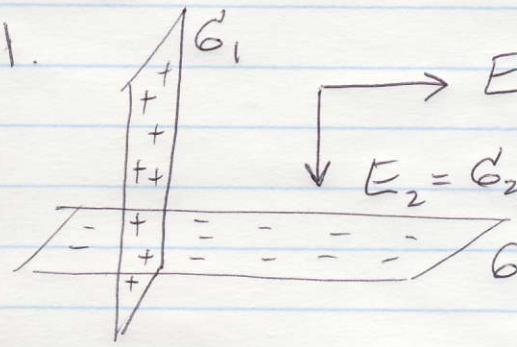
Physics 210 Solutions to Multiple Choice Week 3

1.



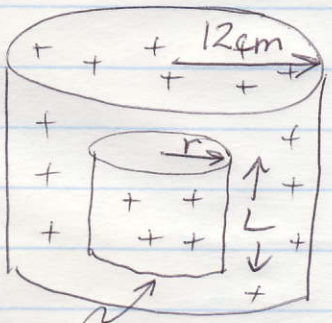
$$E_{net} = \sqrt{E_1^2 + E_2^2}$$

$$= \frac{1}{2\varepsilon_0}\sqrt{\sigma_1^2 + \sigma_2^2}$$

$$= \frac{1}{2\varepsilon_0}\sqrt{\left(60\frac{pC}{m^2}\right)^2 + \left(-80\frac{pC}{m^2}\right)^2}$$

$$= 5.6\,N/C$$

2.

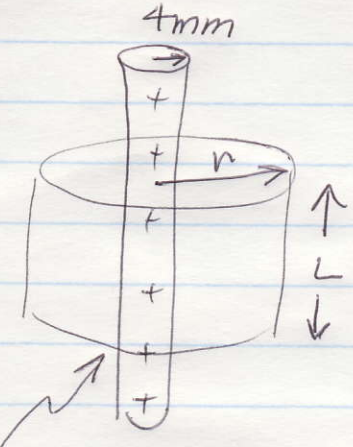


$$E = \frac{Q_{in}}{A\varepsilon_0} = \frac{\rho \cdot V_{in}}{A\varepsilon_0}$$

$$E = \frac{\rho \cdot \pi r^2 \cdot L}{2\pi r L \cdot \varepsilon_0} = \frac{\rho r}{2\varepsilon_0}$$

$$E = \frac{(5nC/m^3)\cdot(.05m)}{2\varepsilon_0} = 14\,N/C$$

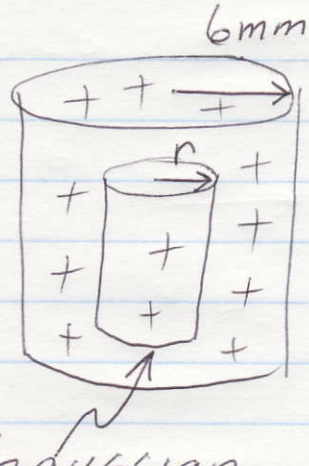
3.



$$E = \frac{Q_{in}}{A\varepsilon_0} = \frac{\lambda L}{2\pi r L \cdot \varepsilon_0} = \frac{K\lambda 2}{r}$$

$$E = \frac{2(9\times10^9)(4nC/2m)}{(5\times10^{-3}m)} = 7200\,N/C$$

4.



$$E = \frac{Q_{in}}{A\varepsilon_0}$$

$$Q_{in} = \int \rho \, dV$$

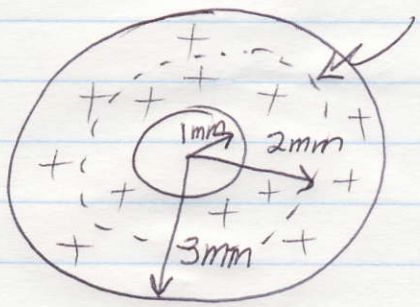
$$= \int_0^{2mm} \alpha r^2 \cdot 2\pi r \, dr \, L$$

$$= 2\pi\alpha L \left. \frac{r^4}{4} \right|_0^{2mm}$$

$$= \frac{2\pi\alpha L}{4} (2\times10^{-3})^4$$

$$E = \frac{2\pi\alpha L (2\times10^{-3})^4}{4 \cdot 2\pi r L \varepsilon_0} = \frac{\alpha (2\times10^{-3})^4}{4 (2\times10^{-3}) \varepsilon_0} = 1.4 N/C$$

