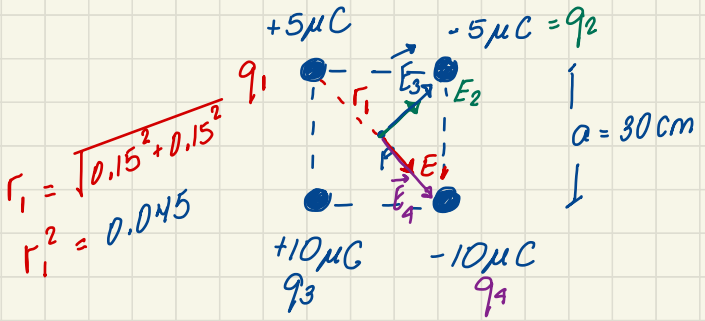
Solución 1er Parcial Física 2 - Temario 14 y Temario 18

problema 1



$r_1 = \sqrt{0.15^2 + 0.15^2}$

$r_1^2 = 0.045$

a) $\vec{E}_p = \vec{E}_1 + \vec{E}_2 + \vec{E}_3 + \vec{E}_4$

$\vec{E}_1 + \vec{E}_2 = 2\vec{E}_{1x}$

$E_{1x} = \dfrac{k|q_1|}{r_1^2}\cos 45\,\hat{i}$

$2E_{1x} = \dfrac{2(9\times10^9)(5\times10^{-6})}{0.045} * \dfrac{\sqrt{2}}{2} =$

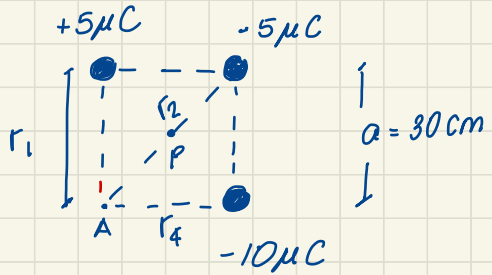
$2E_{1x} = 1,414,213.56$

$\Rightarrow \vec{E}_p = 4.24\times10^6 \dfrac{N}{C}$

$\vec{E}_3 + \vec{E}_4 = 2\vec{E}_{3x}$

como q_3 es $2q_1$

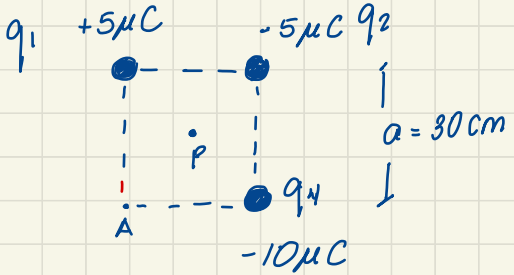
$2E_{3x} = 2,828,427.13\,\hat{i}$



b) $V_A = \dfrac{kq_1}{r_1} + \dfrac{kq_2}{r_2} + \dfrac{kq_4}{r_4} = 9\times10^9\left[\dfrac{5\times10^{-6}}{0.3} - \dfrac{5\times10^{-6}}{0.4243} - \dfrac{10\times10^{-6}}{0.3}\right]$

$V_A = -256\ kV$

Continúa problema 1.

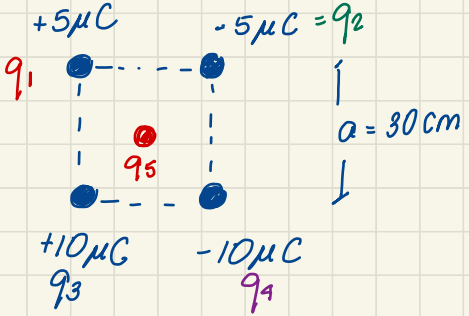


c) $U_{SISTEMA} = \frac{k q_1 q_2}{r_{12}} + \frac{k q_1 q_3}{r_{13}} + \frac{k q_2 q_3}{r_{23}}$

$$= 9\times10^9 \left[\frac{5\times10^{-6}(-5\times10^{-6})}{0.3} + \frac{(5\times10^{-6})(-10\times10^{-6})}{0.4243} + \frac{(-5\times10^{-6})(-10\times10^{-6})}{0.3} \right]$$

$$U_{SISTEMA} = 9\times10^9 \left[-8.333\times10^{-11} - 1.1784\times10^{-10} + 1.6667\times10^{-10} \right]$$

