Note Title 2/20/2008

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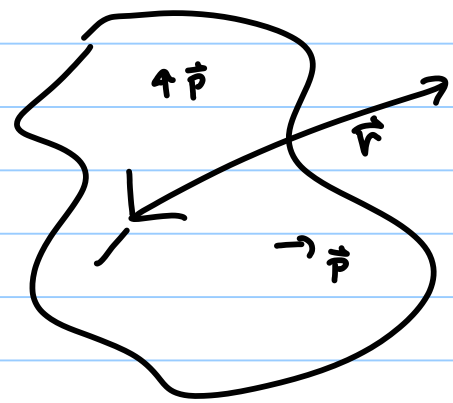
$$V_{mono} = \frac{1}{4\pi\epsilon_0}\frac{q_{tot}}{r}$$

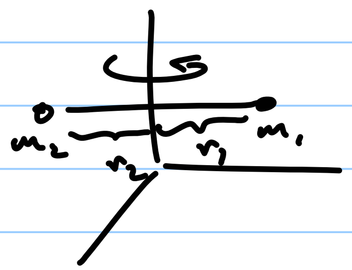
$$V_{dipole} = \frac{1}{4\pi\epsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2}$$

$$\vec{E}_{dipole} = -\vec{\nabla} V$$



moment of inertia

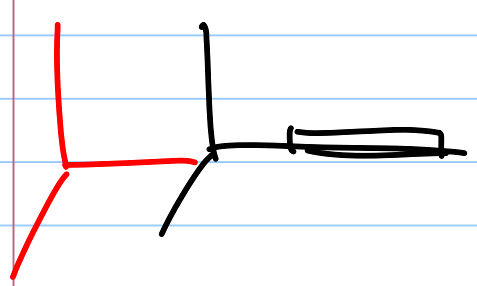
$$I = \sum_i m_i r_i^2 \rightarrow \int r^2\, dm$$
$$dm \rightarrow \rho\, d\tau$$



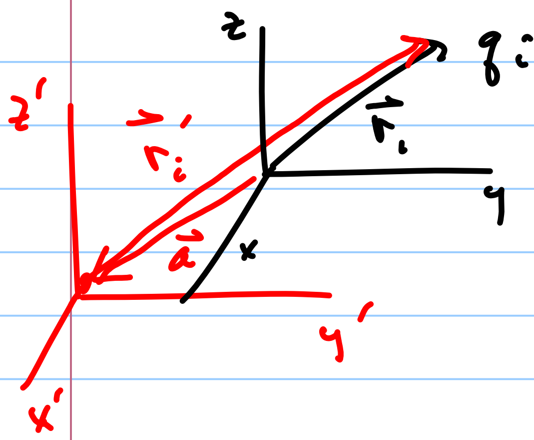
depends on location of axis

Center of mass

$$M_{tot} X_{cm} = \sum_i m_i x_i \rightarrow \int x\, dm$$
$$dm \rightarrow \rho\, d\tau$$



Dipole mom $\quad \vec{p} = \sum_i q_i \vec{r}_i$



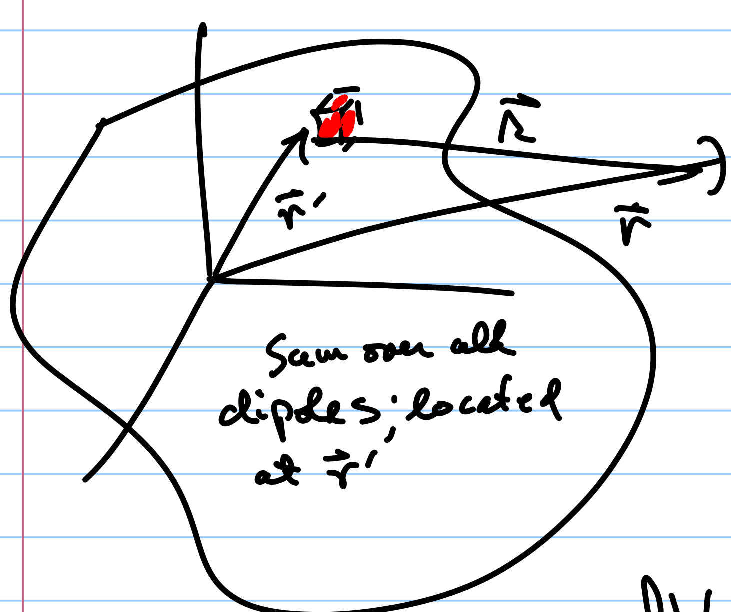
$\vec{a} + \vec{r}_i' = \vec{r}_i$

$\vec{p}' = \sum_i q_i \vec{r}_i' = \sum_i q_i (\vec{r}_i - \vec{a})$

$= \underbrace{\sum_i q_i \vec{r}_i}_{\vec{p}} - \underbrace{\sum_i q_i \vec{a}}_{\vec{a} \underbrace{\sum_i q_i}_{Q_{tot}}}$

