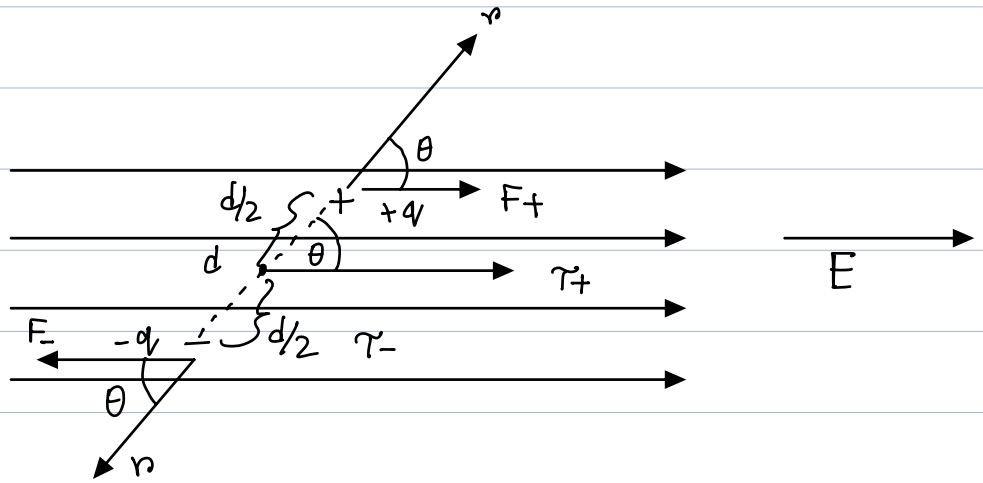
dipole in an electric field

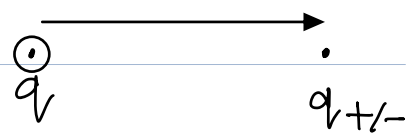
$$\vec{p} = q\vec{d}$$



$$\vec{F} = q_{test}\vec{E}$$

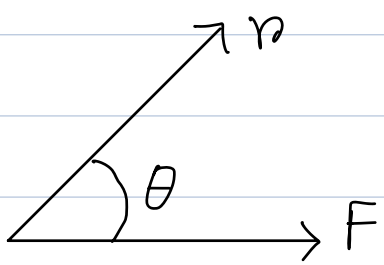
$$\vec{F_+} = q\vec{E} \qquad \vec{F_-} = -q\vec{E}$$

