Chapter 25: Electric Charges and Forces

Coulomb's Law:	$\vec{F} = \frac{\lvert q_1\rvert\lvert q_2\rvert}{4\pi\epsilon_0 r^2}\hat{r}$
Superposition:	$\vec{F}_{Total} = \vec{F}_{12} + \vec{F}_{13} + ...$
Force on charge in an E-Field:	$\vec{F}_{\text{onq}} = q\vec{E}$
E-Field at (x,y,z):	$\vec{E}(x,y,z) = \frac{\vec{F}_{onq}\text{at}(\text{x},\text{y},\text{z})}{q}$
E-Field - point charge:	$\vec{E} = \frac{q}{4\pi\epsilon_0 r^2}\hat{r}$

Chapter 26: The Electric Field

Electric dipole moment:	$\vec{p} = q\vec{d}$
E-Field - Electric dipole (on axis):	$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{2\vec{p}}{r^3}$
E-Field - Electric dipole (bisecting plane):	$\vec{E} = -\frac{1}{4\pi\epsilon_0}\frac{\vec{p}}{r^3}$
Linear charge density:	$\lambda = \frac{Q}{L}$
Surface charge density:	$\eta = \frac{Q}{A}$
E-Field - charged rod:	$\vec{E}_{rod} = \frac{1}{4\pi\epsilon_0}\frac{\lvert Q\rvert}{r\sqrt{r^2+(L/2)^2}}$
E-Field - infinite line:	$\vec{E}_{line} = \frac{1}{4\pi\epsilon_0}\frac{2\lvert\lambda\rvert}{r}$
E-Field - charged ring (on axis):	$\vec{E}_{ring} = \frac{zQ}{4\pi\epsilon_0(z^2+R^2)^{3/2}}$
E-Field - charged disk:	$\vec{E}_{disk} = \frac{\eta}{2\epsilon_0}\left(1 - \frac{z}{\sqrt{z^2+R^2}}\right)$
E-Field - above a plane of charge:	$\vec{E} = \frac{\eta}{2\epsilon_0}$
E-Field - below a plane of charge:	$\vec{E} = \frac{-\eta}{2\epsilon_0}$
E-Field - Outside a Sphere of charge:	$\vec{E}_{sphere} = \frac{\lvert Q\rvert}{4\pi\epsilon_0 r^2}\hat{r}$
E-Field - Capacitor (+ to -):	$\vec{E}_{capacitor} = \frac{\eta}{\epsilon_0}$
Motion in a uniform field:	$\vec{a} = \frac{q\vec{E}}{m}$
Torque on a dipole:	$\vec{\tau} = \vec{p} \times \vec{E}$

Prefixes

10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f

Constants

$\epsilon_0 = 8.854 \times 10^{-12}\ \frac{\text{C}^2}{\text{Nm}^2}$

$e = 1.6 \times 10^{-19}$ C

$m_e = 9.109 \times 10^{-31}$ kg

$k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9\ \frac{\text{Nm}^2}{\text{C}^2}$

$m_p = 1.673 \times 10^{-27} kg$

Units

Force:	$1\ N = 1\ kg\frac{m}{s^2}$
Energy (Joules):	$1\ J = 1\ Nm$
Energy (eV)	$1\ eV = 1.6 \times 10^{-19}\ J$
Electric Field:	$1\ \frac{N}{C} = 1\ \frac{V}{m}$
Electric Potential	$1\ V = 1\ \frac{J}{C}$
Charge:	$1\ C = (1\ A)(1\ s)$
Current:	$1\ A = 1\ \frac{C}{s}$

Chapter 26: Gauss's Law	
Electric Flux (constant E-field):	$\Phi_E = \vec{E} \cdot \vec{A}$
Electric Flux:	$\Phi_E = \int \vec{E} \cdot d\vec{A}$
Gauss's Law:	$\epsilon_0 \Phi_E = q_{enc}$
Gauss's Law:	$\epsilon_0 \oint \vec{E} \cdot d\vec{A} = q_{enc}$

Chapter 28: The Electric Potential	
Work from a constant force:	$W = \vec{F} \cdot \Delta\vec{r}$
Potential Energy and work:	$\Delta U = -W$
Work (general) :	$W = \int_i^f \vec{F} \cdot d\vec{s}$
Pot. Energy - uniform E-field:	$U_{elec} = U_0 + qEs$
Pot. Energy - 2 point charges:	$U_{elec} = k\frac{q_1 q_2}{r}$
Pot. Energy - Multiple point charges:	$U_{elec} = \sum_{i<j} k\frac{q_i q_j}{r}$
Potential Energy - dipole:	$U = -\vec{p} \cdot \vec{E}$
Potential Difference:	$\Delta V = V_f - V_i$
	$\Delta V = \frac{\Delta U}{q}$
	$\Delta V = -\frac{W}{q}$
Potential - capacitor:	$V = Es$
Potential - point charge:	$V = \frac{q}{4\pi\epsilon_0 r}$
Potential - many point charges:	$V = \sum_i \frac{q_i}{4\pi\epsilon_0 r_i}$
Potential - dipole:	$V = \frac{pcos\theta}{4\pi\epsilon_0 r^2}$
Potential - charge distr:	$V = \frac{1}{4\pi\epsilon_0}\int \frac{dq}{r}$
Potential - ring of charge (on axis):	$V_{ring} = \frac{1}{4\pi\epsilon_0}\frac{Q}{\sqrt{R^2 + z^2}}$
Potential - charged disk (on axis):	$V_{disk} = \frac{Q}{2\pi\epsilon_0 R^2}(\sqrt{z^2 + R^2} - z)$