Math Stuff		Constants	
Scalar Product	$\vec{A}\cdot\vec{B} = \lvert\vec{A}\rvert\lvert\vec{B}\rvert\cos\theta$	Coulomb Constant	$k_e = \frac{1}{4\pi\varepsilon_o} = 8.99\times10^9 Nm^2/C^2$
Vector Product	$\vec{A}\times\vec{B} = \lvert\vec{A}\rvert\lvert\vec{B}\rvert\sin\theta$	Permittivity of free space	$\varepsilon_o = \frac{1}{4\pi k_e} = 8.85\times10^{-12} C^2/Nm^2$
Quadratic Formula ($ax^2+bx+c=0$)	$x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$	Permeability of free space	$\mu_o = 4\pi\times10^{-7} Tm/A$
Surface Area of Sphere Volume of Sphere	$4\pi r^2$ $\frac{4}{3}\pi r^3$	Charge of an electron Mass of an electron Mass of a proton	$e = 1.602\times10^{-19}$ C $m_e = 9.11\times10^{-31}$ kg $m_p = 1.67\times10^{-27}$ kg
Unit conversions:	1 cal = 4.186 J	Speed of light	$c = 3.00\times10^8$ m/s
Avogadro's Number	$N_A = 6.022\times10^{23}$	Boltzmann Constant	$k = 1.38\times10^{-23}$ J/K
		Gas Constant	R = 8.31 J/(mol K)

Electric Force / Field / Potential Energy		Gauss's Law / Flux / Electric Potential	
Coulomb's Law	$F_e = \frac{k_e\lvert q_1\rvert\lvert q_2\rvert}{r^2}$	Gauss's Law	$\Phi_e = \frac{q_{in}}{\epsilon_o}$
Electric Field	$\vec{E} = \frac{\vec{F_e}}{q_o}$ $\vec{E} = \frac{k_e q}{r^2}\hat{r}$ (point charge)	Electric Flux	$\Phi_e = \vec{E}\cdot\vec{A} = EA\cos\theta$ (constant E)
Electric Potential Energy	$\Delta U = q_o\Delta V$	Electric Potential	$V = \frac{U}{q_o}$ $\Delta V = \frac{\Delta U}{q_o}$ $V = k_e\frac{q}{r}$ (point charge)
Work	$W = q\Delta V$	Electric Field	$E_x = -\frac{\Delta V}{\Delta x}$

Capacitance		Resistance	
Capacitance	$Q = CV$	Resistance	$V = IR$
Parallel Plate Capacitor	$C = \frac{\varepsilon_o A}{d}$	Resistance	$R = \frac{\rho l}{A}$
Series	$\frac{1}{C_{eq}} = \frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}+\ \ldots$	Series	$R_{eq} = R_1+R_2+R_3+\ \ldots$
Parallel	$C_{eq} = C_1+C_2+C_3+\ \ldots$	Parallel	$\frac{1}{R_{eq}} = \frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+\ \ldots$
Energy Stored	$U = \frac{Q^2}{2C} = \frac{1}{2}QV = \frac{1}{2}CV^2$	Electric Power	$P = IV = I^2R = \frac{V^2}{R}$
Dielectric	$C = \kappa C_o$	Temperature Dependence	$R = R_o[1+\alpha(T-T_o)]$

Electric Current		Kirchhoff's Rules	
Current	$I = \frac{\Delta Q}{\Delta t}$	Junction Rule	$\sum I_{in} = \sum I_{out}$
Ohm's Law	$V = IR$	Loop Rule	$\sum_{closed}\Delta V = 0$

RC Circuits		RL Circuits		LC Circuits	
Charging Capacitor	$q(t) = Q(1-e^{-t/RC})$ $I(t) = \frac{\varepsilon}{R}e^{-t/RC}$	Increasing Current	$I(t) = \frac{\varepsilon}{R}(1-e^{-t/\tau})$	Charge	$Q(t) = Q_{max}\cos(\omega t+\phi)$
Discharging Capacitor	$q(t) = Qe^{-t/RC}$ $I(t) = -\frac{Q}{RC}e^{-t/RC}$	Decreasing Current	$I(t) = \frac{\varepsilon}{R}e^{-t/\tau} = I_{max}e^{-t/\tau}$	Current	$I(t) = \frac{dQ}{dt}$ $= -\omega Q_{max}\sin(\omega t+\phi)$
Time Constant	$\tau = RC$	Time Constant	$\tau = \frac{L}{R}$	Resonant Frequency	$\omega = \frac{1}{\sqrt{LC}}$
				Energy	$U = U_C + U_L = constant$

