Math Stuff		Constants	
Scalar Product	$\vec{A} \cdot \vec{B} = \lvert\vec{A}\rvert\lvert\vec{B}\rvert \cos\theta$	Coulomb Constant	$k_e = \frac{1}{4\pi\varepsilon_o} = 8.99 \times 10^9 Nm^2/C^2$
Vector Product	$\vec{A} \times \vec{B} = \lvert\vec{A}\rvert\lvert\vec{B}\rvert \sin\theta$	Permittivity of free space	$\varepsilon_o = \frac{1}{4\pi k_e} = 8.85 \times 10^{-12} C^2/Nm^2$
Quadratic Formula ($ax^2+bx+c=0$)	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	Permeability of free space	$\mu_o = 4\pi \times 10^{-7} Tm/A$
Surface Area of Sphere	$4\pi r^2$	Charge of an electron	$e = 1.602 \times 10^{-19}$ C
Volume of Sphere	$\frac{4}{3}\pi r^3$	Mass of an electron	$m_e = 9.11 \times 10^{-31}$ kg
		Mass of a proton	$m_p = 1.67 \times 10^{-27}$ kg
		Speed of light	$c = 3.00 \times 10^8$ m/s

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	$\Phi_e = \oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_o}$	
Electric Field	$\vec{E} = \frac{\vec{F_e}}{q_o}$		Electric Flux	$\Phi_e = \vec{E} \cdot \vec{A} = EA\cos\theta$	(constant E)
	$\vec{E} = \frac{k_e q}{r^2}\hat{r}$	(point charge)		$\Phi_e = \int_{surface} \vec{E} \cdot d\vec{A}$	
	$\vec{E} = k_e \int \frac{dq}{r^2}\hat{r}$	(continuous charge distribution)	Electric Potential	$V = \frac{U}{q_o}$	
Electric Potential Energy	$\Delta U = -q_o \int_A^B \vec{E} \cdot d\vec{s}$			$\Delta V = \frac{\Delta U}{q_o} = -\int_A^B \vec{E} \cdot d\vec{s}$	
Work	$\lvert W\rvert = \lvert q\Delta V\rvert$			$V = k_e \frac{q}{r}$	(point charge)
Electric Field	$E_x = -\frac{\partial V}{\partial x}$			$V = k_e \int \frac{dq}{r}$	(continuous charge distribution)

Capacitance		Resistance	
Capacitance	$Q = CV$	Resistance	$V = IR$
Parallel Plate Capacitor	$C = \frac{\varepsilon_o A}{d}$	Resistance	$R = \frac{\rho l}{A}$
Series	$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ \dots$	Series	$R_{eq} = R_1 + R_2 + R_3 + \ \dots$
Parallel	$C_{eq} = C_1 + C_2 + C_3 + \ \dots$	Parallel	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ \dots$
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	$I = \frac{dQ}{dt}$	Junction Rule	$\sum I_{in} = \sum I_{out}$
Current Density	$\vec{J} = nq\vec{v}_d$	Loop Rule	$\sum_{closed} \Delta V = 0$
Ohm's Law	$\vec{J} = \sigma\vec{E}$		

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	$\vec{F}_B = q\vec{v} \times \vec{B}$ $F_B = \|q\|vBsin\theta$ $\vec{F}_B = I\vec{L} \times \vec{B}$	Faraday's Law	$\varepsilon = -N\frac{d\Phi_B}{dt}$
Torque	$\vec{\mu} = I\vec{A}$ $\vec{\tau} = \vec{\mu} \times \vec{B} = I\vec{A} \times \vec{B}$	Generators	$\Phi_B = BAcos\omega t$ $\varepsilon = NAB\omega sin\omega t$
Biot-Savart Law	$\vec{B} = \frac{\mu_o I}{4\pi}\int \frac{d\vec{l} \times \hat{r}}{r^2}$	Inductance	$L = \frac{N\Phi_B}{I}$
Ampere's Law	$\oint \vec{B} \cdot d\vec{s} = \mu_o I_{enc}$	Self Induced EMF	$\varepsilon_L = -L\frac{dI}{dt}$
Magnetic Flux	$\Phi_B = \int \vec{B} \cdot d\vec{A}$	Energy in an Inductor	$U = \frac{1}{2}LI^2$

AC Circuits		Integrals
RMS Current RMS Voltage	$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$	$\int \frac{dx}{x} = \ln x$ $\int \frac{dx}{a-x} = -\ln(a-x)$
Reactance	$\chi_L = \omega L$ $\chi_C = \frac{1}{\omega C}$	$\int \frac{dx}{(a^2+x^2)^{3/2}} = \frac{x}{a^2\sqrt{(a^2+x^2)}}$
Impedance	$Z = \sqrt{R^2 + (\chi_L - \chi_C)^2}$ $\phi = tan^{-1}\left(\frac{\chi_L - \chi_C}{R}\right)$	$\int \frac{xdx}{(a^2+x^2)^{3/2}} = -\frac{1}{\sqrt{(a^2+x^2)}}$ $\int \frac{dx}{\sqrt{x^2 \pm a^2}} = ln\left(x + \sqrt{x^2 \pm a^2}\right)$
Power	$P_{ave} = I_{rms}V_{rms}cos\phi$ $P_{ave} = I_{rms}^2 R$	$\int \frac{xdx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2}$
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	$\int \frac{x^2dx}{(a^2+x^2)^{3/2}} = -\frac{x}{\sqrt{(a^2+x^2)}} + ln\left(x + \sqrt{a^2+x^2}\right)$ $\int \frac{dx}{x(a^2+x^2)^{3/2}} = \frac{1}{a^2\sqrt{(a^2+x^2)}} - \frac{1}{a^3}ln\frac{a+\sqrt{a^2+x^2}}{x}$ $\int cos^2\theta d\theta = \frac{1}{4}sin(2\theta) + \frac{\theta}{2}$
Transformers	$V_2 = \frac{N_2}{N_1}V_1$ $I_1V_1 = I_2V_2$	

Electromagnetic Waves	
Speed of Light	$c = \frac{1}{\sqrt{\mu_o \epsilon_o}} = \frac{E}{B} = 3 \times 10^8 \frac{m}{s}$
Wavelength	$\lambda = \frac{c}{f}$