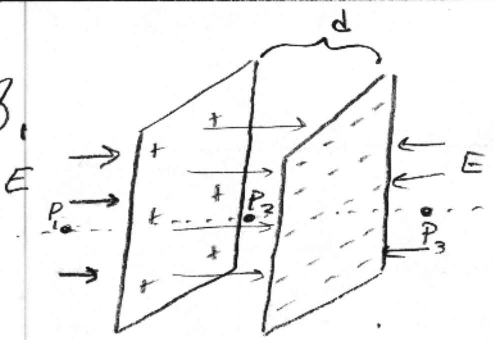
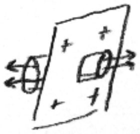
8,



Would be zero if σ was same,



a) P_1

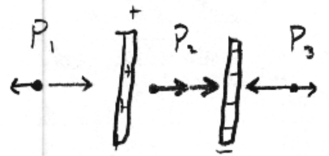
$\sigma_1 = \frac{Q}{A}$

$\vec{E}\cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_0}$

$Q_{in} = \sigma_1 \cdot A$

$E\cdot 2\cancel{A} = \frac{\sigma A}{\varepsilon_0}$

$E = \overset{\text{opposite}}{\frac{\sigma_1 + \sigma_2}{2\varepsilon_0}} = \boxed{7.07\times10^4 N/C}$

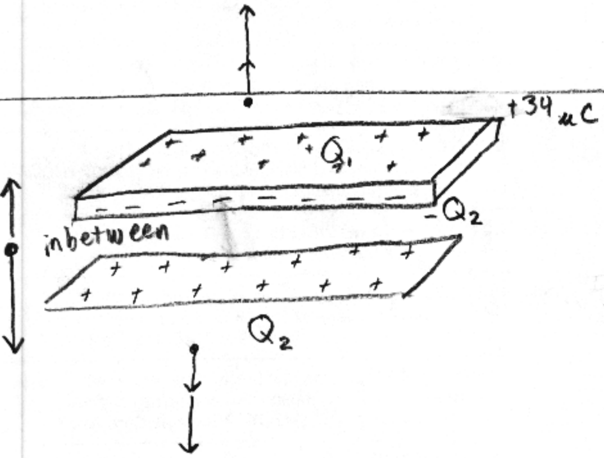


b) (same direction)

(combining) $E = \frac{\sigma_1}{2\varepsilon_0} + \frac{\sigma_2}{2\varepsilon_0} = \boxed{2.12\times10^5 N/C}$

c) $E = \overset{\text{opposite}}{\frac{\sigma_1 + \sigma_2}{2\varepsilon_0}} = \boxed{-7.07\times10^4 N/C}$

9,



a) $E_1 = \frac{\sigma}{2\varepsilon_0} = \frac{Q_1}{2\varepsilon_0 lw} = -3.31\times10^7 N/C$ down

b) $E_2 = \frac{\sigma}{2\varepsilon_0} = \frac{Q_2}{2\varepsilon_0 lw} = 1.81\times10^7 N/C$ up

$E_1 + E_2 \rightarrow$

c) $E = -1.5\times10^7 N/C$ down

d) $F = Eq$

e) $E = \frac{Q_{tot}}{2\varepsilon_0 lw} = 5.12\times10^7 N/C$ up

F) $5.12\times10^7 N/C$ down

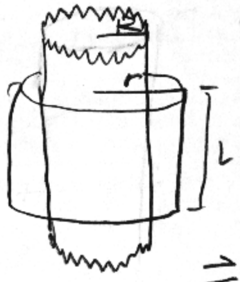
g) zero

h) $\sigma = \frac{Q}{A} = \frac{-12\mu C}{lw}$

$\sigma = \frac{34\mu C}{lw} =$

APC Hwk

#10. First I want to explain why the inner cylinder has linear charge density. Take a (long) solid cylinder of charge density (ρ)



outside E-field

$\rho = \frac{Q}{V}$

$Q_{in} = \rho \pi r^2 L$ $\to$ all is inside

$$\vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_0}$$

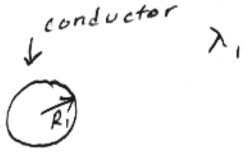
$$E \cdot 2\cancel{\pi} \cancel{r} \cancel{L} = \frac{\rho \cancel{\pi} r^{\cancel{2}} \cancel{L}}{\varepsilon_0}$$

$$E = \frac{\rho r}{2\varepsilon_0}$$

$$E = \frac{Q \cancel{r}}{2\pi\varepsilon_0 r^{\cancel{2}} L} = \frac{1}{2\pi\varepsilon_0 r} \frac{Q}{L}$$

$$\boxed{E = \frac{\lambda}{2\pi\varepsilon_0} \frac{1}{r}}$$

Now we can begin.



