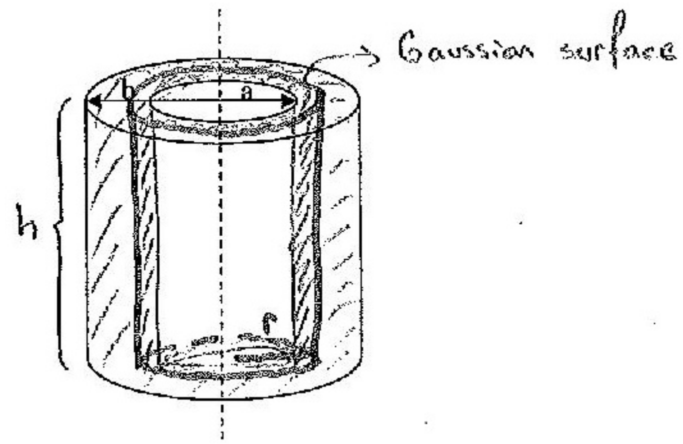


$$\Phi_{Total} = \oint \overrightarrow{E}.d\overrightarrow{a} = \frac{Q_{enc}}{2\epsilon_0}$$

$$\Phi_{Total} = \Phi_{up} + \Phi_{bot} + \Phi_{side} = 0 + 0 + E2\pi rh \Rightarrow \Phi_{Total} = E2\pi rh$$

$$Q_{enclosed} = \rho V_{enc}$$

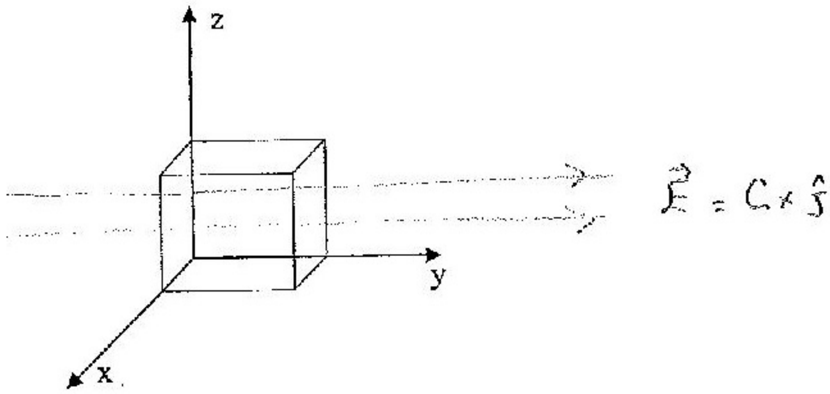
V_{enc}(Volume inside the Gaussian surface -Volume of cavity of radiusa)

$$V_{enc} = \pi r^2 h - \pi a^2 h = \pi h(r^2 - a^2)$$

$$Q_{enc} = \rho \pi h(r^2 - a^2)$$

$$E2\pi rh = \frac{\rho \pi h(r^2 - a^2)}{\epsilon_0}(Gauss' law)$$

$$\overrightarrow{E} = \frac{\rho(r^2 - a^2)}{\epsilon_0}\hat{r}$$



$$\Phi_{total} = \Phi_{up} + \Phi_{bottom} + \Phi_{front} + \Phi_{back} + \Phi_{left} + \Phi_{right}$$

$$\Phi_{up} = EA\cos(\theta) = EA\cos(90) = 0$$

$$\Phi_{bottom} = EA\cos(\theta) = EA\cos(90) = 0$$

$$\Phi_{front} = EA\cos(\theta) = EA\cos(90) = 0$$

$$\Phi_{back} = EA\cos(\theta) = EA\cos(90) = 0$$

$$\Phi_{right} = ELA\cos(\theta) = ELA\cos(0) = ELA$$

$$\Phi_{left} = E \times 0 \times A\cos(\pi) = 0$$

$$\Phi_{total} = ELA$$

Gauss's law

$$\Phi_{Total} = \oint \overrightarrow{E} \cdot \overrightarrow{dA} = \frac{Q_{enc}}{\epsilon_0}$$

