Physics 212 Formula Sheet –2013

Mechanics:

$$K = \frac{1}{2} m\mathrm{v}^2 \qquad a_c = \frac{\mathrm{v}^2}{r}$$

Electrostatics:

$$\vec{F}_{12} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r_{12}^{\;2}} \hat{r}_{12} \qquad \vec{E} \equiv \frac{\vec{F}}{q_0} \qquad \Phi_E = \int \vec{E} \cdot d\vec{S} \qquad \oint \vec{E} \cdot d\vec{S} = \frac{Q_{encl}}{\varepsilon_0}$$

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

Capacitors and RC Circuits:

$$C \equiv \frac{Q}{V} \qquad C_0 = \frac{\varepsilon_0 A}{d} \qquad C = \kappa C_0 \qquad U = \tfrac{1}{2} C V^2 = \tfrac{1}{2} \frac{Q^2}{C} \qquad u_E = \frac{1}{2} \varepsilon_0 E^2$$

$$C = C_1 + C_2 \qquad \frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} \qquad \tau = RC \qquad V = V_0 e^{-t/\tau} \qquad V = V_\infty (1 - e^{-t/\tau})$$

Simple Circuits:

$$R = \frac{V}{I} \qquad R = \frac{\rho L}{A} \qquad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \qquad R = R_1 + R_2$$

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

Magnetostatics:

$$\vec{F} = q\vec{E} + q\vec{\mathrm{v}} \times \vec{B} \qquad d\vec{F} = I d\vec{l} \times \vec{B} \qquad d\vec{B} = \frac{\mu_0}{4\pi} \frac{I d\vec{l} \times \hat{r}}{r^2} \qquad \oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$\vec{\mu} = N I \vec{A} \qquad \vec{\tau} = \vec{\mu} \times \vec{B} \qquad U = -\vec{\mu} \cdot \vec{B}$$

Induction and RL Circuits:

$$EMF = -\frac{d\Phi_B}{dt} \qquad \Phi_B = \int \vec{B} \cdot d\vec{S} \qquad L \equiv \frac{\Phi_B}{I} \qquad V = L \frac{dI}{dt} \qquad \tau = \frac{L}{R}$$

$$U = \frac{1}{2} L I^2 \qquad u_B = \frac{1}{2} \frac{B^2}{\mu_0} \qquad V = V_0 e^{-t/\tau} \qquad V = V_\infty (1 - e^{-t/\tau})$$

LC, LCR, and AC Circuits:

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

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

$$< P > = \frac{1}{2}\varepsilon_{max} I_{max} \cos\phi = I_{rms}^2 R \qquad Q = \frac{\omega_0 L}{R} \approx \frac{\omega_0}{FWHM}$$

EM Waves, Polarization, Reflection and Refraction:

$$\oint \vec{B}\cdot d\vec{l} = \mu_0 I + \mu_0 I_D \qquad I_D = \varepsilon_0 \frac{d\phi_E}{dt}$$

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

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

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

Mirrors and lenses:

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

Important Constants:

$$k \equiv \frac{1}{4\pi\varepsilon_\circ} = 8.99\times10^9 \ \frac{\mathrm{Nm^2}}{\mathrm{C^2}} \qquad \varepsilon_0 = 8.85\times10^{-12} \frac{C^2}{Nm^2} \qquad \frac{\mu_0}{4\pi} \equiv 1\times10^{-7} \ \frac{\mathrm{N}}{\mathrm{A^2}} = 1\times10^{-7}\, T_m/A$$

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}} = 3\times10^8 \mathrm{m/s} \qquad e = 1.60\times10^{-19}\ \mathrm{C} \qquad Z_0 = \mu_0 c = 377\,\Omega$$

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

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