

PHYSICS 2220

Equation Sheet #3

1. $\mathbf{F}_B = q\mathbf{v} \times \mathbf{B}$ $|\mathbf{F}_B| = |q||\mathbf{v}||\mathbf{B}| \sin \phi$ $\mathbf{F}_B = i\mathbf{L} \times \mathbf{B}$ $|\mathbf{F}_B| = i|\mathbf{L}||\mathbf{B}| \sin \phi$

2. Biot-Savart law: $\mathbf{B} = \frac{\mu_0 i}{4\pi} \int \frac{d\mathbf{s} \times \hat{r}}{r^2} = \frac{\mu_0 i}{4\pi} \int \frac{ds \sin \theta}{r^2}$

3. Ampere's law: $\oint \mathbf{B} \cdot d\mathbf{s} = \oint B ds \cos \theta = \mu_0 i$

4. $\Phi_B = \int \mathbf{B} \cdot d\mathbf{A} = \int B dA \cos \theta = BA \cos \theta$ for uniform B

5. Faraday's law: $\mathcal{E} = -N \frac{d\Phi_B}{dt} = -N \frac{\Delta(BA \cos \theta)}{\Delta t}$ $\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$

Generator: $\mathcal{E} = -NAB\omega \sin(\omega t)$ $\mathcal{E} = Blv$

6. Inductance: $L = \frac{N\Phi_B}{i}$ $\mathcal{E} = -L \frac{di}{dt}$

7. Solenoid: $B = \mu_0 ni$ $L = \mu_0 n^2 Al$ $n = \frac{N}{\ell}$

8. RL: $i = \frac{\mathcal{E}}{R}(1 - e^{-Rt/L})$ $i = \frac{\mathcal{E}}{R} e^{-Rt/L}$ $\tau = \frac{L}{R}$

9. $U_B = \frac{1}{2} Li^2$ $u_B = \frac{1}{2\mu_0} B^2$

10. RLC circuit: $V_R = I_m R$ $V_L = I_m X_L$ $V_C = I_m X_C$ $\omega = 2\pi f$

$$X_L = \omega L \quad X_C = \frac{1}{\omega C} \quad Z = \sqrt{R^2 + (X_L - X_C)^2} \quad I_m = \frac{\mathcal{E}_m}{Z}$$

$$\tan \phi = \frac{X_L - X_C}{R} \quad \omega_0 = \frac{1}{\sqrt{LC}} \quad I_{\text{rms}} = \frac{I_m}{\sqrt{2}} \quad \mathcal{E}_{\text{rms}} = \frac{\mathcal{E}_m}{\sqrt{2}}$$

Power: $P_{\text{ave}} = I_{\text{rms}}^2 R = I_{\text{rms}} \mathcal{E}_{\text{rms}} \cos \phi$

11. $\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$ $g = 9.8 \text{ m/s}^2$ $c = 3 \times 10^8 \text{ m/s}$

$e = 1.60 \times 10^{-19} \text{ C}$ $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$

electron mass $m_e = 9.11 \times 10^{-31} \text{ kg}$ proton mass $m_p = 1.67 \times 10^{-27} \text{ kg}$

12. Circle: $C = 2\pi r$ $A = \pi r^2$