Infinite plate:

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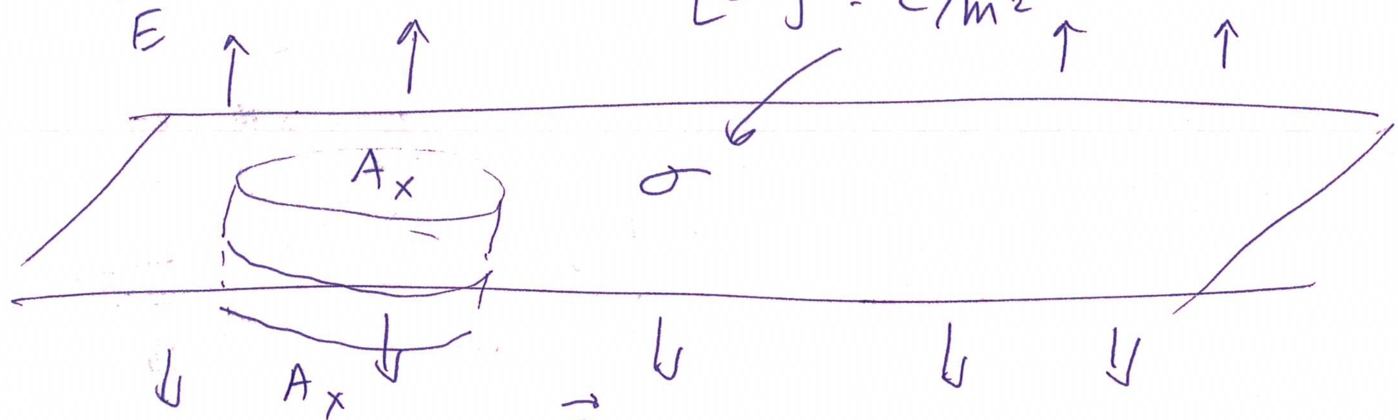
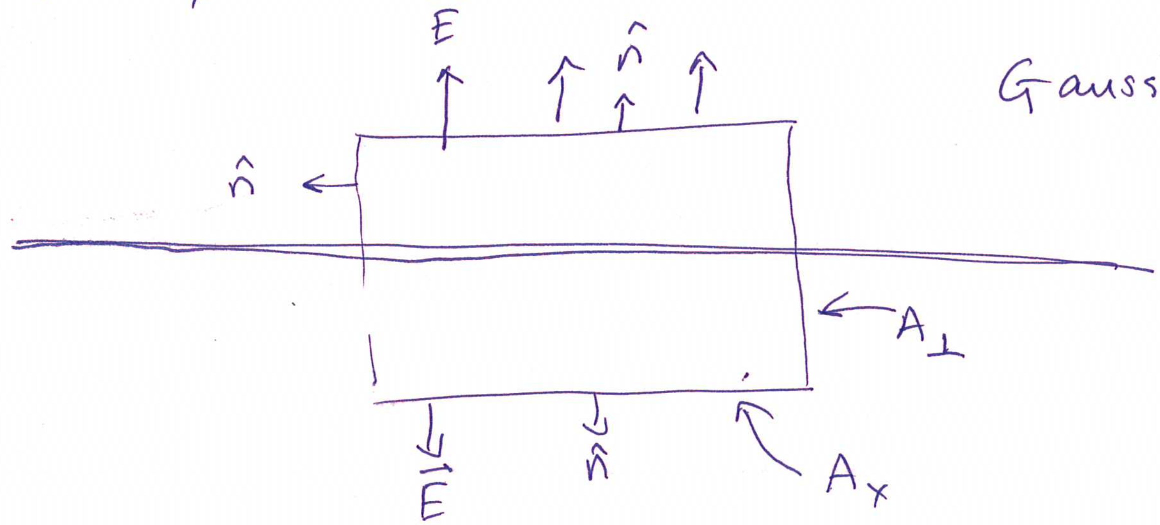
charge density.

$[\sigma] = C/m^2$





Gaussian Pill Box.

