AD ALTIORA

Year 13 Physics Curriculum Summary

PHYSICS CURRICULUM SUMMARY

YEAR GROUP: 13 **SUBJECT: Physics**

When?	Knowledge	Understanding	Assessment
Motion in a circle **– Simple Harmonic Motion**	**<u>Motion in a circle</u>** **Be able to:** • **Define and explain centripetal force** • **Calculate angular speed** • **Calculate centripetal acceleration** • **Calculate centripetal force** **<u>– Simple Harmonic Motion</u>** **Be able to:** • **State characteristic features of simple harmonic motion** • **State the condition for shm** • **Graphical representations linking x, v, a and t** • **Calculate maximum speed** • **Calculate maximum acceleration**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Motion in a circle</u>** • Estimate the acceleration and centripetal force in situations that involve rotation. **<u>– Simple Harmonic Motion</u>** • Sketch relationships between x, v, a and a − t for simple harmonic oscillators. • Students should recognise the use of the small-angle approximation in the derivation of the time period for examples of approximate SHM. • Investigation of the factors that determine the resonant frequency of a driven system.	Motion in a Circle Test Simple Harmonic Motion Test

–Gravitational fields **Electric Fields**	**<u>Gravitational fields</u>** **Be able to:** • **Concept of a force field** • **Representation by gravitational field lines** • **Define g** • **Define and explain gravitational potential** • **Calculate work done in a moving mass** • **Calculate gravitational potential V** • **Define Gravity** • **Calculate the force between two point masses** • **Calculate the magnitude of g in a radial field** • **Describe relation of orbital period and speed to radius of circular orbit** • **Consider energy for an orbiting satellite** • **Significance of a geosynchronous orbit** **<u>– Electric Fields</u>** **Be able to:** • **Define electric field strength, E** • **Represent electric field lines** • **Calculate E in a uniform field** • **Calculate work done in moving**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Gravitational fields</u>** • Students can estimate the gravitational force between a variety of objects • Students should recognise that a force field can be represented as a vector, the direction of which must be determined by inspection • Students use graphical representations to investigate relationships between v, r and g • Estimate various parameters of planetary orbits, eg kinetic energy of a planet in orbit. • Use logarithmic plots to show relationships between T and r for given data **<u>– Electric Fields</u>** • Students can estimate the magnitude of the electrostatic force between various charge configurations • Students can investigate the patterns of various field configurations using conducting paper (2D) or electrolytic tank (3D). • Understanding of definition of absolute electric potential, including zero value at infinity, and of electric potential difference	Gravitational fields Test Electric Fields Test

	charge • **Calculate the force between charged particles using Coulomb's law** • **Compare electric and gravitational fields** • **Define and explain absolute electric potential** • **Calculate V in radial field** • **Calculate E in radial field**		
– Thermal physics	**<u>Thermal physics</u>** **Be able to:** • **Calculating the change in energy** • **Calculate for the change of temperature (specific heat capacity)** • **Calculating the change in energy** • **Calculate for the change of state (specific latent heat)** • **Calculating the change in energy** • **Calculate for the change of state (specific latent heat)**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Thermal physics</u>** • Investigate the factors that affect the change in temperature of a substance using an electrical method or the method of mixtures. • Students should be able to identify random and systematic errors in the experiment and suggest ways to remove them. • Investigate, with a data logger and temperature sensor, the change in temperature with time of a substance undergoing a phase change when energy is supplied at a constant rate **<u>Capacitors</u>**	Thermal Physics Test Capacitors Test

Capacitors	**– Capacitors** **Be able to:** • **Define capacitance** • **Derivation of E = ½ QV** • **Interpretation of area under the graph of Q against V.** • **Graphical representation of charging/discharging capacitor** • **Calculate/determine time constant 'RC'** • **Quantitative treatment of capacitor discharge**	• Determine the relative permittivity of a dielectric using a parallel-plate capacitor. • Investigate the relationship between C and the dimensions of a parallel-plate capacitor eg using a capacitance mete • Graphical representation of charging and discharging of capacitors through resistors. Corresponding graphs for Q, V and I against time for charging and discharging	
- Gases	**Gases** **Be able to:** • **Describe gas laws as experimental relationships between p, V, T and m** • **Concept of absolute zero** • **Define and explain**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **-Gases** • Gas laws as experimental relationships between p, V, T and the mass of the gas • Students should understand that the gas laws are empirical in nature whereas the kinetic theory model	Gases Test magnetic fields Test Electromagnetic Induction Test

– Magnetic Fields **Electromagnetic induction**	**ideal gas equation** • **Describe the difference between molar mass and molecular mass** • **Explain the relationship between p, V, and T using a simple molecular model** • **Derivation and assumptions leading to the kinetic theory equation** • **Calculate the average molecular KE** **– Magnetic Fields** **Be able to:** • **Calculate force on charged particles/a current-carrying wire in a magnetic field** • **State Fleming's left-hand rule** • **Define magnetic flux density and tesla** • **Application in devices such as cyclotrons** • **Define magnetic flux** **– Electromagnetic induction**	arises from theory • Appreciation of how knowledge and understanding of the behaviour of a gas has changed over time **– Magnetic Fields** • Investigate how the force on a wire varies with flux density, current and length of wire using a top pan balance • Convert between 2D representations and 3D situations • Investigate, using a search coil and oscilloscope, the effect on magnetic flux linkage of varying the angle between a search coil and magnetic field direction **– Electromagnetic induction** • Applications such as a straight conductor moving in a magnetic field • Use of an oscilloscope as a dc and ac voltmeter, to measure time intervals and frequencies, and to display ac waveforms • Investigate relationships between currents, voltages and numbers of coils in transformers	