5. Looking down on cylinders



$$E = \frac{Q_{in}}{A\varepsilon_0} = \frac{\rho \cdot V_{in}}{A\varepsilon_0}$$

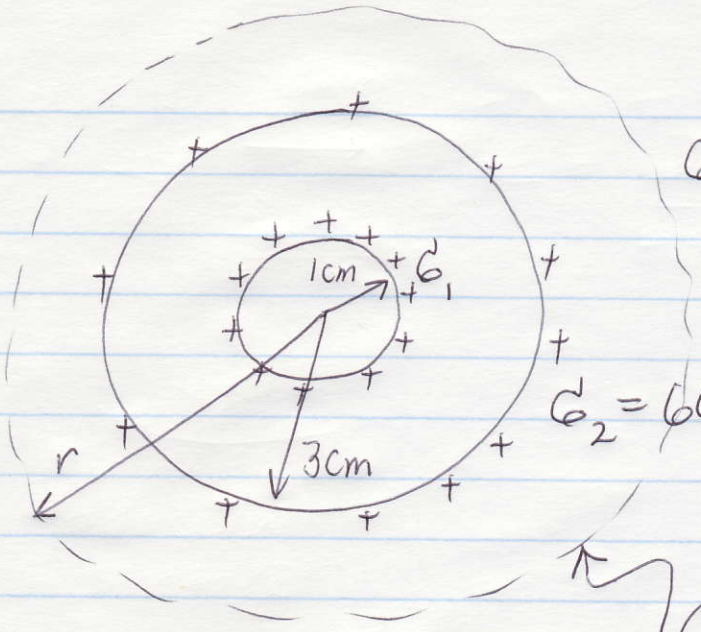
$$= \rho \cdot \frac{(\pi(2mm)^2 - \pi(1mm)^2) L}{2\pi(2mm) \cdot L \varepsilon_0}$$

$$\rho = 80 \frac{nC}{m^3}$$

$$= \rho \frac{[(2\times10^{-3})^2 - (1\times10^{-3})^2]}{2(2\times10^{-3})\varepsilon_0}$$

$$= 6.8 N/C$$

6.



$\sigma_1 = 40 pC/m^2$

$\sigma_2 = 60 pC/m^2$

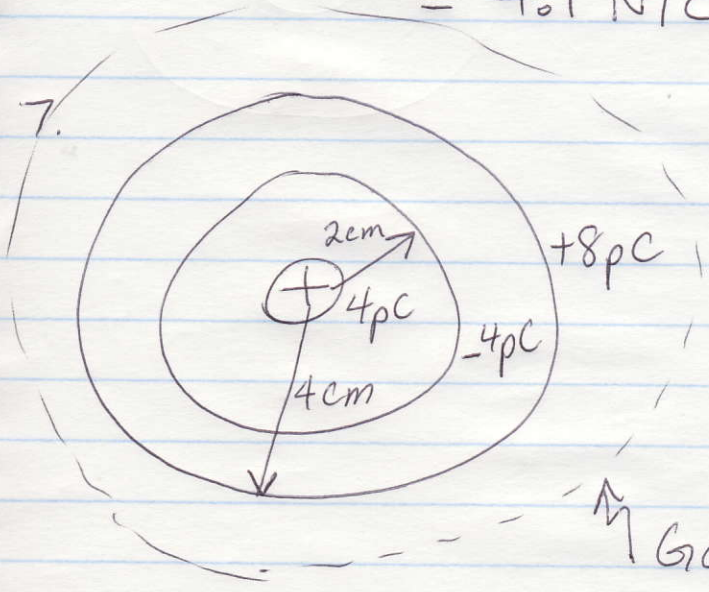
Gaussian surface

$$E = \frac{Q_{in}}{A\varepsilon_0} = \frac{\sigma_1 A_1 + \sigma_2 A_2}{4\pi r^2 \cdot \varepsilon_0}$$

$$= \frac{40 pC/m^2 \cdot 4\pi (.01m)^2 + 60 \frac{pC}{m^2} \cdot 4\pi (.03m)^2}{4\pi (.04m)^2 \cdot \varepsilon_0}$$

$$= 4.1 N/C$$

7.



