Nuclear Physics, Capacitors, Electric and Magnetic Fields Definitions

Coulomb's law: The force between two electric charges is proportional to the product of the charges and inversely proportional to the square of the distance between them.

Electric field strength is the force per unit positive charge at a point.

Electric potential is the work done bringing a positive unit charge from infinity to the point.

Electric potential energy of a charge is the work done in bringing that charge from infinity to the point.

Magnetic flux density is a measure of the strength of a magnetic field, defined by: $B = \frac{F}{ILsin\theta}$

where B = magnetic flux density (T), I = current in the wire (A), L = length of the wire (m), F = the force experienced (N) and θ = the angle between the wire and the field.

1 Tesla is the magnetic flux density that will produce a force of 1 N to act on a 1 m length of wire carrying a current of 1 A perpendicular to the direction of the magnetic field.

Magnetic flux *(ϕ)* is the product of magnetic flux density, B, and the area, A, at right angles to the flux.

1 Weber is the magnetic flux when a magnetic field of magnetic flux density 1 tesla, passes through an area of 1 m^2 at right angles.

Magnetic flux linkage (ϕN) is the product of the magnetic flux and the number of turns on the coil.

Faraday's Law of electromagnetic induction: The magnitude of the induced e.m.f. is equal to the rate of change of magnetic flux linkage.

Lenz's Law: The direction of any induced e.m.f. is such that it opposes the magnetic flux change causing it.

Capacitance is the charge stored per unit potential difference.

1 Farad = one coulomb per volt

The **time constant** (τ) is the time taken for the current, charge stored or p.d. to drop to 1/e (about 37%) of its original value.

The permittivity of free space ε_0 is the proportionality constant that links the capacitance of two parallel plates to the ratio of their area to the separation between them in a vacuum. C = $\varepsilon_0 \frac{A}{d}$

Relative permittivity of a material ε_r is the ratio of the capacitance of a capacitor using that material as a dielectric compared to a similar capacitor that has a vacuum as its dielectric.

The **atomic number** or **proton number**, Z, is the number of protons in the nucleus.

The **mass number** or **nucleon number**, A, is the number of nucleons (protons and neutrons) in the nucleus.

Isotopes are two nuclides (a nucleus with a distinct number of protons and neutrons) with the same number of protons but different numbers of neutrons.

Fundamental particles are particles which cannot be broken down into smaller components**.**

Activity is the rate of decay of radioactive nuclei. Unit = Becquerels.

1 Becquerel (Bq) is 1 radioactive decay per second.

The **decay constant**, λ, is the probability of an individual nucleus of an isotope decaying per unit time.

The **half-life** is the time taken for half the radioactive nuclei in a sample to decay OR the average time taken for the activity of a radioactive source to decrease to one half of an original value.

Binding Energy is the minimum external energy required to separate all the protons and neutrons of a nucleus.

Mass defect is the difference between the mass of a nucleus and the mass of its completely separated constituent nucleons.

Binding Energy per nucleon is the average energy required to remove a nucleon from the nucleus.

Induced nuclear fission involves a slow moving neutron splitting a nucleus into two smaller nuclei as well as several fast moving neutrons.