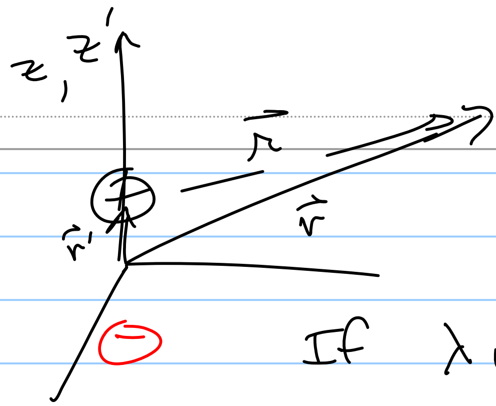
Note Title 2/16/2009



$$\frac{1}{r} = \sum'$$

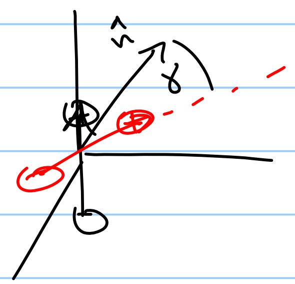
$$V(\vec r) = \frac{1}{4\pi\epsilon_0}\sum_{l=0}^{\infty}\frac{M_l\, P_l(\cos\theta)}{r^{l+1}}$$

If $\lambda(z')$

$$M_l \equiv \int \lambda(z')\,(z')^l\, dz'$$

Dipole case $l=1$

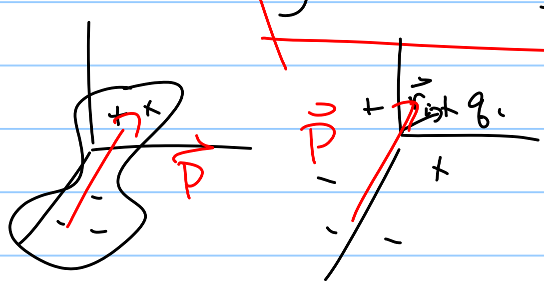
$$V_{dipole} = \frac{1}{4\pi\epsilon_0}\frac{M_1\cos\theta}{r^2}$$



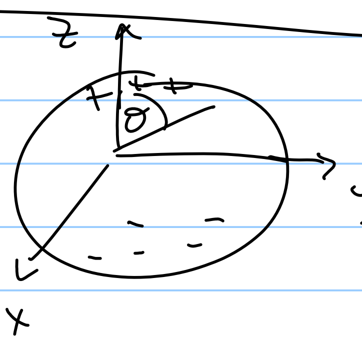
$$M_l\cos\theta \to \vec p\cdot\hat r$$

$$M_l = \int \underbrace{\lambda(z')\,z'\,dz'}_{dq} = \int dq\, z'$$

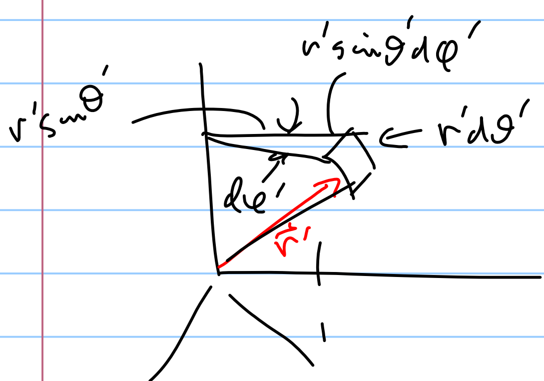
3-D $\rightarrow$ $$\boxed{\int \rho(\vec r\,')\,d\tau'\,\vec r\,' = \vec p = \sum_i q_i \vec r_i\,'}$$ pt charges



Tablet Q.



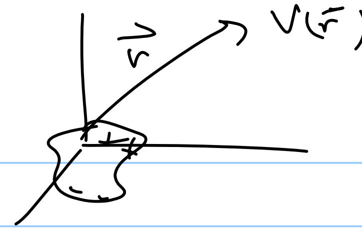
$$\sigma = C\cos\theta$$

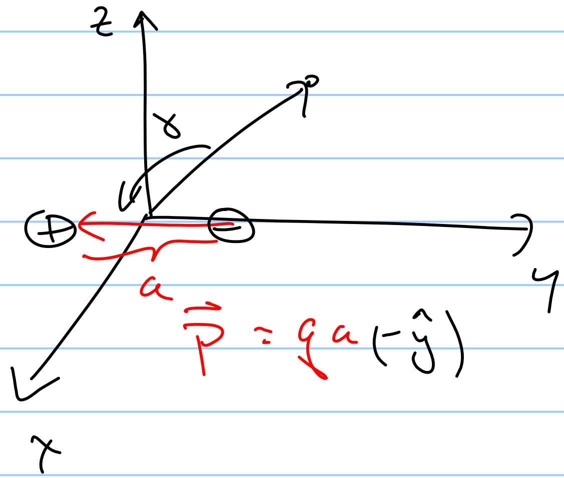


$$\rho\, d\tau = \sigma\, da = C\cos\theta'\, r'^2 \sin\theta'\, d\theta'\, d\varphi'$$

