USEFUL EQUATIONS AND CONSTANTS

k = 8.99 X 10^9 $\frac{Nm^2}{C^2}$ $\varepsilon_0 = 8.85\times10^{-12}\ \mathrm{C^2/N\cdot m^2}$

q_e = -1.6 X10^{-19} C q_p = + 1.6 X10^{-19} C

m_e = 9.1 X 10^{-31}kg m_p = 1.7 X 10^{-27}kg 1 eV = 1.60 x 10^{-19}J

Coulomb's Law:	$F = k\frac{\lvert q_1\rvert\lvert q_2\rvert}{r^2}$	$k = 8.99\times10^9\ \mathrm{N\cdot m^2/C^2}$
Superposition:	$\vec{F}_1 = \vec{F}_{12} + \vec{F}_{13} + \vec{F}_{14}$	Vector Sum
Electric Field:	$\vec{F} = q\vec{E}$	Definition
Electric Field:	$E = k\frac{\lvert q\rvert}{r^2}$	Magnitude (for point charge)
Superposition:	$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3$	Vector Sum
	$\Delta U = -\Delta W_{\mathrm{elect}}$	
Potential Difference:	$\Delta V = \frac{\Delta U}{q_0} = -\frac{\Delta W_{\mathrm{elect}}}{q_0}$	Definition
Potential Energy	U = q V	
	$E = -\frac{\Delta V}{\Delta s}$ *where* Δs *is along the direction of* E	
Electric Potential:	$V = k\frac{q}{r}$	Point Charge
	$V = k\frac{q_1}{r_1} + k\frac{q_2}{r_2} + k\frac{q_3}{r_3}$	Superposition
Energy Conservation:	$K_A + U_A = K_B + U_B$ where	$K = \frac{1}{2}mv^2$
Capacitance:	$C = \frac{Q}{V}$	Definition
	$C = \varepsilon_0\frac{A}{d}$	Parallel Plate,
Dielectric:	$C = \kappa C_0$	$\kappa =$ Dielectric Constant
Energy Stored:	$U = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$	
Current:	$I = \frac{\Delta Q}{\Delta t}$	Definition
Ohm's Law:	$V = IR$	
Resistance:	$R = \rho\frac{L}{A}$	$\rho =$ Resistivity
Power:	$P = IV = I^2R = V^2/R$	

Resistors in Series: $R_{eq} = R_1 + R_2 + R_3 + \ldots$

Resistors in Parallel: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$

Equations for Chapters 22, 23 and 24

Electric Force: $\vec{F} = q\vec{E}$

Ohm's Law: $\mathcal{E} = IR$

Magnetic Force: $F = |q| vB\sin\theta$ Moving Charge

$F = ILB\sin\theta$ Current Carrying Wire

Circular Motion: $\frac{mv^2}{r}$ Centripetal Force

Torque: $\tau = NIAB\sin\theta$ Current Loop

Magnetic Field: $B = \frac{\mu_0 I}{2\pi r}$ Long Straight Wire, $\mu_0 = 4\pi \times 10^{-7}\ \mathrm{T\cdot m/A}$

$B = \frac{N\mu_0 I}{2R}$ Center of Circular Loop

Magnetic Force: $F = \frac{\mu_0 I_1 I_2}{2\pi d} L$ Parallel Current Carrying Wires.

Magnetic Flux: $\Phi = BA\cos\theta$ Definition

Induced EMF: $\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$ Faraday's Law

$\mathcal{E} = NBA\omega\sin(\omega t)$ Electric Generator

Motional EMF: $|\mathcal{E}| = Bvl$ Moving Rod

Transformer: $\frac{I_s}{I_p} = \frac{V_p}{V_s} = \frac{N_p}{N_s}$

Alternating Currents: $V = V_{max}\sin(2\pi ft) = V_{max}\sin(\omega t)$ Voltage

$I = \frac{V_{max}}{R}\sin(\omega t) = I_{max}\sin(\omega t)$ Current in Resistor

RMS Values: $V_{rms} = \frac{1}{\sqrt{2}}V_{max}$ $I_{rms} = \frac{1}{\sqrt{2}}I_{max}$

Average Power Dissipated: $P_{av} = I_{rms}{}^2 R = I_{rms}V_{rms} = V_{rms}{}^2 / R$ For Resistors

Capacitive Reactance $X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi fC}$

Inductive Reactance $X_L = \omega L = 2\pi fL$

Impedance $Z = \sqrt{R^2 + (X_L - X_c)^2} = \sqrt{R^2 + \left(\omega L - \dfrac{1}{\omega C}\right)^2}$

Ohm's Law $I_{rms} = \dfrac{V_{rms}}{Z}$

Voltages $V_R = I_{rms}R,$ $V_C = I_{rms}X_{C,}$ $V_L = I_{rms}X_L$

Phase angle $\tan\phi = \frac{X_L - X_C}{R}$ *or* $\cos\phi = \dfrac{R}{Z}$

Average power $P_{av} = I_{rms}V_{rms}\cos\phi$