Useful Constants

speed of light $c = 2.998 \times 10^8 m/s$
basic unit of charge $e = 1.602 \times 10^{-19}\ C$
mass of electron: $m_e = 9.109 \times 10^{-31}\ kg$
mass of proton: $m_p = 1.673 \times 10^{-27}\ kg$
$\epsilon_o = 8.854 \times 10^{-12}\ C^2/(N\ m^2)$
$k = \frac{1}{4\pi\epsilon_o} = 8.988 \times 10^9\ N\ m^2/C^2$
acc to due gravity (standard) $g = 9.80\ m/s^2$
Charge densities: $\lambda = Q/length$, $\sigma = Q/area$, $\rho = Q/volume$
Energy units: $1\ eV = 1.602 \times 10^{-19}\ J$

Common Prefixes		
Value	Name	Symbol
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c
10^{3}	kilo	k
10^{6}	mega	M

Random Physics 1 equations: $\Sigma\vec{F} = m\vec{a}$
If constant acc: $x(t) = x_o + v_{ox}t + \frac{1}{2}a_x t^2$ || $v_x(t) = v_{ox} + a_x t$ || $v_x^2 = v_{ox}^2 + 2a_x\Delta x$
Work/Energy: $W_{a\ to\ b} = \int_a^b \vec{F} \cdot d\vec{l}$ || $K_b = K_a + \Sigma W$ or $(K_b + U_b) = (K_a + U_a) + \Sigma W_{other}$ || $K = \frac{1}{2}mv^2$
Uniform circular motion: $a_c = v^2/r$ || Period: $T = 2\pi r/v$

Coulomb's Law: $F = k|q_1 q_2|/r^2$. Like charges repel; opposites attract.

Flux: $\Phi_E = \vec{E} \cdot \vec{A} = \int \vec{E} \cdot d\vec{A}$ Gauss's Law: $\oint \vec{E} \cdot d\vec{A} = Q_{encl}/\epsilon_o$

Electric field: $\vec{E} = \vec{F}/q_o$. $\vec{E}$ points out from positive charges, in towards negative charges.
Potential Energy: $U_E = -q\int \vec{E} \cdot d\vec{l} = qV$. Point charges: $U = kq_1q_2/r$
Potential: $\Delta V = V_{ba} = V_b - V_a = \frac{\Delta U}{q} = -\int_a^b \vec{E} \cdot d\vec{l}$ || $\vec{E} = -\vec{\nabla}V = -\frac{\partial V}{\partial x}\hat{\imath} - \frac{\partial V}{\partial y}\hat{\jmath} - \frac{\partial V}{\partial z}\hat{k}$
Series of point charges: $V = \Sigma V_i = k\Sigma\frac{q_i}{r_i}$ Extended object: $V = \int dV = k\int \frac{dq}{r}$
ring of radius a, along line $\perp$ to plane of ring: $V = kq/\sqrt{x^2 + a^2}$ || Sphere: $V = kQ/r$ $(r >= R)$
disk of radius R, along line $\perp$ to plane of disk: $V = \frac{2kQ}{R^2}(\sqrt{x^2 + R^2} - x)$

Charge Distribution	Point of interest	Electric field
point charge Q	distance r from Q	$E = kQ/r^2$ $\vec{E} = \frac{kQ}{r^2}\hat{r}$
conducting sphere	outside $(r > R)$ inside $(r < R)$	$E = kQ/r^2$ $E = 0$
nonconducting sphere	outside	$E = kQ/r^2$
infinite wire	distance r from wire	$E = \lambda/(2\pi\epsilon_o r)$
conducting cylinder	outside inside	$E = \lambda/(2\pi\epsilon_o r)$ $E = 0$
infinite sheet	any point	$E = \sigma/(2\epsilon_o)$
pair of sheets of opposite charge	between plates	$E = \sigma/\epsilon_o$
line segment $a = L/2$ line segment $a = L/2$	along axis $\perp$ to midpoint along axis $\perp$ to midpoint	$E = kQ/(x\sqrt{x^2 + a^2})$ $E = 2k\lambda/(x\sqrt{(x/a)^2 + 1})$
ring of radius a	along axis $\perp$ to ring center	$E = kQx/(x^2 + a^2)^{3/2}$
charged disk radius R	along axis $\perp$ to disk center	$E = \frac{\sigma}{2\epsilon_o}(1 - \frac{1}{\sqrt{(R^2/x^2)+1}})$

Circumference, Area, Volume of various common geometric shapes:
circle: $C = 2\pi r$, $A = \pi r^2$ sphere: $C = 2\pi r$, $A = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$ cylinder: $A = 2\pi rh$, $V = \pi r^2 h$
Quadratic equation If $Ax^2 + Bx + C = 0$ then $x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$