$$\Phi_{Total} = E4\pi r^2$$

$$Q_{enc} = \rho V_{enc}$$

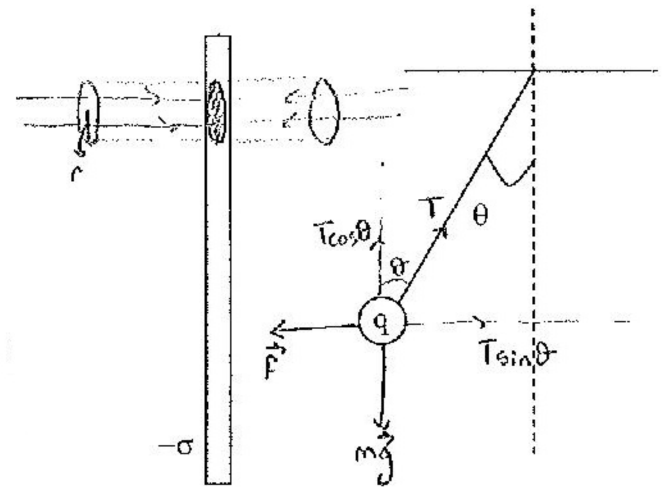
$$V_{enc} = 4/3\pi r^3 - 4/3\pi a^3$$

$$Q_{enc} = 4/3\pi\rho(r^3 - a^3)$$

Gauss's law

$$E4\pi r^2 = \frac{4/3\pi\rho(r^3 - a^3)}{\epsilon_0}$$

$$\overrightarrow{E} = \frac{\rho(r^3 - a^3)}{3\epsilon_0 r^2}\hat{r}$$



Gauss's law

$$\Phi_{Total} = \oint \overrightarrow{E} \cdot \overrightarrow{dA} = \frac{Q_{enc}}{\epsilon_0}$$

$$\Phi_{Total} = \Phi_{left} + \Phi_{right} + \Phi_{inside}$$

$$\Phi_{Total} = E\pi r^2 + E\pi r^2 + 0$$

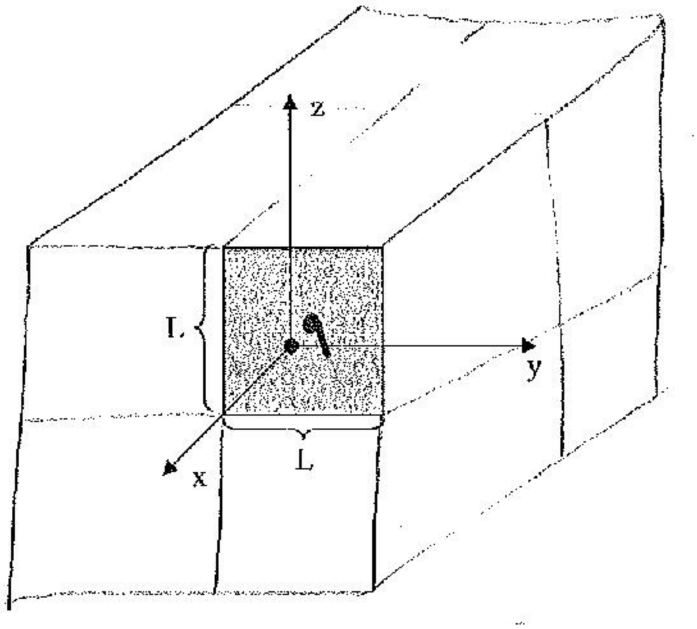
$$= 2E\pi r^2$$

$$Q_{enc} = \sigma\pi r^2$$

$$2E\pi r^2 = \frac{\sigma\pi r^2}{\epsilon_0}$$

$$\overrightarrow{E} = \pm\frac{\sigma}{2\epsilon_0}\hat{y}$$

$$
\begin{aligned}
\overrightarrow{F} &= \overrightarrow{E}q = -\frac{\sigma}{\lambda\epsilon_0}q\hat{y} \\
\Sigma f_x &= 0 \\
\Sigma f_y &= 0 \\
f &= \frac{\sigma}{\lambda\epsilon_0}q = T\sin(\Theta) \\
mg &= T\cos(\Theta) \\
\tan(\Theta) &= \frac{\sigma q}{2\epsilon_0 mg}
\end{aligned}
$$



Gauss's law Consider the cube itself as a Gaussian surface.

Gauss's law

$$\Phi_{Total} = \oint \overrightarrow{E} \cdot \overrightarrow{dA} = \frac{Q_{enc}}{\epsilon_0}$$

The cube consists of $24(L \times L)$-square, since the charged particle is at the center, every little square has the same flux, because their distance from the particle are the same

$$\Phi_{square} = \frac{q}{24\epsilon_0}$$