Physics 122 Formula Sheet — Midterm 1 13 October 2011

## Constants

$k_e = 8.99\times10^{9}\ Nm^2/C^2$

$\varepsilon_o = \dfrac{1}{4\pi k_e} = 8.85\times10^{-12}\ C^2/Nm^2$

$e = +1.6\times10^{-19}C$

$m_e = 9.11\times10^{-31}kg$

$m_p \sim m_n = 6.7\times10^{-27}kg$

$N_A = 6.02\times10^{23}\ items/mole$

$G = 6.67\times10^{-11}Nm^2/kg^2$

## Geometry

Surface Area:

$A_{sphere} = 4\pi R^2$

$A_{cyl} = 2\pi RH + 2\pi R^2$

$A_{cube} = 6a^2$

Volume:

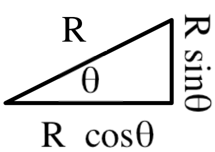
$V_{sphere} = \dfrac{4}{3}\pi R^3$

$V_{cyl} = \pi R^2 H$

$V_{cube} = a^3$

$\cos 30° = \dfrac{\sqrt{3}}{2};\ \sin 30° = \dfrac{1}{2}$

$\cos 45° = \sin 45° = \dfrac{\sqrt{2}}{2}$




## Chemistry

$\dfrac{atoms}{gram} = \dfrac{atoms/mole}{grams/mole} = \dfrac{N_A}{MW}$

$Z = \dfrac{electrons}{atom} = \dfrac{protons}{atom}$

## Coulomb's Law

$\vec{\mathbf{F}}_{12} = k_e \dfrac{Q_1 Q_2}{r_{12}^2}\hat{\mathbf{r}}_{12};\ \vec{\mathbf{r}}_{12} = \vec{\mathbf{r}}_1 - \vec{\mathbf{r}}_2$

$\vec{\mathbf{F}}_0 = \sum_i \vec{\mathbf{F}}_{i0} = k_e Q_o \sum \dfrac{Q_i}{r_{i0}^2}\hat{\mathbf{r}}_{i0}$

## Kinematics

$\vec{\mathbf{a}} = \dfrac{\vec{\mathbf{F}}}{m} = \dfrac{q}{m}\vec{\mathbf{E}}$

$x = x_o + v_o t + \dfrac{1}{2}at^2$

$v = v_o + at$

## Electric Field

$\vec{\mathbf{F}}_{q_o} = q_o \vec{\mathbf{E}}(\vec{\mathbf{r}}_{q_o})$

$\vec{\mathbf{E}}(\vec{\mathbf{r}}_o) = k_e \sum_i \dfrac{Q_i}{r_{oi}^2}\ \hat{\mathbf{r}}_{oi}$

$\vec{\mathbf{E}}(\vec{\mathbf{r}}_o) = k_e \int \dfrac{dq}{r_{qo}^2}\hat{\mathbf{r}}_{qo}$

$\vec{\mathbf{E}}_{point}(\vec{\mathbf{r}}_o) = k_e \dfrac{Q}{r_{Qo}}\hat{\mathbf{r}}_{Qo}$

$\vec{\mathbf{E}}_{inf\,line}(r) = \dfrac{2k\lambda}{r}\hat{\mathbf{r}}$

$\vec{\mathbf{E}}_{plane} = \dfrac{\sigma}{2\varepsilon_o}(out)$

$\vec{\mathbf{E}}_{axis\ of\ ring}(z) = \dfrac{kQz}{\left(z^2+a^2\right)^{3/2}}\hat{\mathbf{z}}$

$\vec{\mathbf{E}}_{dipole}(x >> L) = \dfrac{2k\vec{\mathbf{p}}}{x^3}(x\ along\,\hat{\mathbf{p}})$

Conductor at equilibrium:

$\vec{\mathbf{E}} = 0$ inside

$\vec{\mathbf{E}} = \dfrac{\sigma_{surface}}{\varepsilon_o}$ just outside

## Gauss' Law

Flux

$\Phi_E = \iint \vec{\mathbf{E}}\bullet d\vec{\mathbf{A}} = \iint (\vec{\mathbf{E}}\bullet\hat{\mathbf{n}})dA$

$\Phi_E^{net} = \oint_{\substack{closed\\surface}} \vec{\mathbf{E}}\bullet d\vec{\mathbf{A}} = \dfrac{Q_{enclosed}}{\varepsilon_o}$

$\oint_{\substack{closed\\surface}} \varepsilon\vec{\mathbf{E}}\bullet d\vec{\mathbf{A}} = \iiint_{\substack{enclosed\\volume}} \rho\, dV$

## Other

dipole moment:

$\vec{\mathbf{p}} = q\vec{\mathbf{L}}\ \ (\vec{\mathbf{L}}\ from\ -\ to\ +)$

linear charge density $\lambda = \dfrac{Q}{L}$

area charge density

$\sigma = \dfrac{Q}{A} = \dfrac{Q}{L_x L_y}$

volume charge density

$\rho = \dfrac{Q}{V} = \dfrac{Q}{L_x L_y L_z}$