AP Physics C: Electricity and Magnetism

Key Definitions ·

Almost every E&M free-response question turns on choosing the right surface or loop and stating why the symmetry permits it. Write the principle, name the symmetry, then integrate.

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Electrostatics

Electric field – the force per unit positive charge at a point, a vector field

Gauss's law – the flux of E through a closed surface equals the enclosed charge divided by ε_0; it gives the field easily only where symmetry makes E constant on the surface

Electric flux – the surface integral of the field component perpendicular to the surface

Electric potential – the potential energy per unit charge, a scalar, equal to the negative line integral of E

Equipotential surface – a surface of constant potential, always perpendicular to the field; no work is done moving a charge along it

Conductor in electrostatic equilibrium – a conductor with zero internal field, all excess charge on its surface, and its whole volume at one potential

Capacitance and circuits

Capacitance – the charge stored per unit potential difference, determined by geometry and the dielectric alone

Dielectric – an insulator that polarises in a field, reducing the field between the plates and so increasing capacitance

Resistivity – a material property relating resistance to length and cross-sectional area, unlike resistance itself

RC time constant RC – the product RC, the time for a charging capacitor to reach $1 - 1/e$ of its final charge

Kirchhoff's loop rule – the sum of potential changes around a closed loop is zero, a statement of energy conservation

Magnetism

Magnetic force on a charge – $qv \times B$; because it is always perpendicular to velocity, a magnetic field does no work on a moving charge

Biot-Savart law - – gives the field contributed by a current element, integrated over the whole circuit

Ampère's law – the line integral of B around a closed loop equals μ_0 times the enclosed current; useful only where symmetry makes B constant along the loop

Magnetic flux – the surface integral of the field component perpendicular to a surface

Induction

Faraday's law – the induced emf equals the negative rate of change of magnetic flux, whether the change comes from the field, the area or the orientation

Lenz's law – the induced current opposes the CHANGE in flux that produced it – the minus sign in Faraday's law, and a statement of energy conservation

Inductance – the flux linkage per unit current; an inductor opposes changes in current, not current itself

LR time constant LR – L/R, the time for the current in an inductive circuit to reach $1 - 1/e$ of its final value

Displacement current – the term Maxwell added to Ampère's law for a changing electric field, which makes the set of equations consistent and predicts electromagnetic waves