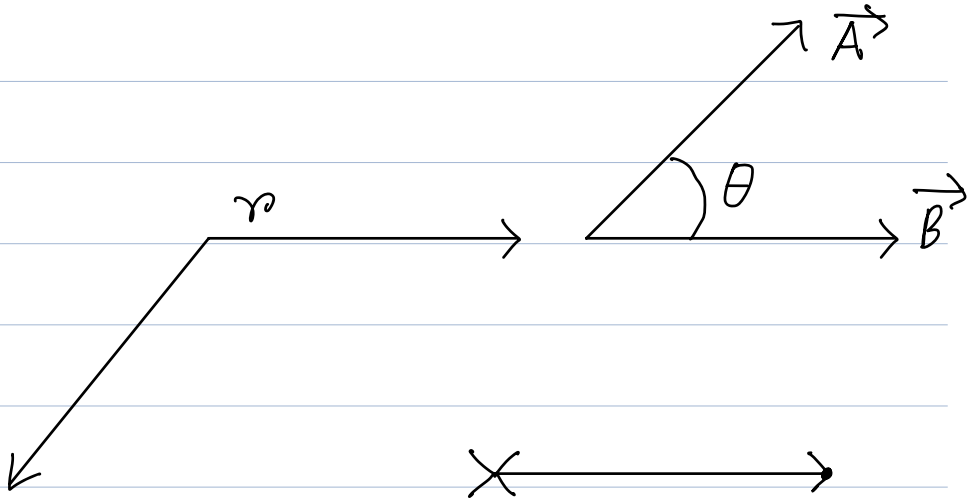
$q > 0$ for q_+



$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$= rF\sin\theta$$





$$\vec{\tau} = \vec{\tau_+} + \vec{\tau_-}$$

$$\Rightarrow \tau = \tau_+ + \tau_-$$

$$= rf\sin\theta + rf\sin\theta$$

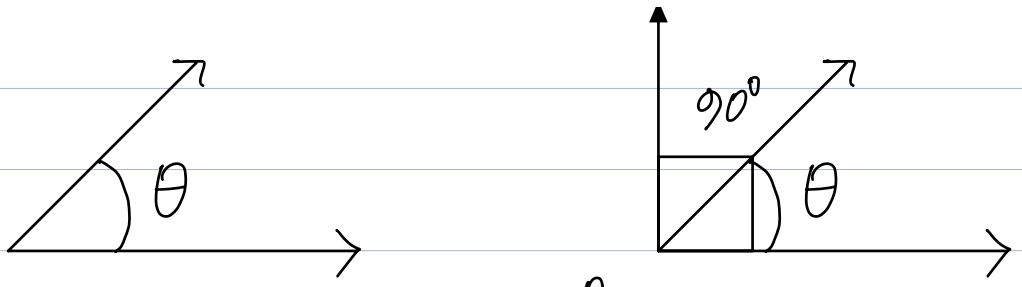
$$= \frac{d}{2} qE\sin\theta + \frac{d}{2} qE\sin\theta$$

$$= qdE\sin\theta$$

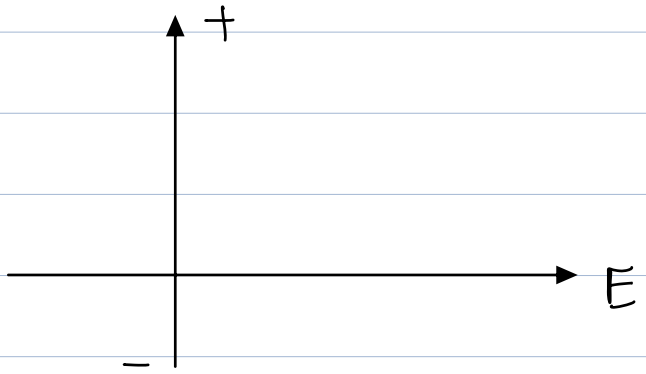
$$= PE\sin\theta$$

$$\vec{\tau} = \vec{p} \times \vec{E}$$

$dw = -\tau d\theta$ $\quad$ $dw \rightarrow$ to rotate an angular distance $d\theta$



$$\Rightarrow \int dW = -\int_{90^\circ}^{\theta} \tau \, d\theta$$



$$F = -\frac{du}{dr}$$

$$F dr = -du$$

$$\int F dr = -\int_{u_1}^{u_2} du$$

$$W = -u\Big|_{u_1}^{u_2}$$

$$W = -(u_2 - u_1)$$

$$\Rightarrow \int dW = -\int_{90^\circ}^{\theta} \tau \, d\theta$$

$$\Rightarrow -\int_{U_{90^\circ}}^{U_\theta} dU = -\int_{90^\circ}^{\theta} PE \sin\theta \, d\theta$$

$$\Rightarrow -\int_{U_{90^\circ}}^{U_\theta} dU = -PE \int_{90^\circ}^{\theta} \sin\theta \, d\theta$$

$$\Rightarrow -\left[U_\theta - U_{90^\circ}\right] = +PE\cos\theta \Big|_{90^\circ}^{\theta}$$

