Physics-2 Formulas
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Electric Charge and Electric Field

- Coulomb's Law: $F = k\frac{|q_1 q_2|}{r^2}$
- Electric Field (Point Charge): $\vec{E} = k\frac{q}{r^2}\hat{r}$
- Electric Field (General): $\vec{E} = \frac{\vec{F}}{q_0}$
- Electric Dipole Moment: $\vec{p} = q\vec{d}$
- Torque on an Electric Dipole: $\vec{\tau} = \vec{p} \times \vec{E}$

Gauss's Law

- Electric Flux: $\Phi_E = \int \vec{E} \cdot d\vec{A}$
- Gauss's Law: $\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}$

Electric Potential

- Electric Potential Energy: $U = k\frac{q_1 q_2}{r}$
- Electric Potential (Point Charge): $V = k\frac{q}{r}$
- Potential Difference: $V_{ba} = -\int_a^b \vec{E} \cdot d\vec{l}$
- Relation between E and V: $\vec{E} = -\nabla V$

Capacitance, Dielectrics

- Capacitance Definition: $C = \frac{Q}{V}$
- Parallel Plate Capacitor: $C = \epsilon_0 \frac{A}{d}$
- Capacitors in Series: $\frac{1}{C_{eq}} = \sum \frac{1}{C_i}$
- Capacitors in Parallel: $C_{eq} = \sum C_i$
- Energy Stored in Capacitor: $U = \frac{1}{2}CV^2$
- Capacitance with Dielectric: $C = \kappa C_0$

Electric Current and Resistance

- Electric Current: $I = \frac{dQ}{dt}$
- Ohm's Law: $V = IR$
- Resistance and Resistivity: $R = \rho\frac{L}{A}$
- Electric Power: $P = IV$

DC Circuits

- Resistors in Series: $R_{eq} = \sum R_i$
- Resistors in Parallel: $\frac{1}{R_{eq}} = \sum \frac{1}{R_i}$
- Kirchhoff's Junction Rule: $\sum I_{in} = \sum I_{out}$
- Kirchhoff's Loop Rule: $\sum \Delta V = 0$
- RC Circuit (Charging): $q(t) = C\mathcal{E}(1 - e^{-t/RC})$
- RC Circuit (Discharging): $q(t) = Q_0 e^{-t/RC}$

Magnetism

- **Magnetic Force on Moving Charge:** $\vec{F}_B = q(\vec{v} \times \vec{B})$
- **Lorentz Force:** $\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$
- **Magnetic Force on Current-Carrying Wire:** $\vec{F}_B = I(\vec{L} \times \vec{B})$
- **Torque on a Current Loop:** $\vec{\tau} = \vec{\mu} \times \vec{B}$

Sources of Magnetic Field

- **Biot-Savart Law:** $d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{r}}{r^2}$
- **Magnetic Field (Long Straight Wire):** $B = \frac{\mu_0 I}{2\pi r}$
- **Magnetic Field (Center of Circular Loop):** $B = \frac{\mu_0 I}{2R}$
- **Ampère's Law:** $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$
- **Magnetic Field inside a Solenoid:** $B = \mu_0 n I$

Electromagnetic Induction and Faraday's Law

- **Magnetic Flux:** $\Phi_B = \int \vec{B} \cdot d\vec{A}$
- **Faraday's Law of Induction:** $\mathcal{E} = -\frac{d\Phi_B}{dt}$
- **Lenz's Law:** Induced current opposes the change in magnetic flux.
- **Motional EMF:** $\mathcal{E} = Blv$

Inductance, Electromagnetic Oscillations and AC Circuits

- **Self-Inductance:** $\mathcal{E}_L = -L\frac{dI}{dt}$
- **Inductance Definition:** $L = \frac{N\Phi_B}{I}$
- **Inductance of a Solenoid:** $L = \mu_0 n^2 A l$
- **Energy Stored in Inductor:** $U_L = \frac{1}{2} L I^2$
- **LC Circuit Oscillation:** $\omega = \frac{1}{\sqrt{LC}}$
- **Impedance (RLC Series):** $Z = \sqrt{R^2 + (X_L - X_C)^2}$
- **Reactance (Inductive, Capacitive):** $X_L = \omega L, \quad X_C = \frac{1}{\omega C}$
- **Resonance Frequency (RLC):** $\omega_0 = \frac{1}{\sqrt{LC}}$

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Ya da buraya tıkla ve interaktif formül sayfasına git.

Maxwell's Equations and Electromagnetic Waves

- **Gauss's Law (Electric):** $\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}$
- **Gauss's Law (Magnetic):** $\oint \vec{B} \cdot d\vec{A} = 0$
- **Faraday's Law (Maxwell):** $\oint \vec{E} \cdot d\vec{l} = -\frac{d\Phi_B}{dt}$
- **Ampère-Maxwell Law:** $\oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc} + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$
- **Speed of Light in Vacuum:** $c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$
- **Wave Equation (e.g., E-field):** $\nabla^2 \vec{E} = \mu_0 \epsilon_0 \frac{\partial^2 \vec{E}}{\partial t^2}$
- **Poynting Vector (Energy Flux):** $\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$
- **Plane EM Waves:** $E = E_{max} \cos(kx - \omega t), B = B_{max} \cos(kx - \omega t); \quad E = cB$
- **Intensity (Average):** $S_{avg} = I = \frac{E_{max} B_{max}}{2\mu_0} = \frac{1}{2} c \epsilon_0 E_{max}^2 = \frac{c B_{max}^2}{2\mu_0} = u_{avg} c$
- **Energy Density (Average):** $u_{avg} = \frac{1}{2} \epsilon_0 E_{max}^2 = \frac{1}{2\mu_0} B_{max}^2 = \epsilon_0 E_{rms}^2$
- **Radiation Pressure (P_{rad}):** $P_{rad} = S_{avg}/c$ (absorption), $P_{rad} = 2S_{avg}/c$ (reflection)
- **Standing EM Wave (e.g., reflected at x=0):** $E_y \propto \sin(kx)\cos(\omega t), B_z \propto \cos(kx)\sin(\omega t)$
- **EM Spectrum (Order: low f to high f):** Radio, Microwave, Infrared, Visible, UV, X-ray, Gamma ray

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