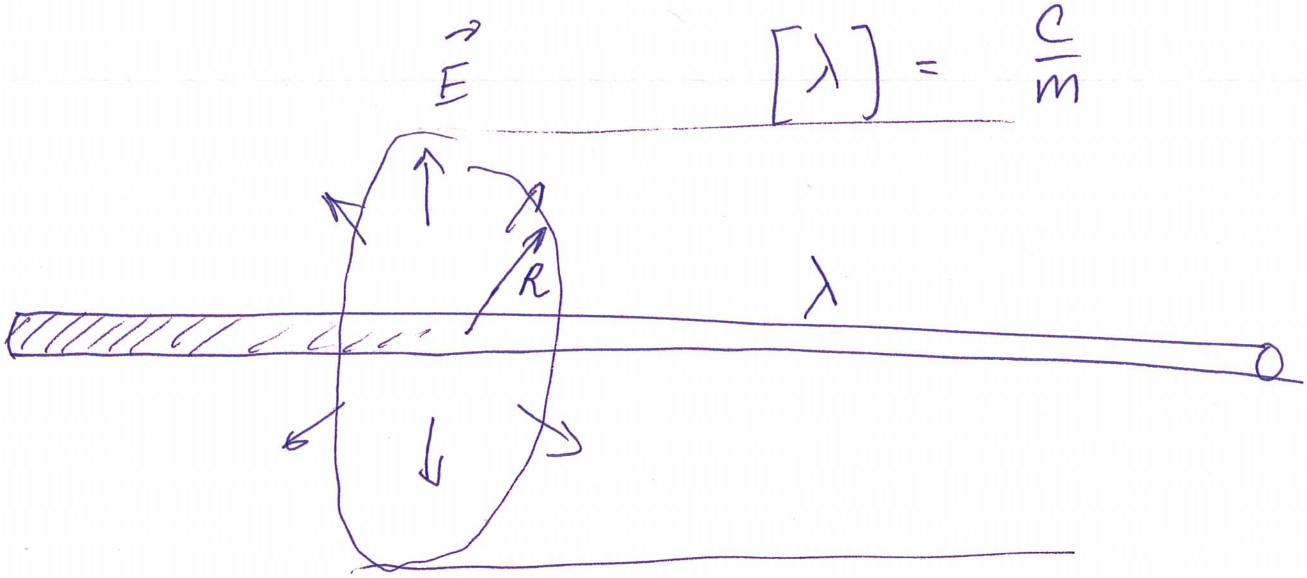
$$\Phi_M = \oint_M d^2A \; \hat{n} \cdot \vec{E} = 2A_x E + 0 \cdot A_\perp = \frac{\overbrace{A_x \sigma}^{Q_{inside}}}{\epsilon_0}$$

$$E = \frac{\sigma}{2\epsilon_0} \Rightarrow \vec{E} = \frac{\sigma}{2\epsilon_0} \hat{z}^*$$

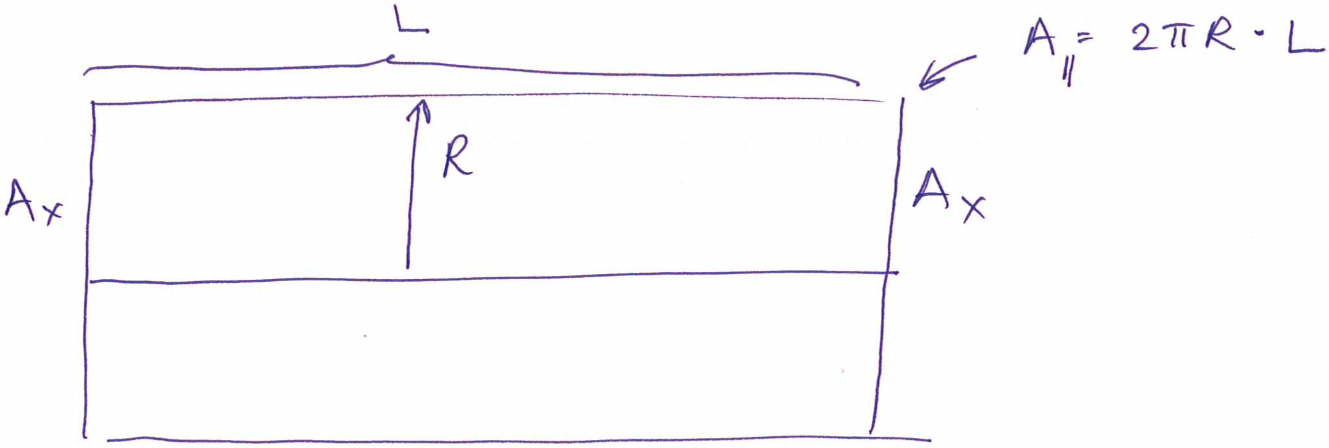
$\hat{z}^* \equiv \frac{\vec{z}}{|z|}$. away from plane.