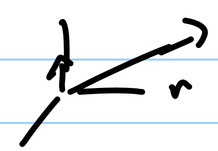
if dipole has $Q_{tot} = \phi$

$\vec{p}' = \vec{p}$ indep of coord location



permant dipoles are embedded in material

find $V(\vec{r}')$



$V_{dipole} = \frac{1}{4\pi\epsilon_0} \frac{\vec{p} \cdot \hat{r}}{r^2}$

$\vec{p} \to d\vec{p}$

$dV_{dipole} = \frac{1}{4\pi\epsilon_0} \frac{\vec{P} \cdot \hat{\mathscr{r}} \, d\tau'}{\mathscr{r}^2} \quad \vec{P} d\tau$

dipole mom/vol

$\sum m_i r^2 \rightarrow \int r^2 dm$

$dm = \rho \, d\tau$ charge/vol

$\vec{P}$ dipole mom / vol $\sim \rho$ $\frac{\text{charge}}{\text{vol}}$ $\left(\frac{\text{mass}}{\text{vol}}\right)$

$$dV = \frac{1}{4\pi\epsilon_0} \frac{\vec{P}(\vec{r}')\cdot(\vec{r}-\vec{r}')}{|r-r'|^3} d\tau' = \frac{1}{4\pi\epsilon_0} \vec{P}\cdot\vec{\nabla}' \frac{1}{|\vec{r}-\vec{r}'|} d\tau'$$

$$\vec{A}\cdot\vec{\nabla} f = \vec{\nabla}\cdot f\vec{A} - f\vec{\nabla}\cdot\vec{A}$$

$$\vec{\nabla}' \frac{1}{|\vec{r}-\vec{r}'|} = \frac{\vec{r}-\vec{r}'}{|\vec{r}-\vec{r}'|^3}$$

$$\hat{x}' \frac{\partial}{\partial x'} \frac{1}{\sqrt{(x-x')^2+\ldots}} + \hat{y}' \frac{\partial}{\partial y'} \frac{1}{\sqrt{\;\;}}$$

$$V = \underbrace{\frac{1}{4\pi\epsilon_0} \int \vec{\nabla}\cdot \frac{\vec{P}}{|\vec{r}-\vec{r}'|} d\tau'} - \frac{1}{4\pi\epsilon_0} \int \frac{\vec{\nabla}\cdot\vec{P}}{|\vec{r}-\vec{r}'|} d\tau'$$

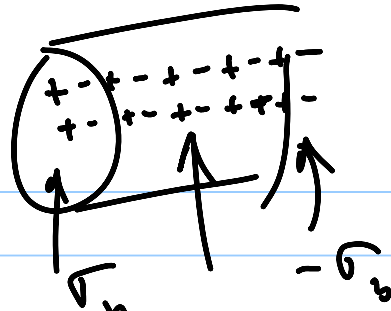
$$V = \oint \frac{\vec{P}}{|\vec{r}-\vec{r}'|}\cdot d\vec{a} + \frac{1}{4\pi\epsilon_0} \int \frac{-\vec{\nabla}\cdot\vec{P}}{|\vec{r}-\vec{r}'|} d\tau'$$

$$\int \vec{\nabla}\cdot\vec{E}\, d\tau = \oint \vec{E}\cdot d\vec{a}$$

$$V = \frac{1}{4\pi\epsilon_0} \int \frac{\rho\, d\tau'}{r}$$

$$V = \frac{1}{4\pi\epsilon_0} \oint \frac{\sigma_b\, da'}{|\vec{r}-\vec{r}'|} + \frac{1}{4\pi\epsilon_0} \int \frac{\rho_b\, d\tau'}{|\vec{r}-\vec{r}'|}$$

$$\sigma_b = \vec{P}\cdot\hat{n}\Big|_{\text{on surface}} \qquad d\vec{a} = \hat{n}\, da \qquad \rho_b = -\vec{\nabla}'\cdot\vec{P}(\vec{r}')$$



have only σ

all charge cancels