

# Advanced Higher Physics

## Quanta

### Key Definitions

Word/Term	Definition
Quantum Theory	Used to explain a number of experimental observations that classical physics could not.
Black Body	A surface that absorbs all wavelengths of electromagnetic radiation but also emits electromagnetic radiation at any wavelength.
Black Body Radiation	The continuous spectrum of radiation emitted by a black body. The curve has a characteristic shape.
Ultraviolet Catastrophe	When two physicists developed an equation which fitted the observed black body graph but only at long wavelengths. At shorter wavelengths (higher frequencies), their graph tended to infinity. Their equation had made the assumption that energy was added continuously as the frequency of the radiation increased.
Photoelectric Effect	Photoelectrons are ejected from the surface of a metal when photons of light with sufficient energy are incident on the surface. For photoemission to occur: <ul style="list-style-type: none"><li>• the energy of the photons must be greater than the work function of the metal</li><li>• the frequency of the photons must be greater than the threshold frequency.</li></ul>
Photoelectron	An electron emitted from the surface of a material due to a photon incident on the material.
Photoemission	The emission of photoelectrons from the surface of a material in the photoelectric effect.
Photon	A particle of light that can also be thought of as a short burst of wave energy.
Threshold Frequency	The minimum frequency of a photon required to cause the emission of photoelectrons from a metal surface.
Work Function	The minimum energy of a photon required to cause the emission of photoelectrons from a metal surface.
Irradiance	The power per unit area of electromagnetic radiation incident on a surface. It can be associated with the intensity or brightness of the incident light.

Word/Term	Definition
Bohr Model of the Atom	<p>A model of the atom which describes the arrangement of electrons within it.</p> <p>It proposes that electrons are in circular orbits around the nucleus which correspond to energy levels.</p> <p>The electrons can only occupy discrete energy levels; the ground state or an excited state.</p>
Ground State	<p>The lowest energy orbit.</p> <p>It is the orbit closest to the nucleus of an atom.</p>
Excited State	<p>An energy level above the ground state.</p> <p>Electrons can move into an excited state when they gain energy.</p>
Quantised	When a quantity exists only in discrete chunks/packages. E.g. an integer multiple.
Wave-Particle Duality	The idea that light can act both like a wave and like a particle without contradiction.
Electron Diffraction	When electrons are incident on multiple tiny slits, interference fringes are produced.
Compton Scattering	An experiment involving the scattering of x-rays from electrons in a carbon target. The scattered x-rays were observed to have a longer wavelength than the incident x-rays.
de Broglie Wavelength	<p>The wavelength associated with an orbiting electron.</p> <p>It explains the stability of orbits in the Bohr model of the atom.</p>
Uncertainty Principle	<p>It is not possible to measure the <b>position</b> and the <b>momentum</b> of a particle with absolute certainty. The more accurately one of these is known, the less accurately the other is known.</p> <p>In other words, it is not possible to know the position and the momentum of a quantum particle simultaneously.</p> <p>It is also not possible to know the <b>lifetime</b> of a quantum particle and the associated <b>energy change</b> simultaneously.</p>
Quantum Tunnelling	<p>Consider an electron facing an energy barrier where it requires a certain amount of energy to get to the other side.</p> <p>In <b>classical physics</b>, if the energy of the electron is below the energy barrier then it will remain on the side that it is on.</p> <p>In <b>quantum physics</b>, the electron can be treated as a wave function and there is a finite probability that it can tunnel through the barrier and appear on the other side.</p>

Word/Term	Definition
Cosmic Rays	<p>Energetic subatomic particles which arrive in the Earth's atmosphere from outer space.</p> <p>They are made up from 89% protons, 9% alpha particles, 1% carbon, oxygen and nitrogen nuclei and the rest electrons and gamma rays.</p>
Cosmic Air Shower	<p>The showers of secondary particles (electrons, photons, neutrinos and muons) that are produced when cosmic rays hit the top of the atmosphere.</p>
Solar Wind	<p>Consists of a stream of charged particles which escape from the upper atmosphere of the Sun. It flows outwards as a plasma at great speed and consists mainly of electrons, protons and alpha particles.</p>
Aurorae	<p>Cosmic particles trapped in the Earth's magnetic field come down into the atmosphere near the north and south poles. Nitrogen and oxygen molecules become excited and when they return to their ground state they emit light.</p>
Simple Harmonic Motion	<p>When an object oscillates with a repeated motion under the influence of an unbalanced force (restoring force) which always acts towards the equilibrium position (rest position).</p> <p>The magnitude of the unbalanced force is proportional to the object's displacement, but in the opposite direction.</p>
Damping	<p>When an oscillating system loses energy to frictional forces such as air resistance and eventually comes to rest.</p> <p>The amplitude of the motion decreases to zero because energy is lost from the system (i.e. it changes to other forms).</p>