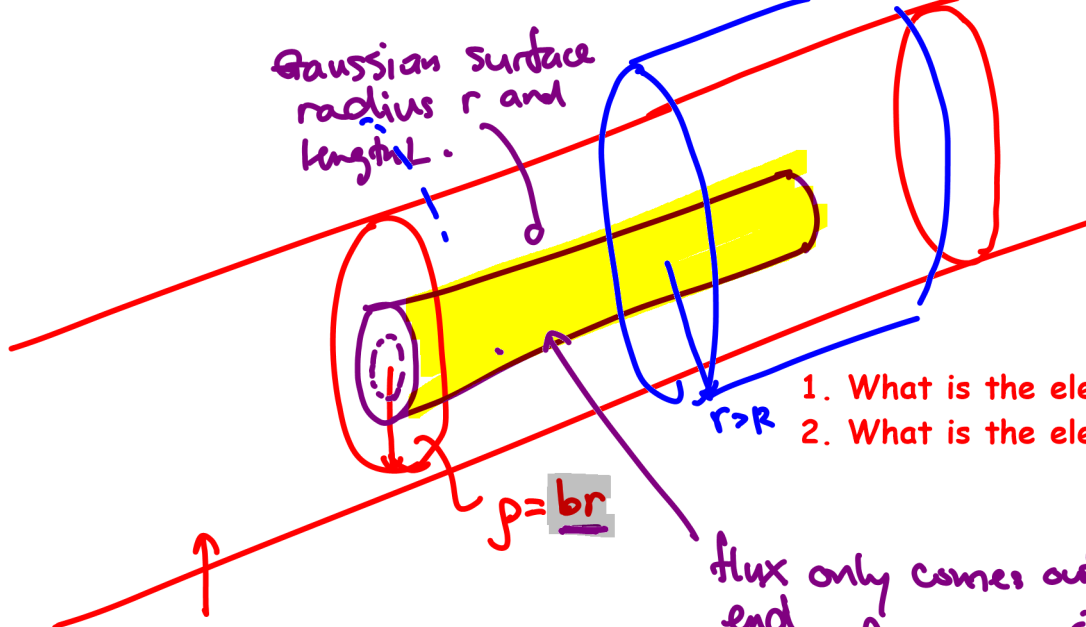


Gaussian surface radius r and length L .



1. What is the electric field inside the rod?
2. What is the electric field outside the rod?

flux only comes out of the side, not the end.

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

$$E \cdot (2\pi r L) = \frac{2\pi b L}{3\epsilon_0} r^3$$

$$E = \frac{br^2}{3\epsilon_0}$$

Infinitely long rod with radius R

$$Q_{enc} = \int_0^r dQ = \int_0^r \rho dV = \int_0^r \rho (2\pi r L dr)$$

$$= \int_0^r (br) (2\pi r L) dr = 2\pi b L \int_0^r r^2 dr$$

$$= \frac{2\pi b L}{3} r^3$$

$$Q_{enc} = \int_0^R dQ = \frac{2\pi b L}{3} R^3$$

outside

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

$$E (2\pi r L) = \frac{2\pi b L R^3}{3\epsilon_0}$$

$$E = \left(\frac{b R^3}{3\epsilon_0} \right) \frac{1}{r}$$

