

Unit 1 and Unit 2

Key knowledge retained

for

Year 11/12 Composite Class

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Unit 1: How is energy useful to society?

Area of Study 1: How are light and heat explained? (U1AoS1)

Electromagnetic radiation (U1AoS1)

- identify all electromagnetic waves as transverse waves travelling at the same speed, c , in a vacuum as distinct from mechanical waves that require a medium to propagate (U1AoS1)
- identify the amplitude, wavelength, period and frequency of waves (U1AoS1)
- calculate the wavelength, frequency, period and speed of travel of waves using: $\lambda = \frac{v}{f} = vT$ (U1AoS1)
- explain the wavelength of a wave as a result of the velocity (determined by the medium through which it travels) and the frequency (determined by the source) (U1AoS1)
- describe electromagnetic radiation emitted from the Sun as mainly ultraviolet, visible and infrared (U1AoS1)
- compare the wavelength and frequencies of different regions of the electromagnetic spectrum, including radio, microwave, infrared, visible, ultraviolet, x-ray and gamma, and compare the different uses each has in society (U1AoS1)

Area of study 2: How is energy from the nucleus utilised? (U1AoS2)

- Nil

Area of Study 3: How can electricity be used to transfer energy? (U1AoS3)

Concepts used to model electricity.(U1AoS3)

- apply concepts of charge (Q), electric current (I), potential difference (V), energy (E) and power (P), in electric circuits.(U1AoS3)
- analyse and evaluate different analogies used to describe electric current and potential difference .(U1AoS3)
- investigate and analyse theoretically and practically electric circuits using the relationships:
 $I = \frac{Q}{t}$, $V = \frac{E}{Q}$, $P = \frac{E}{t} = VI$.(U1AoS3)
- justify the use of selected meters (ammeter, voltmeter, multimeter) in circuits .(U1AoS3)

Using electricity.(U1AoS3)

- investigate practically the operation of simple circuits containing resistors, variable resistors, ~~diodes and other~~ non-ohmic devices .(U1AoS3)
- describe energy transfers and transformations with reference to resistors, ... potentiometers(U1AoS3)

Unit 2: How does physics help us to understand the world? (U2AoS1)

Area of Study 1: How is motion understood? (U2AoS1)

Concepts used to model motion (U2AoS1)

- identify parameters of motion as vectors or scalars (U2AoS1)
- analyse graphically, numerically and algebraically, straight-line motion under constant acceleration: (U2AoS1)

$$v = u + at, v^2 = u^2 + 2as, s = \frac{1}{2}(u + v)t, s = ut + \frac{1}{2}at^2, s = vt - \frac{1}{2}at^2 \text{ (U2AoS1)}$$

- analyse, graphically, non-uniform motion in a straight line (U2AoS1)
- apply concepts of momentum to linear motion: $p = mv$ (U2AoS1)

Forces and motion (U2AoS1)

- explain changes in momentum as being caused by a net force: $\Delta p = F_{net} \Delta t$ (U2AoS1)
- model the force due to gravity, F_g , as the force of gravity acting at the centre of mass of a body, $F_{on \text{ body by Earth}} = mg$, where g is the gravitational field strength (9.8 N kg^{-1} near the surface of Earth) (U2AoS1)
- model forces as vectors acting at the point of application (with magnitude and direction), labelling these forces using the convention 'force on A by B' or $F_{on A \text{ by B}} = -F_{on B \text{ by A}}$ (U2AoS1)
- apply Newton's three laws of motion to a body on which forces act: $a = \frac{F_{net}}{m}$, $F_{on A \text{ by B}} = -F_{on B \text{ by A}}$ (U2AoS1)
- apply the vector model of forces, including vector addition and components of forces, to readily observable forces including the force due to gravity, friction and normal forces (U2AoS1)

Energy and motion (U2AoS1)

