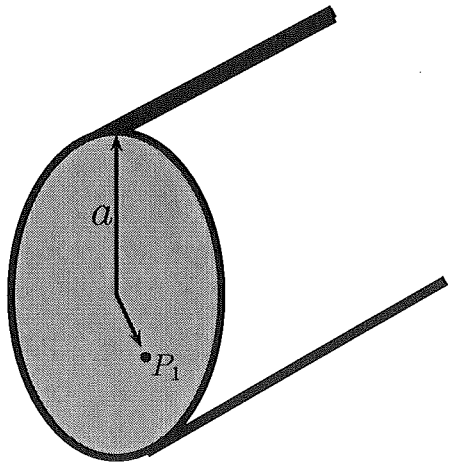
PHYSICS 161 TEST 2

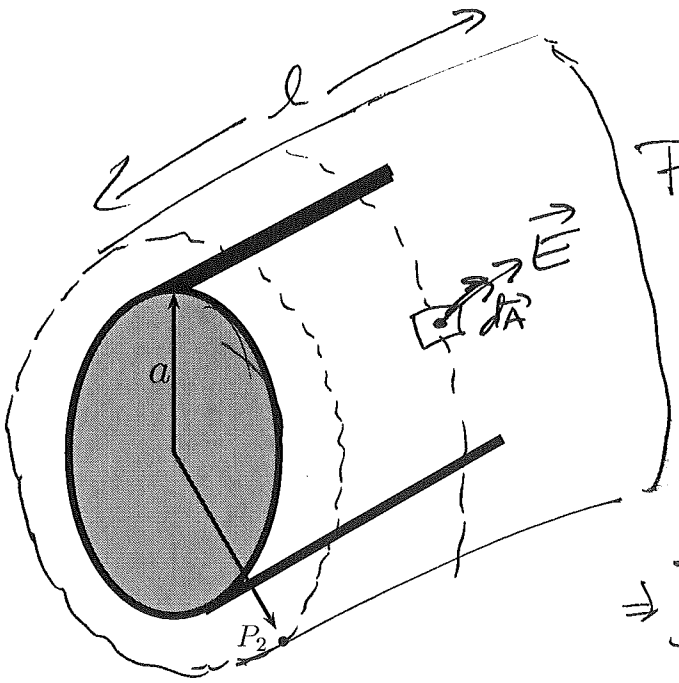
An infinitely long cylindrical **conductor** of radius $a = 0.3\,m$ has surface charge density $\sigma = 6.50\,\mu C/m^2$.



(a) What is the magnitude of the electric field at a point P_1 which is a radial distance $r = 0.15\,m$ from the center of the conductor? *(4pts)*

P_1 IS INSIDE CONDUCTOR $\Rightarrow$ $E = 0$

(b) What is the magnitude of the electric field at a point P_2 which is a radial distance $r = 0.45\,m$ from the center of the conductor? *(6pts)*



P_2 OUTSIDE CONDUCTOR SO $E \neq 0$

BY SYMMETRY USE GAUSSIAN CYLINDER

$\Rightarrow \Phi_{TOTAL} = EA$

$\vec{E}$ PASSING THROUGH CIRCULAR SIDES OF CYLINDER $\Rightarrow A = 2\pi r\ell$

GAUSS'S LAW: $EA = \frac{Q_{encl}}{\epsilon_0} \Rightarrow E(2\pi r\ell) = \frac{Q_{encl}}{\epsilon_0}$

CHARGE ONLY ON SURFACE OF CONDUCTOR AT a $\Rightarrow Q_{encl} = \sigma(2\pi a\ell)$

$\therefore E(2\pi r\ell) = \frac{\sigma(2\pi a\ell)}{\epsilon_0} \Rightarrow E = \frac{\sigma}{\epsilon_0}\left(\frac{a}{r}\right)$

$E = \frac{(6.5\times10^{-6}\,C/m^2)}{(8.85\times10^{-12}\,C^2/N\cdot m^2)}\left(\frac{.3m}{.45m}\right) \Rightarrow \boxed{E = 4.896\times10^5\,N/C = 4.9\times10^5\,N/C}$