

Definitions and Concepts for Edexcel Physics A Level

Topic 11: Nuclear Radiation

Activity: The activity of a radioactive source is the number of nuclei that decay per second, measured in Becquerels (Bq).

Alpha Radiation: The radiation of a particle containing two protons and two neutrons. It is strongly ionising, slow moving and positively charged so therefore deflected by a magnetic field.

Atomic Mass Unit: $1/12$ the mass of a Carbon-12 nuclei.

Background Radiation: Constant radiation everywhere that is due to radioactive substances in the environment.

Beta-minus Radiation: Radiation consisting of a high energy electron that is mildly ionising, fast moving and negatively charged so therefore deflected by a magnetic field.

Beta-plus Radiation: Radiation consisting of a high energy positron that is mildly ionising, fast moving and positively charged so therefore deflected by a magnetic field in the opposite direction to beta-minus radiation.

Binding Energy: The energy required to split a nucleus into its individual nucleons. The greater the binding energy per nucleon the more stable the nucleus is.

Chain Reaction: When the fission of one nuclei produces neutrons that cause fission in another nuclei.

Control Rod: A rod that is inserted into a reaction vessel that stops neutrons preventing them from continuing on to cause more fission reactions. These are made from substances that absorb neutrons without fissioning themselves.

Coolant: A fluid that passes around the reaction vessel and carries away any thermal energy produced by the fission reactions. This thermal energy is used to generate steam and drive generators to produce electricity.

Cooling Pond: A large pool of water that nuclear waste is placed in to allow it to cool to safe temperatures.

Critical Mass: The minimum amount of a fissile substance needed to maintain a chain reaction and a steady flow of fission.

Decay Constant: The probability of a decay occurring per unit time.



Fuel Rod: Contains the fissile material, each rod has many pellets of nuclear fuel which prevents the critical mass of fuel being reached meaning the reactions are controlled.

Gamma Radiation: High energy photons, it is weakly ionising, travels at the speed of light and has no charge so is not deflected by magnetic or electric fields.

Half-Life ($T_{1/2}$): The time taken for half of the radioactive nuclei to decay.

Moderator: A substance inserted between the nuclear fuel that reduces the speed of the neutrons coming from a fission reaction allowing them to become thermal neutrons that can induce further fission.

Nuclear Fission: The splitting of a large nucleus to produce smaller nuclei, fast moving neutrons and energy.

Nuclear Fusion: The fusing of two smaller nuclei to form a single nucleus producing a large quantity of energy. Very high temperatures and pressures are needed as well as high magnetic fields to contain the fusing plasma.

Nuclear Waste: The by-product of a nuclear reaction. This waste is no longer undergoing fission that can be used due to the reduced activity but the waste is still radioactive and will be for thousands of years so it is stored underground in reinforced containers.

Mass Defect: The difference between the mass of the nuclei and its individual components. If this mass defect is large and positive then when a nucleus undergoes fission this mass defect is released as energy. If this mass defect is negative then when two nuclei are fused together the mass defect is released as energy.

Spontaneous Fission: The process by which a nucleus splits without absorbing a thermal neutron.

Thermal Neutron: A slow moving neutron that when absorbed by an unstable nucleus causes it to undergo fission.

