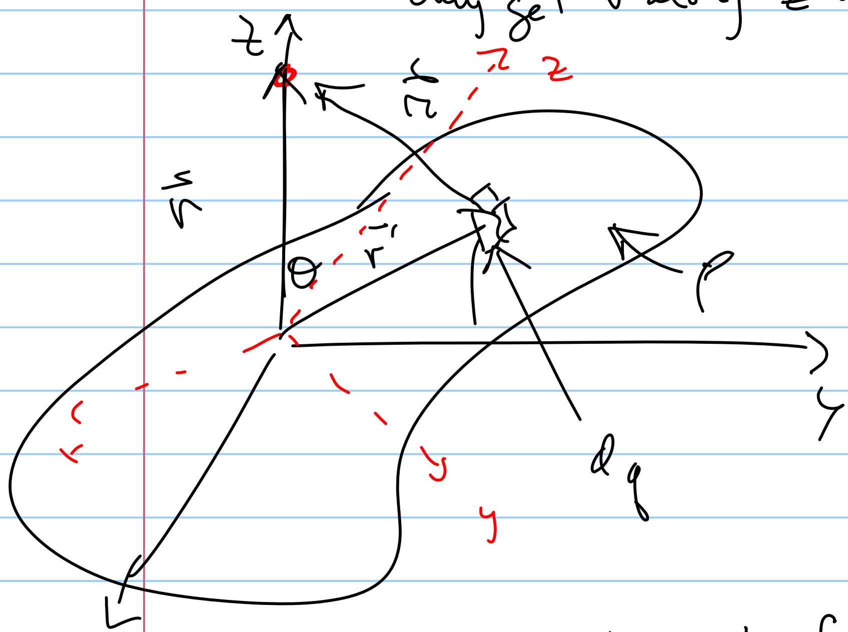
Note Title 2/21/2007



Only get V along z axis. Now find $\vec{E} = -\vec{\nabla} V$

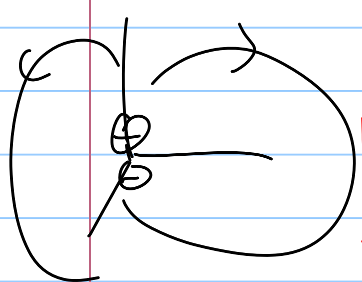
$= -\frac{\partial V}{\partial x}\hat{x} - \frac{\partial V}{\partial y}\hat{y} - \frac{\partial V}{\partial z}\hat{z}$

find V only on z axis

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

expand $\frac{1}{r}$ in ϵ

$$V_{dipole} = \frac{1}{4\pi\epsilon_0}\frac{1}{r^2}\int r'\cos\theta'\,\rho(\vec{r}')\,d\tau'$$

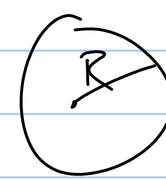


$\hat{r}\cdot\vec{r}' = r'\cos\theta' = \hat{k}\cdot\vec{r}' = |\hat{k}||\vec{r}'|\cos\theta'$

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

$\vec{r}\cdot\vec{r}'$

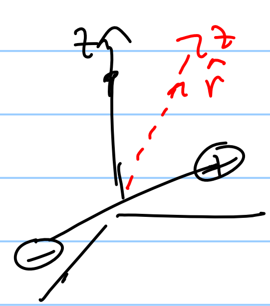
$$\vec{p} = \int \vec{r}'\rho(\vec{r}')\,d\tau'$$



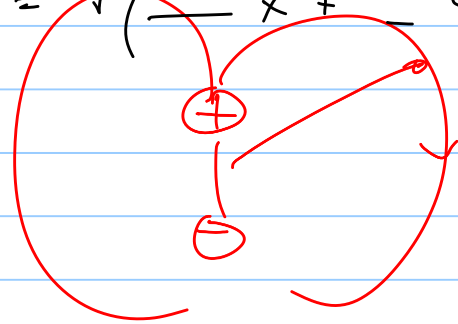
Write an integral expression for the dipole moment of the charge distribution ρ = k (R-2 r) sinθ

