

Equation Sheet for Exam 3

Magnetic forces

- The Lorentz force is $\mathbf{F} = q \mathbf{v} \times \mathbf{B}$. The direction is determined by the right-hand rule.
- Combined electric and magnetic forces, $\mathbf{F} = q \mathbf{E} + q \mathbf{v} \times \mathbf{B}$.
- The magnetic force on a current carrying wire is $\mathbf{F} = \mathbf{I} \times \mathbf{B} L$.
- The cyclotron equation. For a charged particle moving on a circle in a uniform magnetic field,

$$\frac{mv^2}{r} = qvB$$

Ampere's Law

- The magnetic field due to a long straight current carrying wire is $B = \frac{\mu_0 I}{2\pi r}$.
- The magnetic field in a solenoid is $B = \frac{\mu_0 NI}{L}$.
- The magnetic constant is $\mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}$.

Faraday's Law

- Faraday's law of electromagnetic induction:

$$\mathcal{E} = -\frac{\Delta\Phi}{\Delta t}, \text{ where } \mathcal{E} = \text{electromotive force}$$

around a loop, and Φ = the magnetic flux through any surface bounded by the loop; $\Phi = B A_{\text{perp}} = B A \cos \theta$.

- Transformer equations

$$\frac{V_2}{N_2} = \frac{V_1}{N_1} \quad \text{and} \quad I_1 V_1 = I_2 V_2$$

Light

- Snell's law : $n_1 \sin \theta_1 = n_2 \sin \theta_2$.

- The index of refraction is $n = c/v$

- $c = 2.998 \times 10^8 \text{ m/s}$

- $\lambda f = c$

- $I = \frac{P}{4\pi r^2}$

Other information

- proton mass = $1.67 \times 10^{-27} \text{ kg}$

- proton charge = $e = 1.60 \times 10^{-19} \text{ C}$