$$\Rightarrow -U_\theta + U_{90^\circ} = PE\cos\theta$$

$$\Rightarrow -U_\theta - 0 = PE\cos\theta$$

$$\Rightarrow -U_\theta = \vec{P} \cdot \vec{E}$$

$$\therefore U_\theta = -\vec{P} \cdot \vec{E}$$

Fundamental of Physics

22 Chapter

5, 6, 8, 9, 14, 15, 23, 24, 26, 30
31, 32, 34, 35

Sunday – Quiz (EM Notes - Chapter 2)
Gauss law
→ Theory
Problem Solving
পর্যন্ত

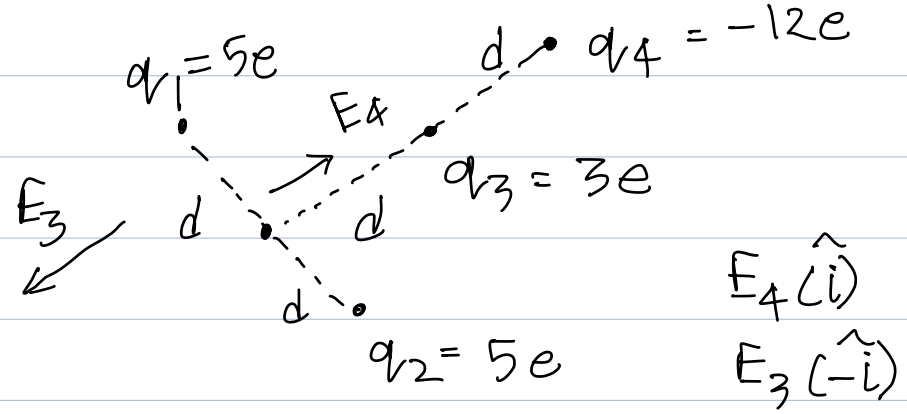
5| $E = 2$

$r = 50\,cm = 0.5m$

$$E = \frac{1}{4\pi\epsilon_0} \times \frac{q}{r^2}$$

$$\Rightarrow 2 = 9 \times 10^9 \times \frac{q}{(0.5)^2}$$

8|



$$\vec{E_3} = \frac{1}{4\pi\epsilon_0}\frac{|3e|}{d^2}(-\hat{i})$$

$$\vec{E_4} = \frac{1}{4\pi\epsilon_0}\frac{|-12e|}{(2d)^2}(\hat{i})$$

$$= \frac{1}{4\pi\epsilon_0}\frac{12e}{4d^2}\hat{i}$$

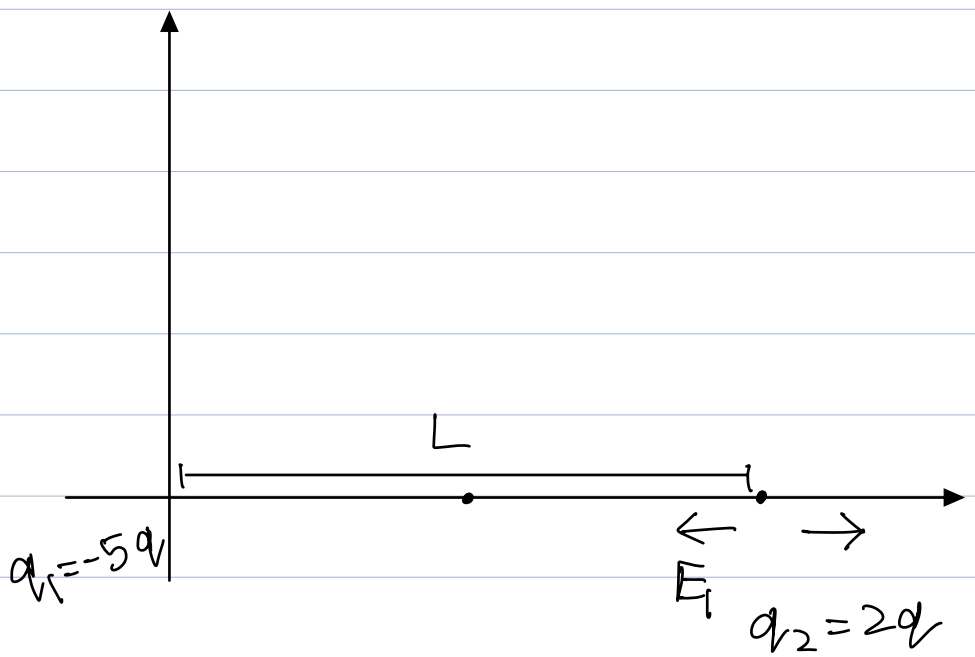
$$\vec{E} = \cancel{\vec{E_1}} + \cancel{\vec{E_2}} + \vec{E_3} + \vec{E_4}$$

$$= \frac{1}{4\pi\epsilon_0 d^2}\left(-3e + \frac{12e}{4}\right)$$

$$= 0$$

---

14)



$$\vec{E_1} = \frac{1}{4\pi\varepsilon_0} \frac{|-5q|}{x^2} (-\hat{i})$$

$$\vec{E_2} = \frac{1}{4\pi\varepsilon_0} \frac{|2q|}{(x-L)^2} (\hat{i})$$

$$\Rightarrow \vec{E} = \vec{E_1} + \vec{E_2} = 0$$

$$\Rightarrow \frac{1}{4\pi\varepsilon_0} \frac{5q}{x^2} (-\hat{i}) + \frac{1}{4\pi\varepsilon_0} \frac{2q}{(x-L)^2} (\hat{i}) = 0$$

$$\hookrightarrow \Rightarrow \frac{\sqrt{5}}{x} = \frac{\sqrt{2}}{(x-L)}$$