Infinite line:

$$[\lambda] = \frac{C}{m}$$



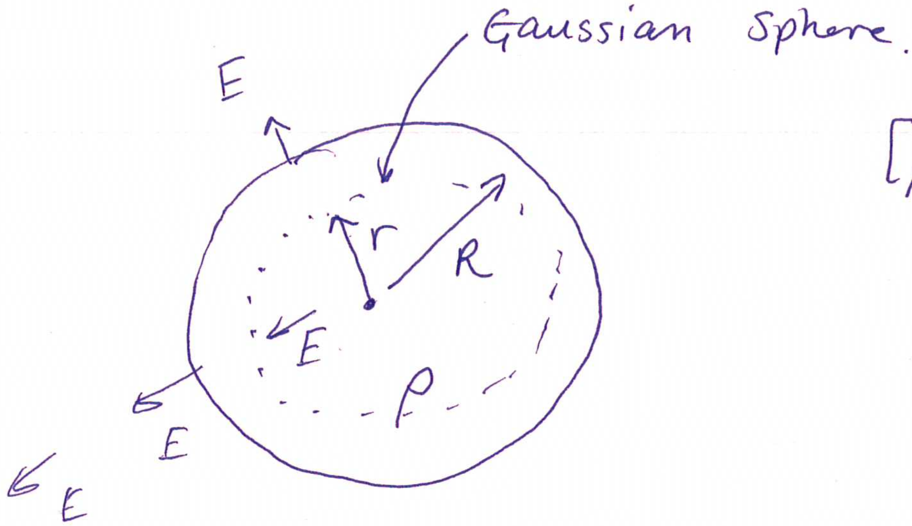
Gaussian cylinder.



$$\Phi_M = 2\pi R \cdot L \cdot E + 0 \cdot A_{\perp} = \frac{L\lambda}{\epsilon_0}$$

$$E = \frac{\lambda}{\epsilon_0 2\pi R} = \frac{k\lambda}{2R} \checkmark$$

Sphere



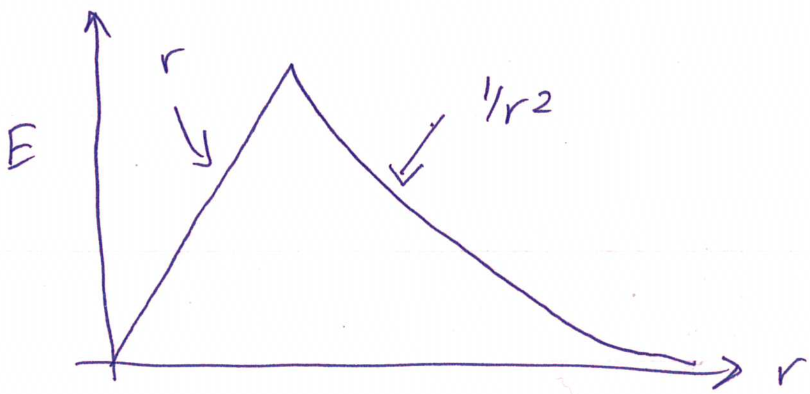
$$[\rho] = \frac{C}{m^3}$$

$A_{\parallel} = 4\pi r^2$ surface area.

$$4\pi r^2 E = \frac{1}{\epsilon_0}\begin{cases} \rho \dfrac{4\pi r^3}{3} & r < R \\ \underbrace{\rho \dfrac{4\pi R^3}{3}}_{Q_0} & r > R \end{cases}$$