- apply the concept of work done by a force using: (U2AoS1)
 - work done = force $\times$ displacement: $W = F \cos \theta$, where force is constant (U2AoS1)
 - work done = area under force vs distance graph (U2AoS1)
- investigate and analyse theoretically and practically Hooke's Law for an ideal spring: $F = -kx$, where x is extension (U2AoS1)
- analyse and model mechanical energy transfers and transformations using energy conservation: (U2AoS1)
 - changes in gravitational potential energy near Earth's surface: $E_g = mg\Delta h$ (U2AoS1)
 - elastic potential energy in ideal springs: $E_s = \frac{1}{2}kx^2$ (U2AoS1)
 - kinetic energy: $E_k = \frac{1}{2}mv^2$ (U2AoS1)
- analyse rate of energy transfer using power: $P = \frac{E}{t}$ (U2AoS1)
- analyse impulse in an isolated system (for collisions between objects moving in a straight line): $F\Delta t = m\Delta v$ (U2AoS1)
- investigate and analyse theoretically and practically momentum conservation in one dimension (U2AoS1)

Unit 2 Area of Study 3 *cf* Unit 4 Area of Study 2

Scientific Inquiry

- The two versions of the Key Knowledge (Unit 2 and Unit 4) for the Inquiry study are shown here side-by-side. They are so similar as to be virtually indistinguishable (it is one of the well-known fatal flaws in Bloom).
- The proposal is to **use only the Unit 4 version**, with some allowance for Unit 2 students to be more guided in respect of the theory to be used for the investigation (*dpt 1* in both) and the level of complexity of experimental evaluation (*dpt4* in U2 *cf.* *dpt3* in U4).

Unit 2 Area of Study 3: How do physicists investigate questions?	Unit 4 Area of Study 2 How is scientific inquiry used to investigate fields, motion or light?
Investigation design	
• apply the physics concepts specific to the selected investigation and explain their significance, including definitions of key terms, and physics representations • evaluate the characteristics of the scientific methodology relevant to the investigation, selected from: experiment; fieldwork, classification and identification, modelling, simulation, and the development of a product, process or system • apply techniques of primary qualitative and quantitative data generation relevant to the investigation • identify and apply concepts of accuracy, precision, repeatability, reproducibility, resolution, and validity of data in relation to the investigation • identify and apply health, safety and ethical guidelines relevant to the selected scientific investigation	• identify the physics concepts specific to the investigation and explain their significance, including definitions of key terms and physics representations • explain the characteristics of the selected scientific methodology and method including: techniques of primary qualitative and quantitative data generation relevant to the selected investigation; and appropriateness of the use of independent, dependent and controlled variables in the selected scientific investigation • identify and apply concepts of accuracy, precision, repeatability, reproducibility, resolution and validity of data; and the identification of, and distinction between, error and uncertainty • identify and apply health, safety and ethical guidelines relevant to the selected investigation

Scientific evidence	
- distinguish between an aim, a hypothesis, a model, a theory and a law - identify and explain observations and experiments that are consistent with, or challenge, current models or theories - describe the characteristics of primary data - evaluate methods of organising, analysing and evaluating primary data to identify patterns and relationships including scientific error, causes of uncertainty, and limitations of data, methodologies and methods - model the scientific practice of using a logbook to authenticate generated primary data	- discuss the nature of evidence that supports or refutes a hypothesis, model or theory - apply methods of organising, analysing and evaluating primary data to identify patterns and relationships including: the physical significance of the gradient of linearised data; causes of uncertainty; use of uncertainty bars; and assumptions and limitations of data, methodologies and methods - model the scientific practice of using a logbook to authenticate generated primary data
Science communication	
- apply the conventions of scientific report writing including scientific terminology and representations, standard abbreviations, units of measurement, significant figures and acknowledgement of references - apply the key findings of the selected investigation and their relationship to key physics concepts.	- apply the conventions of science communication: scientific terminology and representations; symbols, equations and formulas; standard abbreviations; significant figures; and units of measurement - apply the conventions of scientific poster presentation, including succinct communication of the selected scientific investigation, and acknowledgement of references - explain the key findings and implications of the selected investigation.