	Be able to: • **Describe simple experimental phenomena** • **State and explain Faraday's and Lenz's laws** • **Calculate the magnitude of induced emf as equal to rate of change of flux linkage** • **Define and calculate flux linkage** • **Applications such as a moving straight conductor** • **Calculate emf induced in a coil rotating uniformly in magnetic field** • **Describe the operation of a transformer** • **Use the transformer equation** • **Calculate the efficiency of a transformer**		

Stars	**Stars** **Be able to:** • **Describe relation between brightness and apparent magnitude** • **Describe relation between intensity and apparent magnitude** • **Measure m from photographic plates** • **Define parsec and light year** • **Define M in relation to m** • **State Stefan's law and Wien's displacement law** • **Describe general shape of black-body curves** • **Use Wein's law to estimate temperature** • **Use Stefan's law to estimate temperature** • **State the inverse-square law and its assumptions** • **Description of main classes: O, B, A, F, G, K and M** • **Describe the H-R diagram, general shape: main sequence, dwarfs**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **Stars** • General shape of black-body curves, use of Wien's displacement law to estimate black-body temperature of sources • Students should be familiar with the light curve of typical type 1a supernovae • Calculation of the radius of the event horizon for a black hole, Schwarzschild radius • Use of type 1a supernovae as standard candles to determine distances. Controversy concerning accelerating Universe and dark energy • Students should be familiar with the position of the Sun on the HR diagram **Radioactivity** • Appreciation of how knowledge and understanding of the structure of the nucleus has changed over time. • Appreciation of balance between risk and benefits in the uses of radiation in medicine • Investigation of the inverse-square law for gamma radiation • Investigate the decay equation using a variety of approaches (including the use of experimental data, dice simulations etc) and a variety of analytical methods. **–Nuclear Energy** • Existence of nuclear excited states; γ ray emission; application eg use of technetium-99m as a γ source in medical diagnosis	Stars Test Radioactivity Test Nuclear Energy Test

	and giants • **Describe stellar evolution – path of star similar to sun on H-R diagram** • **Define properties of supernovae, neutron stars and black holes** • **Use of supernovae as standard candles** • **Describe supermassive black holes** • **Calculate the radius of an event horizon for a black hole**	• Students may be expected to identify, on the plot, the regions where nuclei will release energy when undergoing fission/fusion • Simple calculations involving mass difference and binding energy • Simple calculations from nuclear masses of energy released in fission and fusion reactions • Students study a simple mechanical model of moderation by elastic collisions • Appreciation of balance between risk and benefits in the development of nuclear power.	
Radioactivity	**Radioactivity** **Be able to:** • **Qualitative study of Rutherford scattering** • **Describe α, β and γ radiation properties and experimental identification** • **Define and explain the inverse square law for γ radiation** • **Describe the experimental verification of the inverse square law** • **Describe the random nature of radioactive decay** • **Calculate the constant decay probability** • **Calculate the half-life** • **Calculate the activity**		

Nuclear Energy	• **Determination of above from graphical decay data** **<u>–Nuclear Energy</u>** **Be able to:** • **Apply $E=mc^2$ to all energy changes** • **Calculate mass difference and binding energy** • **Interpret graph of average binding energy per nucleon against nucleon number** • **Describe fission and fusion processes** • **Calculate energy released in fission and fusion reactions** • **Describe induced fission by thermal neutrons** • **Explain the functions of the moderator, control rods and the coolant in a thermal nuclear reactor** • **Describe the safety aspects**		
	<u>Cosmology</u> **Be able to:** • **Calculate red-shift, frequency and wavelength**	Students will carry out a range of practicals during the topic, some of which will be formally assessed for the practical endorsement qualification. **<u>Cosmology</u>**	Cosmology Test Lenses and optical telescopes Test

	given v << c • **State Hubble's law and use to estimate age of universe** • **Qualitative treatment of Big Bang theory** • **Describe quasars** **<u>Lenses and optical telescopes</u>** **Be able to:** • **Use of lenses- principal focus, focal length of converging lenses** • **Draw ray diagrams for formation of images by converging lenses** • **Draw ray diagrams to show the image formation in normal adjustment** • **Calculate angular magnification** • **Ray diagrams for concave/convex mirrors in reflecting telescopes** • **Description of merits of reflectors and**	• Calculations on binary stars viewed in the plane of orbit • Qualitative treatment of Big Bang theory including evidence from cosmological microwave background radiation, and relative abundance of hydrogen and helium **<u>Lenses and optical telescopes</u>** • Relative merits of reflectors and refractors including a qualitative treatment of spherical and chromatic aberration • Similarities and differences of radio telescopes compared to optical telescopes. Discussion should include structure, positioning and use, together with comparisons of resolving and collecting powers • Students should be familiar with the rad as the unit of angle	

	refractors • **State the diffraction pattern produced by circular aperture** • **Describe the use, structure and operation of CCD**		