Definitions and Concepts for AQA Physics A Level

Topic 7: Fields and their Consequences

Back Emf: An emf generated by the coil in an AC generator that acts against the potential difference that has been supplied to the motor.

Capacitance, C: The charge stored per unit pd in a capacitor.

Capacitor: An electrical component that stores charge. A parallel-plate capacitor is made of two parallel conducting plates with an insulator between them (dielectric).

Coulomb's Law: The size of the force that acts between two point charges is proportional to the product of their charges and inversely proportional to the square of their separation. It is attractive for opposite charges and repulsive for like charges.

Cyclotron: A particle accelerator made up of two D shaped electrodes positioned opposite each other. The electric field changes direction each time a particle moves from one electrode to the other, causing the particle to accelerate.

Dielectric: An insulating material placed between the two plates of a capacitor in order to increase the amount of charge it can store.

Electrical Conductor: A material that contains free electrons that are able to move throughout the material and carry charge.

Electrical Insulator: A material that does not contain any free electrons. All electrons in an insulator are part of the individual atoms that make it up.

Electric Field: A region surrounding a charged object which causes a force to be exerted on any charged object placed within the field.

Electric Field Strength, E (at a point in the field): The force per unit positive charge exerted on a charged object placed at that point in the field. This is a vector acting in the same direction as the force on a positive charge.

Electric Potential, V (at a point in the field): the work done per unit charge on a positive test charge in bringing it from infinity to that point in the field.

Electromagnetic Induction: When an emf is induced in a wire/conducting rod when it is moved relative to a magnetic field.

Equipotential: A surface of constant potential. No work is done by the field when an object moves along an equipotential.

Escape Velocity: The minimum velocity required by an object to be able to escape a gravitational field of a mass when projected vertically from its surface.

Faraday's Law: The magnitude of the induced emf is equal to the rate of change of flux linkage through the circuit.

Field Line / Line of Force: A line representing the path that a north pole (magnetic field), positive charge (electric field) or mass (gravitational field) would take when placed within the field.

Force Field: An area in which an object will experience a non-contact force.

Geostationary Satellite: A satellite that orbits above the equator with a 24 hour period, so it will always remain above the same position on the Earth. They orbit approximately 36,000km above the surface of the Earth.

Gravitational Field: A region surrounding a mass in which any other object with mass will experience an attractive force.

Gravitational Field Strength: The force per unit mass exerted on a small test mass placed within the field.

Gravitational Potential, V (at a point in the field): The work done per unit mass required to move a small test mass from infinity to that point.

Gravitational Potential Energy: The component of an object's energy due to its position in a gravitational field.

Kepler's Third Law: The square of an object's orbital period (T) is directly proportional to the cube of its orbital radius (r) – $T^2 \propto r^3$.

Lenz's Law: The induced EMF opposes the change in magnetic flux that produces it.

Magnetic Field: A region surrounding a magnet or current-carrying wire that will exert a force on any other magnet or current-carrying wire placed within it.

Magnetic Flux, ϕ: A value which describes the magnetic field or field lines passing through an area. It is the product of magnetic flux density and the perpendicular area it passes through.

Magnetic Flux Density, B: The force per unit current per unit length on a current-carrying wire placed at 90º to the field lines. Sometimes also referred to as the magnetic field strength.

Magnetic Flux Linkage, Nϕ: The magnetic flux multiplied by the number of turns, N, of the coil.

Motor Effect: When a current-carrying wire is placed within a magnetic field (non-parallel to the field lines) and experiences a force perpendicular to both the wire and the field lines.

Permittivity of free space, ε_0: A measure of the ability of a vacuum to allow an electric field to pass through it.

Polarised: An atom/molecule becomes polarised when an external electric field causes the negative electron cloud to be shifted in the opposite direction to the positive nucleus – the charges are pulled in opposite directions. (This is what happens to the molecules of the dielectric in a capacitor).

Potential Gradient: The change of potential per metre at a point in the field.

Radial Field: A field in which the field lines are all directed towards a single point (e.g. the centre of a planet or a point charge).

Relative Permittivity: The ratio of charge stored in a capacitor *with* the dielectric to charge stored *without* the dielectric. Also sometimes referred to as the **dielectric constant**.

Step-down Transformer: A device made of two insulated wires coiled around an iron core in which the output voltage is *smaller* than the input voltage due to the secondary coil having *fewer* turns than the primary coil.

Step-up Transformer: A device made of two insulated wires coiled around an iron core in which the output voltage is *greater* than the input voltage due to the secondary coil having *more* turns than the primary coil.

Synchronous Orbit: An orbit in which the period of the orbit is equal to the rotational period of the object that it is orbiting.

Time Constant: The time taken for a capacitor to discharge to 37% (e^{-1}) of its initial charge. The time constant is equal to the product of the capacitance and the resistance of the fixed resistor (that the capacitor is being discharged through).

Uniform Field: A field in which all of the field lines are parallel and equally spaced – field strength is equal in all areas of the field.