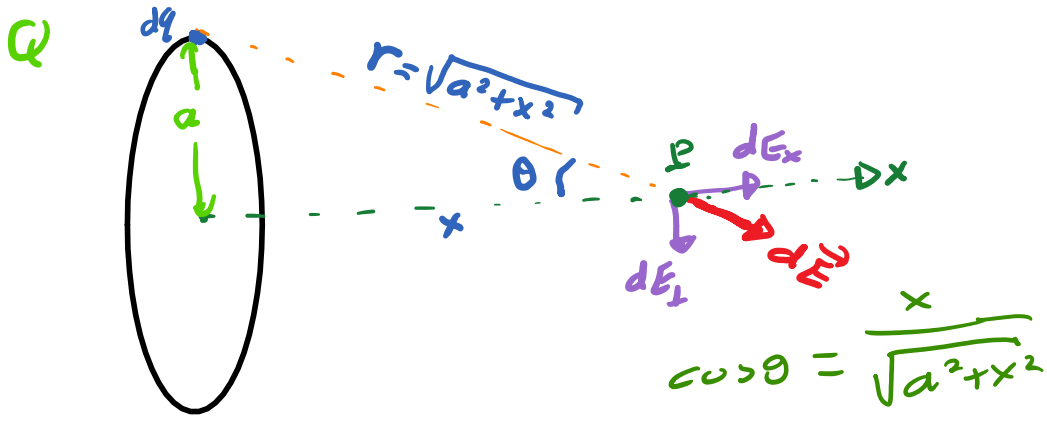
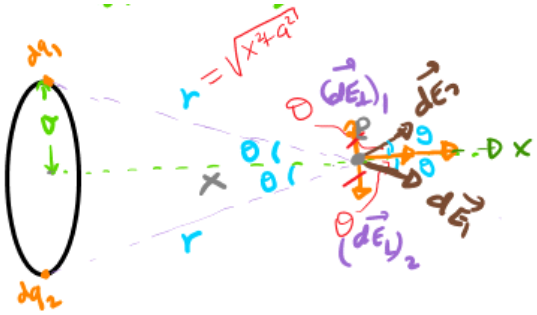
Lecture 8 (12-1)

Thursday, March 11, 2021 12:07 PM

Ex 23.8:





* Perpendicular components cancel due to symmetry

$$\Rightarrow dE_{tot} = dE_x = k_e \frac{dq}{r^2}\cos\theta$$

Integrate $\Rightarrow E_{tot} = E_x = k_e \int \frac{dq}{r^2}\cos\theta$

But $\cos\theta = \frac{x}{r} = \frac{x}{\sqrt{x^2+a^2}}$, $r=\sqrt{x^2+a^2}$ $\Rightarrow r^2 = x^2+a^2$

$$\Rightarrow E = k_e \int \frac{dq}{(x^2+a^2)} \frac{x}{(x^2+a^2)^{\frac{1}{2}}}$$

$$= \frac{k_e x}{(x^2+a^2)^{3/2}} \int dq \quad (= Q)$$

$$\Rightarrow \boxed{E = \frac{k_e x}{(a^2+x^2)^{3/2}} Q} \checkmark$$

- If $x=0 \Rightarrow$ (at the center of the ring) $\Rightarrow E = ?$

$\Rightarrow E = 0$

$$r = \frac{k_e Q}{}$$

- If $x \ll a \Rightarrow \boxed{E = \frac{k_e Q}{a^3} x}$
- If $x \gg a \Rightarrow E = \frac{k_e Q}{x^2}$ → point charge!!