

## Definitions and Concepts for AQA Physics A Level

### Topic 8: Nuclear Physics

**Activity:** The rate of decay of the radioactive nuclei in a given isotope. It is proportional to the total number of nuclei in the sample and is measured in Becquerels.

**Alpha Decay:** The emission of an alpha particle (2 protons and 2 neutrons) from an unstable nucleus (usually one with too much mass) to make it more stable. Alpha radiation is strongly ionising and is stopped by a few centimetres of air or a sheet of paper.

**Atomic Mass Unit:** A unit used to express atomic masses. One AMU is equal to the one twelfth of the mass of a carbon atom.

**Background Radiation:** Radiation that is found in small quantities all around us. It originates from natural sources such as rocks and cosmic rays as well as man-made sources such as nuclear accidents and medical sources.

**Beta Decay:** The emission of a beta particle when a proton turns into a neutron (or vice versa) in an unstable nucleus. Beta minus radiation is weakly ionising. Beta plus radiation is immediately annihilated by electrons.

**Binding Energy:** The amount of energy required to split a nucleus into all its separate constituent nucleons. It is equivalent to the mass defect.

**Chain Reaction:** The process of the neutrons released by a fission reaction inducing further fissile nuclei to undergo fission.

**Closest Approach:** A method of estimating a nuclear radius by firing an alpha particle at it. It involves calculating the distance at which all the alpha particle's kinetic energy is converted to electric potential energy.

**Contamination:** The introduction of radioactive material to another object. The object is consequently radioactive.

**Control Rods:** Rods found in nuclear reactors to absorb neutrons and control the rate of reaction. They can be raised or lowered depending on the rate required.

**Coolant:** A substance that passes through nuclear reactors and is responsible for removing heat from the core. This heat is then used to generate energy.



**Critical Mass:** The smallest mass of fissile material required in a fission reactor for a chain reaction to be sustained.

**Electron Capture:** A process that occurs in proton-heavy nuclei, in which an electron is drawn into the nucleus, causing a proton to transition into a neutron. An electron neutrino is also produced.

**Fission:** The splitting a nucleus, to form two smaller daughter nuclei, neutrons and energy.

**Fusion:** The joining of two smaller nuclei to form a larger nucleus and to release energy.

**Gamma Decay:** The emission of gamma rays from an unstable nucleus that has too much energy. Gamma radiation is only very weakly ionising but requires several centimetres of lead to be stopped.

**Half-Life:** The average time it takes for the number of radioactive nuclei in a sample to halve.

**Inverse Square-Law:** A law that governs the intensity of gamma radiation. It means that the intensity of radiation at any point is inversely proportional to the square of the distance from its source.

**Irradiation:** The exposure of an object to radiation. The exposed object does not become radioactive.

**Mass Defect:** The difference in mass between a nucleus and the sum of the masses of its constituent nucleons.

**Moderator:** A material in nuclear reactors that absorbs energy from fast moving neutrons, to slow them down to speeds that can be absorbed by fissile neutrons to induce fission.

**Radioactive Dating:** The use of radioactive isotopes with known half-lives to date objects. The isotope that is usually used is Carbon-14.

**Radioactive Waste:** The waste produced from the products of fission reactions. Since the waste is unstable and radioactive, it must be stored and handled carefully.

**Random Nature of Radioactive Decay:** Radioactive decay is random - you cannot predict when a nucleus will decay or which nucleus will decay next.



**Rutherford Scattering:** An experiment involving firing alpha particles at a thin gold foil and observing their deflections. It showed the existence and nature of the nucleus.

