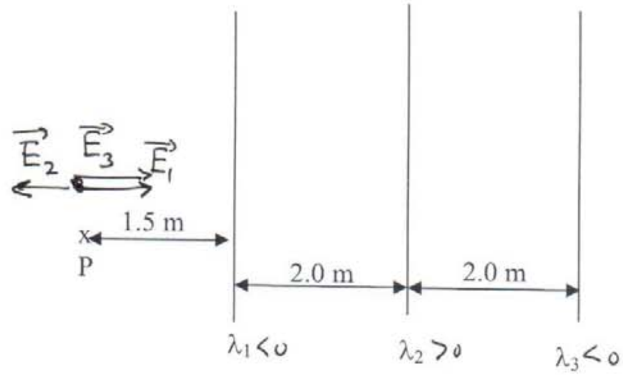
KING FAHD UNIVERSITY OF PERTOLEUM & MINERALS

PHYSICS DEPARTMENT

QUIZ #7- CHAPTER 23

NAME: Key ID# SECTION#

Consider the three long line charges with linear charge densities $\lambda_1 = -2.0\ \mu C/m$, $\lambda_2 = +4.0\ \mu C/m$, and $\lambda_3 = -10\ \mu C/m$. Calculate the magnitude and direction of the net electric field at point P.



$$E_{net} = E_1 - E_2 + E_3$$

$$= \frac{2k|\lambda_1|}{r_1} - \frac{2k|\lambda_2|}{r_2} + \frac{2k|\lambda_3|}{r_3}$$

$$= 2 \times 9 \times 10^9 \left(\frac{2 \times 10^{-6}}{1.5} - \frac{4 \times 10^{-6}}{3.5} + \frac{10 \times 10^{-6}}{5.5} \right)$$

$$\boxed{E_{net} = 4.02 \times 10^3\ \frac{N}{C}}$$ to the right

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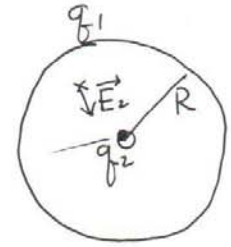
Consider a thin spherical shell of charge $q_1 = +10$ nC and radius R = 10 cm. At the center of the shell is a point charge $q_2 = -20$ nC. Calculate the magnitude and direction of the electric field at

(a) r = 5 cm

only q_2 will contribute to E



$$E_2 = -\frac{k|q_2|}{r^2}$$

$$= -\frac{9\times10^{9}\times 20\times10^{-9}}{(0.05)^2} = \boxed{-7.2\times10^{4}\ \frac{N}{C}}$$ ← inward

$\vec{E}_1 \leftarrow \times \rightarrow \vec{E}_2$

(b) r = 20 cm

both q_1 and q_2 will contribute

$$E_{net} = E_1 - E_2$$

$$= \frac{k|q_1|}{r^2} - \frac{k|q_2|}{r^2} =$$

$$= \frac{9\times10^{9}\times 10\times10^{-9}}{(0.2)^2} - \frac{9\times10^{9}\times 20\times10^{-9}}{(0.2)^2}$$

$$= 2250 - 4500 = \boxed{-2250\ \frac{N}{C}}$$ ← inward

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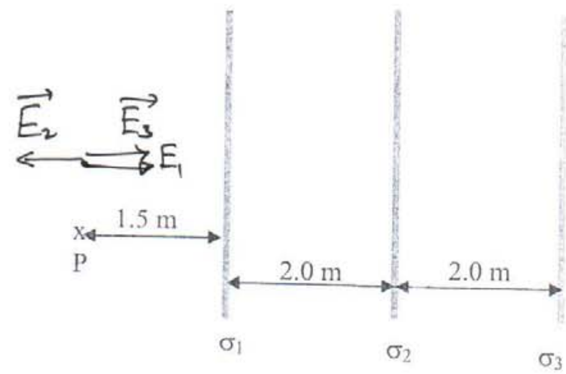
Consider the three non-conduction large sheets with surface charge densities $\sigma_1 = -2.0\ \mu C/m^2$, $\sigma_2 = +4.0\ \mu C/m^2$, and $\sigma_3 = -10\ \mu C/m^2$. Calculate the magnitude and direction of the net electric field at point P.



$$E_{net} = E_1 + E_3 - E_2$$

$$= \frac{|\sigma_1|}{2\varepsilon_0} - \frac{|\sigma_2|}{2\varepsilon_0} + \frac{E_3}{2\varepsilon_0}$$

$$= \frac{1}{2\varepsilon_0}\left(|\sigma_1| - |\sigma_2| + |\sigma_3|\right)$$

$$= \frac{1}{2(8.85\times10^{-12})}\left(2\times10^{-6} - 4\times10^{-6} + 10\times10^{-6}\right)$$

$$= \boxed{4.52\times10^{5}\ \frac{N}{C}}$$

to the right because E_{net} is positive.