

# Capacitor.

E3.31

Find Capacitance  $C$ .



$C = ?$

$$C = \frac{Q}{\Delta V} = \frac{2\pi L \epsilon}{\ln \frac{b}{a}}$$

Conductor so charges only on surface.

At  $p=a$  and  $p=b$ .

charge density is  $\sigma$ .

Find  $\vec{E}$  at Gaussian cylinder w radius  $p$   $a \leq p \leq b$ .

$$\oint \vec{E} \cdot d\vec{s} = \frac{Q_{enc}}{\epsilon}$$

Gaussian surface  $\Rightarrow 2\pi pL$   
only depends on  $p$

$$\vec{E} = E_p \hat{p}$$

$$\Rightarrow E_p (2\pi pL) = \frac{1}{\epsilon} 2\pi aL \Rightarrow E_p = \frac{a\sigma}{\epsilon p}$$

$$\text{Find } V = - \int_a^b \vec{E} \cdot d\vec{p} = - \int_a^b \frac{a\sigma}{\epsilon p} dp = - \frac{a\sigma}{\epsilon} [\ln p]_a^b =$$

$$= - \frac{a\sigma}{\epsilon} \ln(a) - \ln(b) = - \frac{a\sigma}{\epsilon} \ln \frac{a}{b} = \frac{a\sigma}{\epsilon} \ln \left( \frac{b}{a} \right) \quad C = \frac{2\pi L}{\ln \frac{b}{a}}$$