Physics 203 Cheat Sheet

1 Circuits

	Resistor (Ω)	Capacitor (F)	Inductor (H)
Symbol	–/\/\/\/–	–||–	–∩∩∩–
I-V Characteristic	$V = IR$	$Q = CV$	$\psi = LI$
How to Calculate	$R = \frac{\rho l}{A}$	$C = \frac{\epsilon A}{d}$	$L = \frac{\mu N^2 A}{l}$
Energy Storage	-	$E_C = \frac{1}{2}CV^2$	$E_L = \frac{1}{2}LI^2$
Air as a Circuit Element	No (but, can get arcing)	Yes	Yes
Power	$IV = I^2R = V^2/R$	IV	IV
AC Impedance	$Z_R = R$	$Z_C = \frac{1}{j\omega C}$	$Z_L = j\omega L$
Low Frequency Impedance	R	Open Circuit	Short Circuit
High Frequency Impedance	R	Short Circuit	Open Circuit
Series Connections (2)	$R_T = R_1 + R_2$	$C_T = \frac{C_1 C_2}{C_1 + C_2}$	$L_T = L_1 + L_2$
Parallel Connections (2)	$R_T = \frac{R_1 R_2}{R_1 + R_2}$	$C_T = C_1 + C_2$	$L_T = \frac{L_1 L_2}{L_1 + L_2}$
Series Connections (2 or more)	$R_T = \sum_i R_i$	$C_T^{-1} = \sum_i C_i^{-1}$	$L_T = \sum_i L_i$
Parallel Connections (2 or more)	$R_T^{-1} = \sum_i R_i^{-1}$	$C_T = \sum_i C_i$	$L_T^{-1} = \sum_i L_i^{-1}$

KVL: $\sum_{loop} V_{cw} = \sum_{loop} V_{ccw}$
KCL: $\sum_{node} I_{in} = \sum_{node} I_{out}$

2 Units

Common Conversions

1. $1.609\ km = 1\ mile$
2. $1\ m/s = 2.237\ mi/hr$
3. $1eV = 1.602 \times 10^{-19}\ J$
4. $1kW \cdot hr = 3.6\ MJ$

Common Physical Constants

1. $k = 8.99 \times 10^9\ Nm^2/C^2$
2. $\epsilon_0 = 8.854 \times 10^{-12}\ F/m$
3. $\mu_0 = 4\pi \times 10^{-7}\ H/m$
4. $E_{air,breakdown} = 3\ kV/cm$
5. $e = 1.602 \times 10^{-19}\ C$
6. $m_e = 9.109 \times 10^{-31}\ kg$
7. $c = 2.998 \times 10^8\ m/s$ (Speed of Light)
8. $\lambda_{human} = 0.4\mu m - 0.7\mu m$
9. $I_{fromSun} = 1400W/m^2$

3 Electric Fields

$\mathbf{F_{point\ mass}} = -\frac{Gm_1m_2}{R^2}\mathbf{u_R}$
$\mathbf{F_{point\ charge}} = \frac{kq_1q_2}{R^2}\mathbf{u_R}$
$\mathbf{E_{point\ charge}} = \frac{kq}{R^2}\mathbf{u_R}$
$E_{parallel\ plate\ capacitor} = \frac{V}{d}$

4 E/M Waves

$\mathbf{E}(\mathbf{x}, \mathbf{t}) = E_0 cos(kz - \omega t)\mathbf{u_x}$
$k = \frac{2\pi}{\lambda}$
$\omega = 2\pi f = \frac{2\pi}{T}$
$v_{phase} = \frac{\omega}{k} = \frac{\lambda}{T} = \frac{c}{n}$
$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$

$I = \frac{c\epsilon_0 n}{2}E_0^2 = \frac{P}{A}$ (Intensity)
$P_r = \frac{I}{c}$ (Radiation Pressure)
$E_{photon} = hf = \frac{hc}{\lambda}$

5 Magnetism

$\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$

Rules of Thumb

1. Magnetic fields tend to align magnetic moments.
2. Magnets tend to move toward regions of higher flux, i.e. North attracts South

6 Transformers

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

7 Polarizers

$I = I_0 cos^2(\theta)$

8 Optics

$n_1 sin\theta_1 = n_2 sin\theta_2$
$R_{normal\ incidence} = \left(\frac{n_1 - n_2}{n_1 + n_2}\right)^2$
$\theta_{critical} = sin^{-1}\left(\frac{n_2}{n_1}\right)\ (n_2 < n_1)$
$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
$\frac{1}{s_1} + \frac{1}{s_2} = \frac{1}{f}$
$M_x = -\frac{s_2}{s_1}$