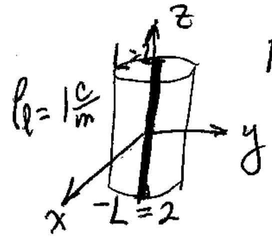
Gauss Law for E — Symmetric charges only or "Far Away"

$$Q = \oint_s \bar{D} \cdot d\bar{S}$$



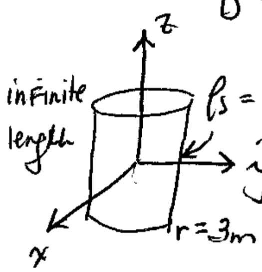
Find $\bar{D}$ on $\hat{y}$ axis (anywhere $z \neq 0$ would not be symmetric)

$$Q = \int_{z=-2}^{2} \left(1\frac{C}{m}\right) dz = 4C$$

$$\underbrace{\int_{\phi=0}^{2\pi}\int_{z=-2}^{2} D_r \hat{r} \cdot r\,d\phi\,dz}_{\text{side}} + \underbrace{\iint}_{\text{top}} + \underbrace{\iint}_{\text{bottom}} = 2\pi r (4) D_r$$

(top + bottom = and opposite)

$$\bar{D} = \frac{1}{2\pi r}\hat{r} \text{ on } \hat{y} \text{ axis}$$



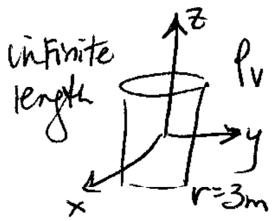
$$Q = \int_{z=-L}^{L}\int_{\phi=0}^{2\pi} \left(1\,C/m^2\right) r\,d\phi\,dz = 2\pi r(2L)\,C \quad r \geq 3m$$

(r = 3m); 0 otherwise

$$\oint_s \bar{D}\cdot d\bar{S} = 2\pi r\,(2L) \text{ same as above}$$

$\bar{D} = 0$ inside cylinder $r < 3$

$$= \frac{2\pi(3)(2L)}{2\pi\, r\,(2L)}\hat{r} = \frac{3}{r}\hat{r} \quad \text{for } r \geq 3$$



$$Q = \int_{z=-L}^{L}\int_{\phi=0}^{2\pi}\int_{r=0}^{r} \left(1\,C/m^3\right) r\,dr\,d\phi\,dz = 2\pi \frac{r^2}{2}(2L)$$

$$= 2\pi \frac{r^2}{2}(2L) \text{ inside } r < 3m \quad = 2\pi \frac{(3)^2}{2}(2L) \quad r \geq$$

$$\oint_s \bar{D}\cdot d\bar{S} = 2\pi r(2L) \text{ same as above}$$

$$\bar{D} = \frac{2\pi r^2/2\, 2L}{2\pi r\; 2L} = \frac{r}{2} \quad r < 3m$$

$$= \frac{2\pi(9/2)\,2L}{2\pi\, r\,(2L)} = \frac{9}{2r} \quad r \geq 3m$$