

Physics 212 Formula Sheet –2013

Mechanics:

$$K = \frac{1}{2}mv^2$$

$$a_c = \frac{v^2}{r}$$

Electrostatics:

$$\vec{F}_{12} = \frac{1}{4\pi\epsilon_0} \frac{q_1q_2}{r_{12}^2} \hat{r}_{12}$$

$$\vec{E} \equiv \frac{\vec{F}}{q_0}$$

$$\Phi_E = \int \vec{E} \cdot d\vec{S}$$

$$\oint \vec{E} \cdot d\vec{S} = \frac{Q_{encl}}{\epsilon_0}$$

$$\vec{E} = -\vec{\nabla}V$$

$$V_B - V_A \equiv \frac{W_{AB}}{q_0} = -\int_A^B \vec{E} \cdot d\vec{l}$$

$$\Delta U_{AB} = -W_{AB}$$

Capacitors and RC Circuits:

$$C \equiv \frac{Q}{V}$$

$$C_0 = \frac{\epsilon_0 A}{d}$$

$$C = \kappa C_0$$

$$U = \frac{1}{2}CV^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$u_E = \frac{1}{2} \epsilon_0 E^2$$

$$C = C_1 + C_2$$

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$$

$$\tau = RC$$

$$V = V_0 e^{-t/\tau}$$

$$V = V_\infty (1 - e^{-t/\tau})$$

Simple Circuits:

$$R = \frac{V}{I}$$

$$R = \frac{\rho L}{A}$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = R_1 + R_2$$

$$P = IV = I^2 R$$

Magnetostatics:

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

$$d\vec{F} = Id\vec{l} \times \vec{B}$$

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{Id\vec{l} \times \hat{r}}{r^2}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$\vec{\mu} = NI\vec{A}$$

$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

$$U = -\vec{\mu} \cdot \vec{B}$$

Induction and RL Circuits:

$$EMF = -\frac{d\Phi_B}{dt}$$

$$\Phi_B = \int \vec{B} \cdot d\vec{S}$$

$$L \equiv \frac{\Phi_B}{I}$$

$$V = L \frac{dI}{dt}$$

$$\tau = \frac{L}{R}$$

$$U = \frac{1}{2} LI^2$$

$$u_B = \frac{1}{2} \frac{B^2}{\mu_0}$$

$$V = V_0 e^{-t/\tau}$$

$$V = V_\infty (1 - e^{-t/\tau})$$

LC, LCR, and AC Circuits:

$$\omega_0 = \frac{1}{\sqrt{LC}} \quad X_C \equiv \frac{1}{\omega C} \quad X_L \equiv \omega L$$

$$Z \equiv \sqrt{R^2 + (X_L - X_C)^2} \quad \mathcal{E}_{\max} = I_{\max} Z \quad \mathcal{E}_{rms} = \frac{1}{\sqrt{2}} \mathcal{E}_{\max} \quad V_2 = \frac{N_2}{N_1} V_1$$

$$\langle P \rangle = \frac{1}{2} \mathcal{E}_{\max} I_{\max} \cos \phi = I_{rms}^2 R \quad Q = \frac{\omega_0 L}{R} \approx \frac{\omega_0}{FWHM}$$

EM Waves, Polarization, Reflection and Refraction:

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I + \mu_0 I_D \quad I_D = \epsilon_0 \frac{d\phi_E}{dt} \quad Z_0 = 377 \Omega$$

$$\vec{S} \equiv \frac{\vec{E} \times \vec{B}}{\mu_0} \quad E = cB \quad u = u_E + u_B \quad Intensity = \frac{\langle P \rangle}{area} = c \langle u \rangle = \frac{1}{2} \frac{E_{\max}^2}{Z_0}$$

$$\omega = 2\pi f \quad v = \lambda f = \frac{\omega}{k} \quad Intensity_2 = Intensity_1 \cos^2(\theta_1 - \theta_2)$$

$$v = c/n \quad n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad \sin \theta_c = \frac{n_2}{n_1} \quad f' = f \sqrt{\frac{1 \pm v/c}{1 \mp v/c}}$$

Mirrors and lenses:

$$f = \frac{R}{2} \quad \frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \quad \frac{1}{f} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \quad m = -\frac{s'}{s}$$

Important Constants:

$$k \equiv \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \frac{Nm^2}{C^2} \quad \epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{Nm^2} \quad \frac{\mu_0}{4\pi} \equiv 1 \times 10^{-7} \frac{N}{A^2} = 1 \times 10^{-7} \frac{Tm}{A}$$

$$c = \frac{1}{\sqrt{\mu_0\epsilon_0}} = 3 \times 10^8 \text{ m/s} \quad e = 1.60 \times 10^{-19} \text{ C} \quad Z_0 = \mu_0 c = 377 \Omega$$

SI Prefixes		
Power	Prefix	Symbol
10 ⁶	mega	M
10 ³	kilo	k
10 ⁰	—	—
10 ⁻³	milli	m
10 ⁻⁶	micro	μ
10 ⁻⁹	nano	n
10 ⁻¹²	pico	p

Geometry
Circle area = πR^2 circumf. = $2\pi R$
Sphere area = $4\pi R^2$ volume = $\frac{4}{3}\pi R^3$

$$\vec{\nabla} V = \hat{x} \frac{\partial V}{\partial x} + \hat{y} \frac{\partial V}{\partial y} + \hat{z} \frac{\partial V}{\partial z}$$