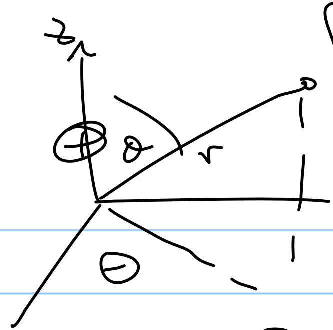
R/r2

$$\vec{p} = \int_0^R\int_0^\pi\int_0^{2\pi} \vec{r}\, k(R-2r)\sin\theta\, r^2\sin\theta\, d\theta\, d\phi\, dr \quad \frac{R}{r^2}$$

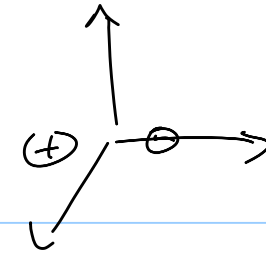


$r\hat{r} = r(\_\hat{x} + \_\hat{y} + \_\hat{z})$





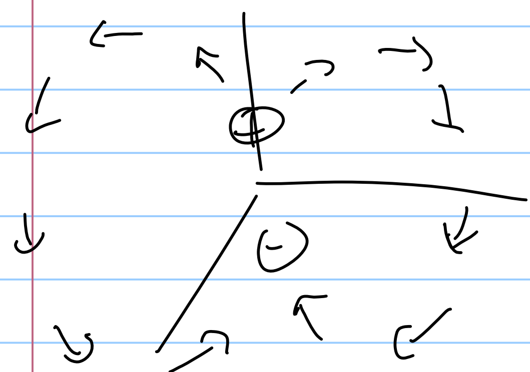
$$\boxed{V = \frac{\vec{p}\cdot\hat{r}}{4\pi\epsilon_0 r^2}} = \frac{p_0 \cos\vartheta}{4\pi\epsilon_0 r^2}$$



$$V(x,y,z) = \frac{p_0}{4\pi\epsilon_0}\frac{z}{\sqrt{x^2+y^2+z^2}}\frac{1}{(x^2+y^2+z^2)} \qquad r = \sqrt{x^2+y^2+z^2}$$

$$r\cos\vartheta = z \qquad \cos\vartheta = \frac{z}{r}$$

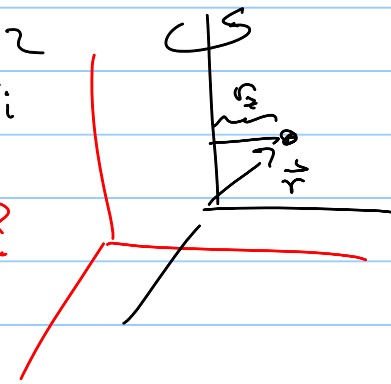
$$\vec{E} = -\vec{\nabla} V(x,y,z) \Rightarrow E_z = -\frac{\partial V}{\partial z} \quad E_y = -\frac{\partial V}{\partial y} \quad E_x = -\frac{\partial V}{\partial x}$$



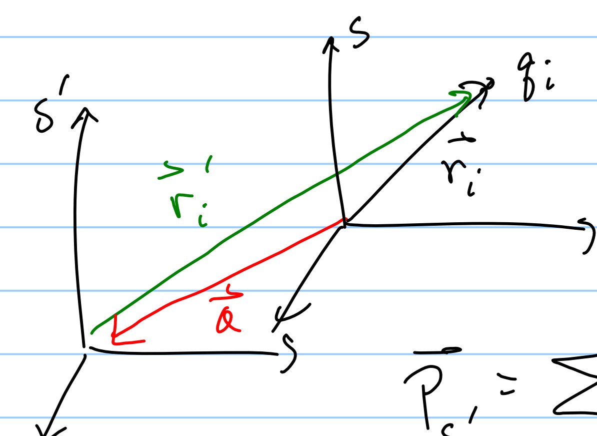
Have an expression for V_{dipole} & $\vec{E}_{dipole}$. Do these expressions depend on coord system chosen

moment of inertia:

$$I = \sum m_i r_i^2$$



Is dipole moment indep. of coords?



$$\vec{p}_s = \int r'\rho(r')\,d\tau = \sum \vec{r}_i' q_i$$

$$= \sum_i \delta(r-r_i') q_i$$

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

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

$$= \sum q_i \vec{r}_i - \sum_i q_i \vec{a} = \vec{p}_s - \vec{a}\sum_i q_i$$

If $\sum_i q_i = 0$ (no net charge) then

$\vec{P}_{s'} = \vec{P}_s$