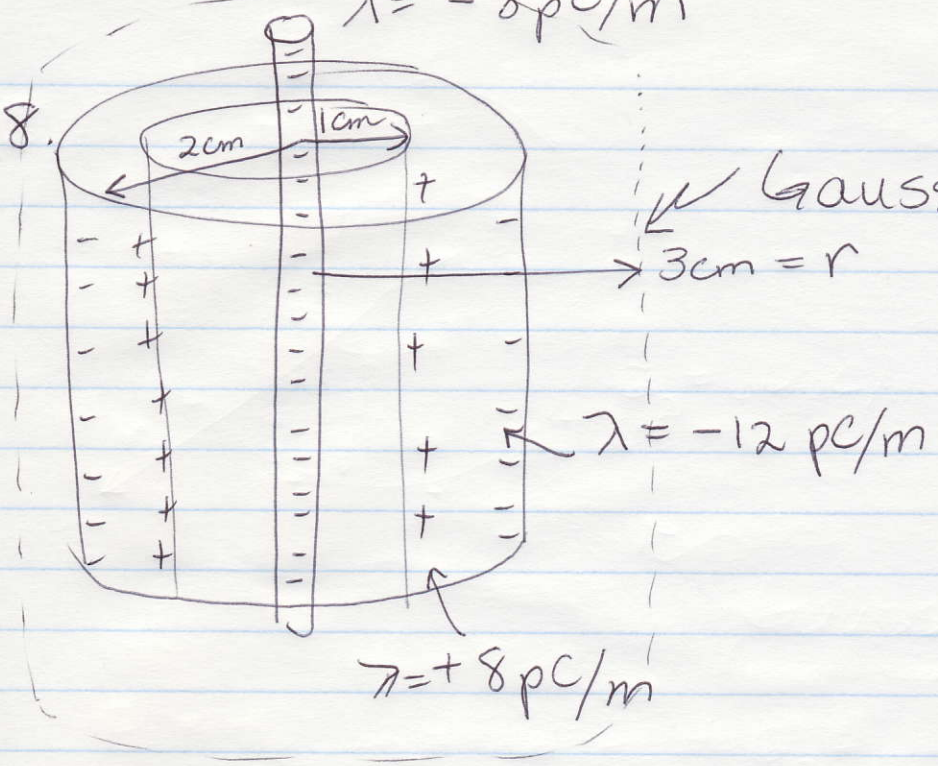
$$E = \frac{Q_{in}}{A\varepsilon_0} = \frac{4pC - 4pC + 8pC}{4\pi r^2 \cdot \varepsilon_0}$$

$$= \frac{8pC}{4\pi\varepsilon_0 \cdot (.06)^2}$$

$$= 20 N/C$$

Gaussian surface

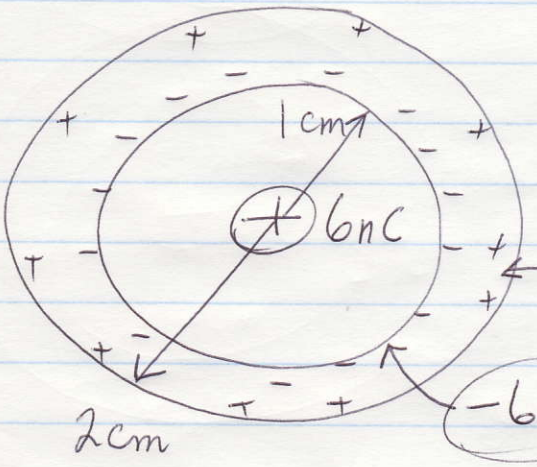
8.



$$E = \frac{Q_{in}}{A\varepsilon_0} = \frac{(-8\,pC/m)L + (8\,pC/m)L - (12\,pC/m)L}{2\pi r L \cdot \varepsilon_0}$$

$$= \frac{-12\,pC/m}{2\pi\varepsilon_0 \cdot (.03m)} = 7.2\,N/C$$

9.



$$\Rightarrow \sigma = \frac{-6nC}{4\pi(.01m)^2} = 4.8\,\mu C/m^2$$