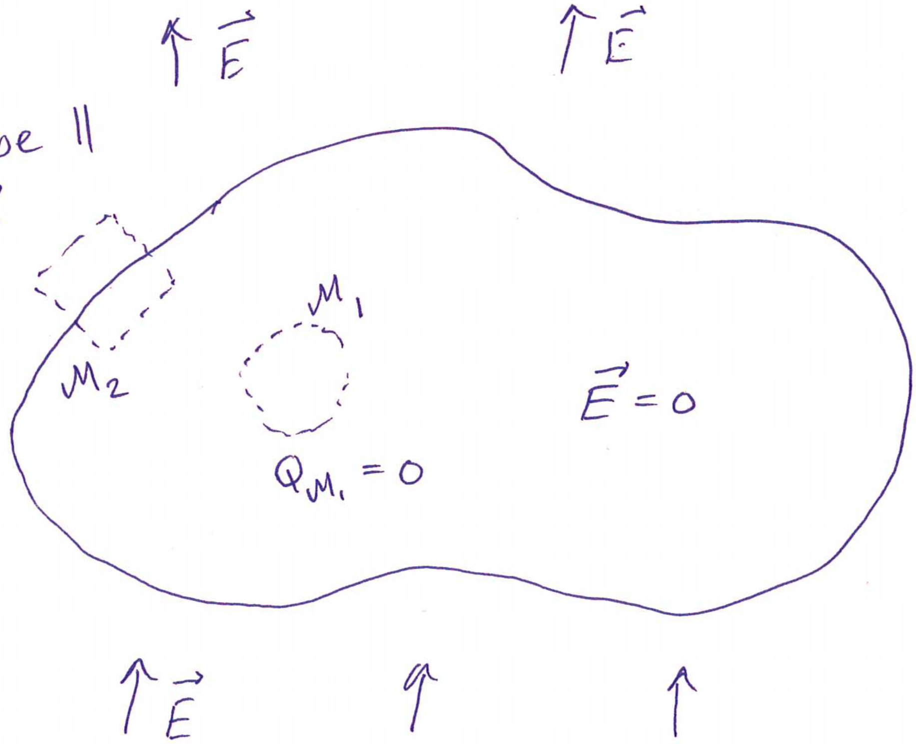
$$4\pi r^2 E = \frac{1}{\epsilon_0}\begin{cases} Q_0 \left(\dfrac{r}{R}\right)^3 & r < R \\ Q_0 & r > R \end{cases}$$

$$E = \frac{Q_0}{4\pi\epsilon_0}\begin{cases} \dfrac{r}{R^3} & r < R \\ \dfrac{1}{r^2} & r > R \end{cases}$$

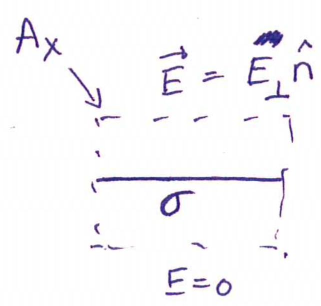


all free charge is @ the surface

Can $\vec{E}$ be $\parallel$ to surface?



M_2



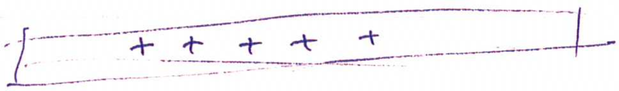
$\vec{E}_\parallel = 0$

no $\frac{1}{2}$!

$$A_x E_\perp = \frac{A_x \sigma}{\epsilon_0}$$

$$E_\perp = \frac{\sigma}{\epsilon_0}$$

$\vec{E} = +\frac{1}{2}\frac{\sigma}{\epsilon_0}$

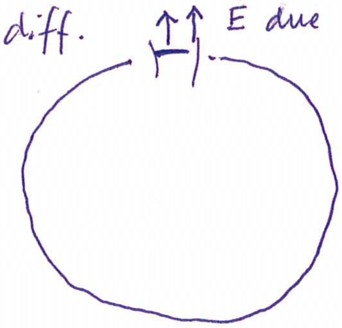


$\vec{E} = -\frac{1}{2}\frac{\sigma}{\epsilon_0}\hat{z}$

Where does the extra $\vec{E}$ come from?

$\vec{E}$ due to diff. part of surface.

$\vec{E}$ due to the rest of the sphere. (shape)



σ