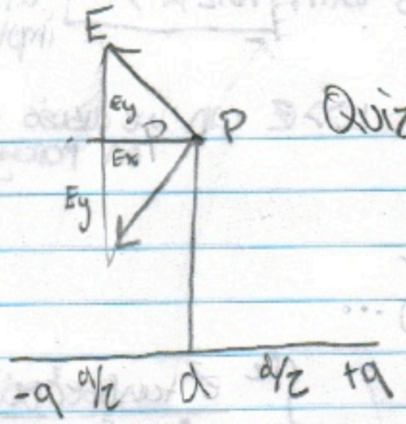
Striker
11/7/20
Phys 330

Quiz #2

1).



$\bar{p} = qd$ from $-q$ to q

$\bar{E} = E_0 \hat{x}$

Force x distance

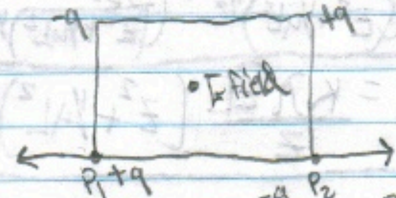
components of dipole $\quad T = p \times E$

$E_x = F = qE\sin\theta \quad \tau = dqE\sin\theta$ therefore Torque = +$pE\sin\theta$ counterclockwise

$E_y = -qE\sin\theta$

$$\boxed{\bar{\tau} = \bar{p} \times \bar{E} = pE\sin\theta}$$

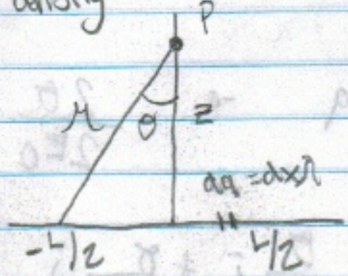
2).



Because the dipoles are pointing away from the origin the total $\bar{E}$-field will be $\boxed{\text{zero}}$ especially since the charges cancel themselves out since the dipole moments are dependent on charge. $\boxed{\bar{p} = qd}$

2). Total charge $Q = L\lambda$ λ is charge density

$\lambda dx = dq$



$$dE = \frac{K\,dq\,\hat{r}}{r^2}$$

$r = r - r'$

$= z\hat{z} - x\hat{x}$

$r^2 = z^2 + x^2$

$$\frac{K\lambda dx\,(z\hat{z} - x\hat{x})}{(z^2+x^2)\,(z^2+x^2)^{1/2}}$$

$$\int_{-L/2}^{L/2} \frac{K\lambda dx\,(z\hat{z} - x\hat{x})}{(z^2+x^2)^{3/2}} \qquad = \frac{K\lambda dx\,(z\hat{z} - x\hat{x})}{(z^2+x^2)^{3/2}}$$

$$E = K\lambda \left\{ z\hat{z} \int_{-L/2}^{L/2} \frac{dx}{(z^2+x^2)^{3/2}} - \hat{x} \int_{-L/2}^{L/2} \frac{x\,dx}{(z^2+x^2)^{3/2}} \right.$$

$x = z\tan\theta$

$dx = z\sec^2\theta\, d\theta$

$x\,dx = z^2 \tan\theta \sec^2\theta\, d\theta$

$$E = K\lambda \left\{ z\hat{z} \int_{\theta_1}^{\theta_2} \frac{z\sec^2\theta\, d\theta}{(z^2 + z^2\tan\theta)^{3/2}} \right.$$

assuming L becomes infinity, Z approaches zero but never becomes zero leaving us with $\boxed{K\lambda\hat{z}L \to \infty}$ which implies $\boxed{E=0}$

$L \gg Z$ can we discuss this on monday?

$$= K\lambda\left\{\frac{z^2\hat{z}}{z^3}\int_{\theta_1}^{\theta_2}\frac{\sec^2\theta d\theta}{(1+\tan^2\theta)^{3/2}}\right.$$

If $L \gg Z$, the E-field essentially becomes zero. using gausses law because L goes to infinity Z essentially goes to zero or close to it giving us either ∞ or gausses law being undefined.

$$= K\lambda\left(\frac{\hat{z}}{z}\right)\int_{\theta_1}^{\theta_2}\cos\theta d\theta - \int \ldots$$

$$= \sin\theta \qquad \int_{\theta_1}^{\theta_2}\frac{z^2\tan\theta\sec^2\theta d\theta}{z^3\sec^3\theta d\theta}$$

$$\boxed{E = \frac{K\lambda\hat{z}L}{z^2}}$$

Gausses $\boxed{E = \frac{1}{4\pi E_0}\frac{\lambda L}{z^2}\hat{z}}$

$$= \frac{K\lambda\hat{z}}{z}(\sin\theta_2 - \sin\theta_1)$$

$$= \frac{K\lambda\hat{z}}{z}\left(\frac{1/2L}{(z^2+1/4L^2)^{1/2}} + \frac{+1/2L}{(z^2+1/4L^2)^{1/2}}\right)$$

$L \gg Z$
Gausses Law

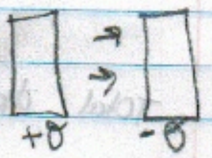
$$\boxed{E = \frac{K\lambda\hat{z}L}{z}(z^2+1/4L^2)^{-1/2}}$$

$$\oint E \cdot dA = \frac{Q_{enc}}{E_0} = \frac{1}{E_0}\lambda L \qquad E = \frac{1}{4\pi E_0}\frac{q}{r^2}\hat{r}$$

$$E = \frac{1}{4\pi E_0}\frac{\lambda L}{z^2}$$

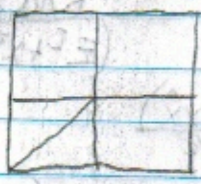
2). $\sigma/2E_0$ opposites attract

1). $+q \quad +q \qquad q-q=0 \quad \boxed{\frac{\sigma}{2E_0}} \boxed{=0}$



2). $+q \quad -q \qquad \frac{2\sigma}{2E_0} \quad \boxed{=\frac{\sigma}{E_0}}$

3). $\frac{\sigma}{2E_0}i + \frac{\sigma}{2E_0}j = \sqrt{\frac{\sigma}{2E_0}^2 + \frac{\sigma}{2E_0}^2} = \frac{2\sigma}{2E_0}$



$\boxed{=\frac{\sigma}{2E_0}}$

$\oint E \cdot dl = 0$

3). $V(b) - V(a) = -\int_{0}^{b} E \cdot dl + \int_{0}^{a} E \cdot dl$

$= -\int_{0}^{b} E \cdot dl - \int_{a}^{0} E \cdot dl = \boxed{-\int_{a}^{b} E \cdot dl}$

b). $V(r) = -\int_{\infty}^{r} E(r')dr'$ $\quad E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}$ $\quad \boxed{K = \frac{1}{4\pi\epsilon_0}}$

$V(r) = \int_{0}^{r} E \cdot dl = \frac{-1}{4\pi\epsilon_0} \int_{\infty}^{r} \frac{q}{r'^2} dr' = \frac{1}{4\pi\epsilon_0} \frac{q}{r'} \Big|_{\infty}^{r} = \frac{1}{4\pi\epsilon_0} \frac{q}{r}$

$\boxed{= \frac{Kq}{r}}$