a.) i) $r < R_1$

$E = 0$

ii) $R_1 < r < R_2$

lik a line of charge

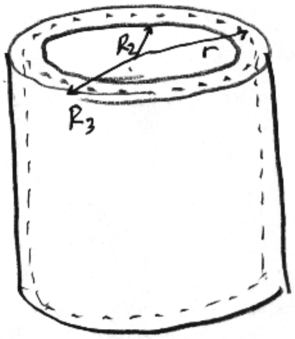
$$E \cdot 2\pi r L = \frac{\rho \pi r^2 L}{\varepsilon_0}$$

$$\boxed{E = \frac{\lambda}{2\pi\varepsilon_0} \frac{1}{r}}$$

iii) $R_2 < r < R_3$ inside the insulator shell (tricky and need calculus) Insulators will not polarize lik conductors so we must add the E-fied inside R_2 to what we found for the conductor.

$$E_{net} = E_{conductor} + E_{inside\ insulator}$$

$$\vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_0}$$



$Q_{in} = \rho(\pi r^2 L - \pi R_2^2 L)$

$Q_{in} = \rho \pi L(r^2 - R_2^2)$

$$E \cdot 2\cancel{\pi} r \cancel{L} = \frac{\rho \cancel{\pi} \cancel{L}(r^2 - R_2^2)}{\varepsilon_0}$$

$$E = \frac{\rho(r^2 - R_2^2)}{2r\varepsilon_0}$$

$$\rho = \frac{Q}{\pi L(R_3^2 - R_2^2)}$$

$$\boxed{E = \frac{\lambda}{2\pi\varepsilon_0 r} + \frac{\rho(r^2 - R_2^2)}{2r\varepsilon_0}}$$

iiii) $r > R_3$ cannot just say net charge as point

$$E_{net} = E_{cond} + E_{insul}$$

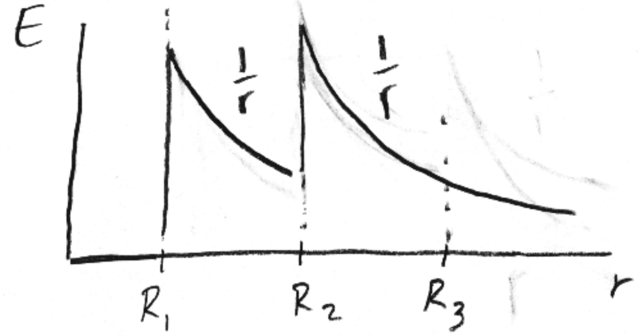
$$\boxed{E = \frac{\lambda}{2\pi\varepsilon_0 r} + \frac{\rho(R_3^2 - R_2^2)}{2\varepsilon_0 r}}$$

$$E = \frac{\lambda_1}{2\pi\varepsilon_0 r} + \frac{\lambda_2}{2\pi\varepsilon_0 r}$$

$$E \cdot 2\pi r \cancel{L} = \frac{\rho\pi\cancel{L}(R_3^2 - R_2^2)}{\varepsilon_0}$$

$$E = \frac{\rho(R_3^2 - R_2^2)}{2\varepsilon_0 r}$$

b)



c)

$$E = \frac{\lambda_1}{2\pi\varepsilon_0 r} + \frac{\rho(r^2 - R_2^2)}{2r\varepsilon_0} = \frac{2.2\times10^{-6}\,C/m}{2\pi\varepsilon_0(2\times10^{-2}\,m)} + \frac{747\times10^{-6}\,C/m^3\,((2\times10^{-2})^2-(1.5}{2(2\times10^{-2}\,m)\varepsilon_0}$$

$$= 1978197 + 369279.6 = 2347476 = \boxed{2.35\times10^6\,N/C}$$