suitability of apparatus to measure speed/frequency/wavelength. Making observations of the effects of the interaction of electromagnetic waves with matter (links to A-level AT i and j).
AT 5 = Safe use of appropriate apparatus in a range of contexts to measure energy changes/ transfers and associated values such as work done (links to A-level AT a, b).
AT6 = Use of appropriate apparatus to measure current, potential difference (voltage) and resistance, and to explore the characteristics of a variety of circuit elements (links to A level AT f).
AT 7 = Use of circuit diagrams to construct and check series and parallel circuits including a variety of common circuit elements (links to A-level AT g).
AT 8 (physics only) = Making observations of waves in fluids and solids to identify the suitability of apparatus to measure the effects of the interaction of waves with matter (links to A-level AT h, j).