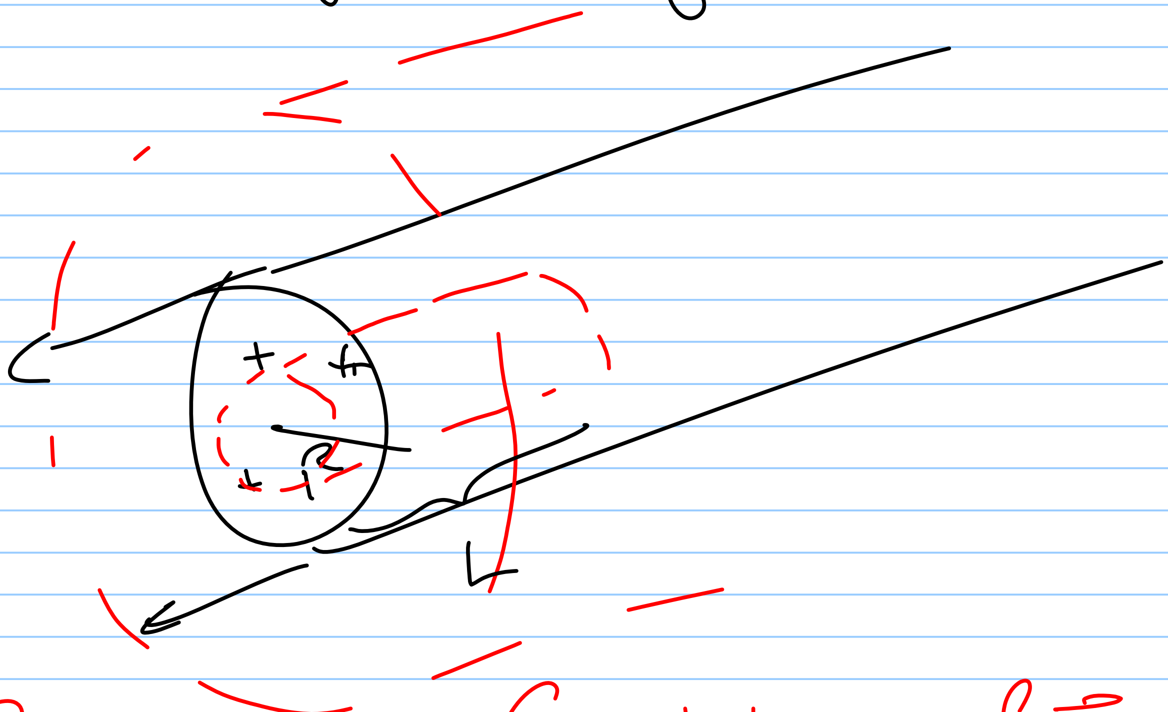
Ex: Find $\vec{E}$ for a uniformly charged cylinder of radius R.

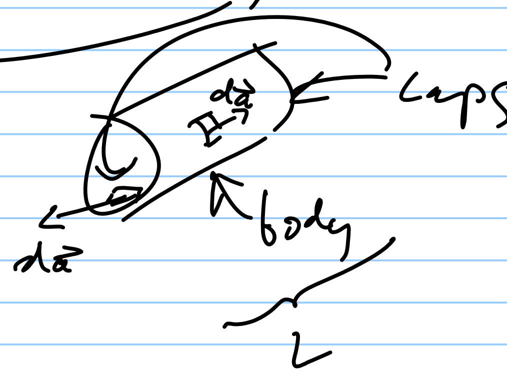


Principle: Gauss's Law $\oint \vec{E} \cdot d\vec{a} = \frac{Q_{encl}}{\epsilon_0}$

Method: 1.) Find direction of $\vec{E}$: radially out

2.) want $\vec{E} \perp d\vec{a}$ or $\vec{E} \parallel d\vec{a}$ so we don't have to calculate, $\vec{E} \cdot d\vec{a} = |\vec{E}||d\vec{a}| \cos\theta$

Choose cylinder of radius r



3.) find flux

endcaps : 0 $\quad E \perp d\vec{a}$

body : $\int_{body} \vec{E} \cdot d\vec{a} = \int |\vec{E}||d\vec{a}| \cos\theta = E \int |d\vec{a}|$

($\theta = 0$; $\int$ ← all tiles; $\int |d\vec{a}|$ ← sum areas of all tiles)

$= E \, 2\pi r \, E$

4.) find $Q_{enc} = \int \rho_0 \, d\tau = \rho_0 \pi r^2 L$

5.) Put into G.L. to find E

Check:

E for ∞ wire far away

$\rho_0 \to 0 \quad E \to 0$

$E_{r_-} = E_{r_+}$

just inside ↑ ↑ just outside