$$\vec r\,' = r'\sin\theta'\cos\varphi'\,\hat x + r'\sin\theta'\sin\varphi'\,\hat y + \text{---}$$

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

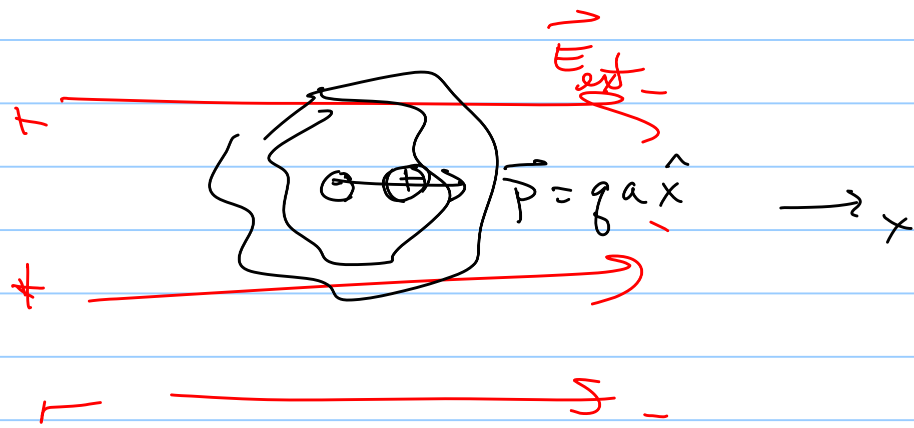




$\vec{p} = qa(-\hat{y})$

$$\frac{\vec{p}\cdot\hat{r}}{r^2} = |\vec{p}||\hat{r}|\cos\gamma$$

atom



$\vec{p} = qa\hat{x}$

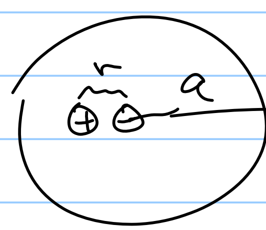
$\vec{p} = \alpha\vec{E}$ doesn't always work

units $E = \frac{1}{4\pi\epsilon_0}\frac{Q}{r^2}$ $E: \frac{1}{4\pi\epsilon_0}\frac{C}{m^2}$ $p: C\cdot m$

$$\alpha: \frac{C\cdot m}{\frac{1}{4\pi\epsilon_0}\frac{C}{m^2}} = 4\pi\epsilon_0 m^3$$

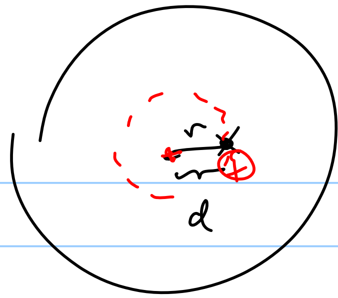
vol

Cal: α assume



q in sphere electron

$F = qE$ of ⊖ charge inside



$$\rho = \frac{q}{\frac{4}{3}\pi a^3}$$

$$E\, 4\pi r^2 = \frac{Q_{encl}}{\epsilon_0} = \frac{\rho \frac{4}{3}\pi r^3}{\epsilon_0}$$

$$E = \frac{\rho \frac{4}{3}\pi r^3}{\epsilon_0 4\pi r^2} = \frac{\rho}{\epsilon_0 3} r = \frac{q}{\frac{4}{\cancel{3}}\pi a^3} \frac{r}{\epsilon_0 \cancel{3}}$$

Force from E_{ext} going to balance the internal force

$$E_{int} = q \frac{\overset{r = d}{r}}{4\pi a^3 \epsilon_0} = E_{ext} \qquad d = \frac{4\pi a^3 \epsilon_0 E_{ext}}{q}$$

$$P = q \overset{d}{\overset{\shortparallel}{r}} = \underbrace{4\pi a^3 \epsilon_0}_{\alpha} E_{ext}$$