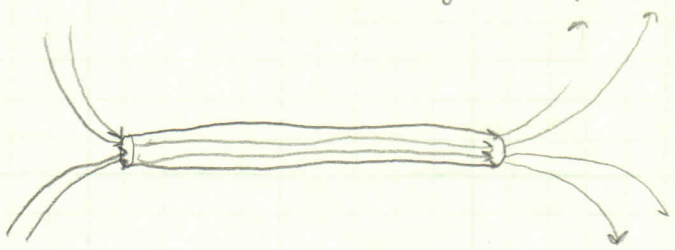
4.11

$\vec{P}(\vec{r}) = P\hat{z} \Rightarrow \sigma_b = \begin{cases} \pm P & \text{on the end caps} \\ 0 & \text{on the curved surface} \end{cases}$

$\rho(\vec{r}) = -\vec{\nabla}\cdot\vec{P} = 0$

(i) $L \gg a$ ---->

In this case we can consider the endcaps as point charges with charge $P(4\pi a^2)$ on the right, and $-4\pi a^2 P$ on the left. Thus, this is simply a physical dipole



(ii) $L \ll a$ ---->

This is essentially a parallel plate capacitor

(iii) $L \approx a$

This is somewhere inbetween the two