

Unit 6 Synthesis

An understanding of the principles in this unit and in the general requirements is expected in familiar and unfamiliar situations. In examination questions where the context is beyond the content of the specification it will be fully described.

The content of this unit draws together different areas of physics. The assessment will be synoptic, requiring students to show understanding and application of the principles involved rather than recall. Please refer to the Summary of the specification content on page 4.

Analogies in physics

Unit	Topic	Content
6.1	Comparison of springs and capacitors.	$F = kx$ and $V = Q/C$ as mathematical models for springs and capacitors. Energy stored.
6.2	Comparison of electric and gravitational fields.	Inverse square law for radial fields. $E = \frac{kq}{r^2}$ and $g = \frac{Gm}{r^2}$ Similarities and differences between gravitational & electrical fields.
6.3	Comparison of capacitor discharge and radioactive decay.	Exponential decay: form of discharge graph. $Q = Q_0 e^{-t/RC}$ and $N = N_0 e^{-\lambda t}$ Current, $I = \frac{Q}{RC}$ and activity $A = \lambda N$ Time constant: $t_{1/2} / RC$ and $\lambda t_{1/2} = \ln 2$

Accelerators

Unit	Topic	Content
6.4	Conservation of mass-energy.	$\Delta E = \Delta m \times c^2$ applies in all situations. Simple calculations relating mass difference to energy change. Unified atomic mass unit, u . Fission and fusion.
6.5	Linear accelerators	Production of MeV particles using a Van de Graaff generator. Principle of a <i>linac</i> to reach GeV. Understanding that particles never reach the speed of light. Fixed target experiments.
6.6	Ring accelerators	Force on charged particle moving perpendicular to a uniform magnetic field, $F = BQv$ Principle of the cyclotron: derivation of supply frequency for non-relativistic particles. Colliding beam experiments.
6.7	Detecting particles	Principles of cloud/bubble chambers and spark/drift chambers. Interpretation of photographs showing particle tracks to determine charge and momentum of particles.