Magnetism		Induction	
Magnetic Force	$\vec{F}_B = q\vec{v} \times \vec{B}$ $F_B = \|q\|vBsin\theta$ $\vec{F}_B = I\vec{L} \times \vec{B} = ILBsin\theta$	Magnetic Flux	$\Phi = BAcos\theta$
Torque	$\vec{\mu} = I\vec{A}$ $\vec{\tau} = N\vec{\mu} \times \vec{B} = NI\vec{A} \times \vec{B}$	Faraday's Law	$\varepsilon = -N\frac{\Delta\Phi_B}{\Delta t}$
Ampere's Law	$\sum B_{\parallel}\Delta L = \mu_o I_{enclosed}$	Generators	$\Phi_B = BAcos\omega t$ $\varepsilon = NAB\omega sin\omega t$
Magnetic Field of a long, straight wire	$B = \frac{\mu_o I}{2\pi R}$	Inductance	$L = \frac{N\Phi_B}{I}$
Magnetic Field at the center of a current loop	$B = \frac{N\mu_o I}{2R}$	Energy in an Inductor	$U = \frac{1}{2}LI^2$
Magnetic Field of an ideal solenoid	$B = \mu_o\left(\frac{N}{L}\right)I = \mu_o nI$		

AC Circuits		Thermodynamics	
RMS Current RMS Voltage	$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$	Converting Temperatures	$T_F = \frac{9}{5}T_C + 32$ $T_C = \frac{5}{9}(T_F - 32)$ $T = T_C + 273.15$
Reactance	$\chi_L = \omega L$ $\chi_C = \frac{1}{\omega C}$	Thermal Expansion	$\Delta L = \alpha L_o \Delta T$ $\Delta A \approx 2\alpha A\Delta T$ $\Delta V = \beta V\Delta T \approx 3\alpha V\Delta T$
		Calorimetry	$Q = cm\Delta T$ $Q = mL$
Impedance	$Z = \sqrt{R^2 + (\chi_L - \chi_C)^2}$ $\phi = tan^{-1}\left(\frac{\chi_L - \chi_C}{R}\right)$	Heat Transfer	Conduction: $Q = \frac{kA\Delta T}{L}t$ Radiation: $P = e\sigma AT^4$ $P_{net} = e\sigma A(T^4 - T_S^4)$ Stefan-Boltzmann: $\sigma = 5.67 \times 10^{-8}\ W/(m^2 \cdot K^4)$
Power	$P_{ave} = I_{rms}V_{rms}cos\phi$ $P_{ave} = I_{rms}^2 R$	Ideal Gas Law	$PV = NkT$ $PV = nRT$ $K_{av} = \frac{3}{2}kT$
RLC Circuits	$I_{rms} = \frac{V_{rms}}{Z}$ $v_R = I_{max}Rsin\omega t$ $v_L = I_{max}\chi_L sin\left(\omega t + \frac{\pi}{2}\right)$ $v_C = I_{max}\chi_C sin\left(\omega t - \frac{\pi}{2}\right)$ $\omega_o = \frac{1}{\sqrt{LC}}$ resonance frequency	RMS Speed	$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$
		Internal Energy (Ideal Gas)	$U = \frac{3}{2}NkT = \frac{3}{2}nRT$
		1st Law of Thermodynamics	$\Delta U = Q - W$
		Work done in an isothermal process	$W = nRTln\left(\frac{V_f}{V_i}\right)$
Transformers	$V_2 = \frac{N_2}{N_1}V_1$ $I_1V_1 = I_2V_2$	Molar Specific Heat, C Constant Volume Constant Pressure	$Q = nC\Delta T$ $C_V = \frac{3}{2}R$ $C_P = \frac{5}{2}R$ $\gamma = \frac{C_P}{C_V}$
Thermodynamics		Adiabatic Process	$PV^\gamma = constant$
Entropy Change Coefficient of Performance Heat Pump Refrigerator	$\Delta S = \frac{Q}{T}$ $COP = \frac{Q_H}{W}$ $COP = \frac{Q_C}{W}$	Heat Engines Efficiency	$e = \frac{W}{Q_H} = \frac{Q_H - Q_C}{Q_H} = 1 - \frac{Q_C}{Q_H}$ $e_{max} = 1 - \frac{T_C}{T_H}$