$$= \boxed{-0.311\ J}$$

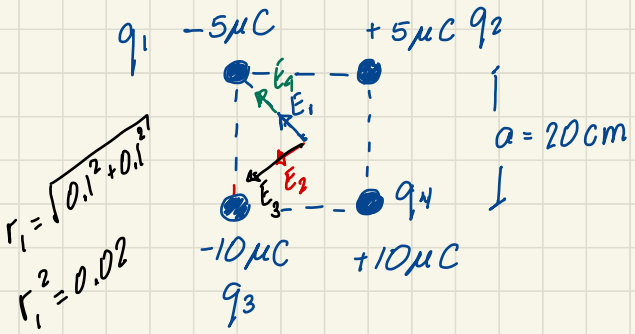


$q_5 = -8\mu C$

$\vec{F}_5 = q_5 \vec{E}_P = -8\times10^{-6}(1.24\times10^6)\ N\uparrow$

$\vec{F}_5 = -33.92\ N\uparrow$ $\quad \boxed{|F_5| = 33.9\ N}$

problema 1



a) $\vec{E_p} = \vec{E_1} + \vec{E_2} + \vec{E_3} + \vec{E_4}$

por simetría $\vec{E_{p_y}} = \emptyset$

$\vec{E_1} + \vec{E_2} = 2\vec{E_{1x}}$

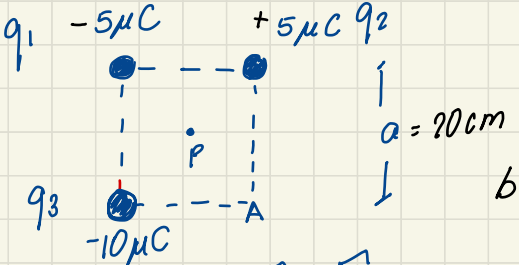
$\vec{E_{4x}} = 2\vec{E_{1x}}$

$\vec{E_4} + \vec{E_3} = 2\vec{E_{4x}} = 4\vec{E_{1x}}$

por lo que $\vec{E_p} = 6\vec{E_{1x}}$

$$E_{1x} = \frac{k|q_1|}{r_1^2}\cos 45\,(-\hat{i}) = \frac{9\times10^9(5\times10^{-6})}{0.02}\cos 45 = -1.59\times10^6\,\frac{N}{C}\,\hat{i}$$

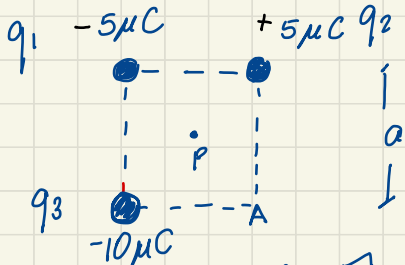
$$\vec{E_p} = 9.55\,\frac{MN}{C}(-\hat{i}) \qquad |E_p| = 9.55\,\frac{MN}{C}$$



b) $V_A = V_{A_1} + V_{A_2} + V_{A_3} = 9\times10^9\left[\frac{-5\times10^{-6}}{\sqrt{2}/5} + \frac{5\times10^{-6}}{0.2} + \frac{-10\times10^{-6}}{0.2}\right]$

$V_A = -384,099\ V$ $\qquad V_A = -384\,kV$

Continúa problema 1.

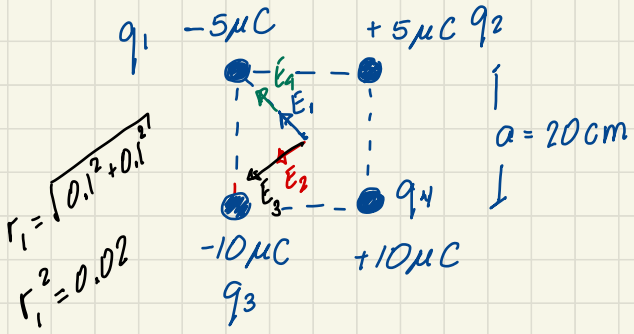


$$r_{23} = \sqrt{0.2^2 + 0.2^2} = \frac{\sqrt{2}}{5}$$

c) $$U = \frac{kq_1q_2}{r_{12}} + \frac{kq_1q_3}{r_{13}} + \frac{kq_2q_3}{r_{23}}$$

$$U = 9\times10^9 \left[\frac{(-5\times10^{-6})(5\times10^{-6})}{0.2} + \frac{(-5\times10^{-6})(-10\times10^{-6})}{0.2} + \frac{(5\times10^{-6})(-10\times10^{-6})}{\sqrt{2}/5} \right]$$

$$U = -0.466\ J$$

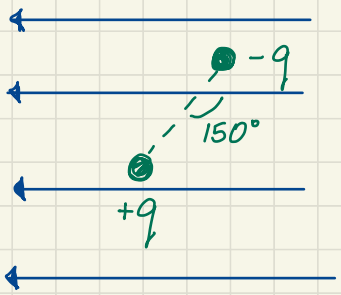


$$\vec{F} = Q\vec{E}_p = -6\times10^{-6}\left(-9.55\times10^6 \frac{N}{C}\right)\hat{i}$$

$$\vec{F} = 57.3\ N\ \hat{i}$$

$$|F| = 57.3\ N$$

problema 2.

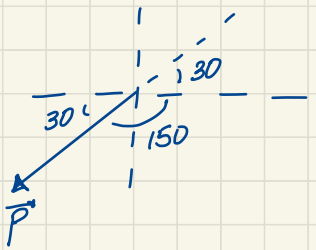


$q = 4.5\,mC$

$d = 0.06$

$E = 5.75 \times 10^5 \frac{N}{C}$

a y b)



$\vec{P} = qd\cos 30\,(-\hat{i}) + qd\,\text{sen}\,30\,(-\hat{j})$

$\vec{P} = 4.5\times10^{-3}(0.06)\cos 30\,(-\hat{i}) + 4.5\times10^{-3}(0.06)\,\text{sen}\,30\,(-\hat{j})$

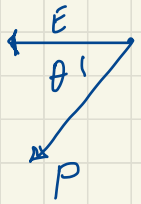
$\vec{P} = -233.8\,\mu C\cdot m\,\hat{i} - 135\,\mu C\cdot m$

$P_x = -233.8\,\mu C\cdot m$ $\qquad P_y = -135\,\mu C\cdot m$

c) $|\vec{\tau}| = pE\,\text{sen}\,\theta$

$|M| = 2.7\times10^{-4} * 5.75\times10^5\,\text{sen}\,30$

$|M| = 77.6\,N\cdot m$

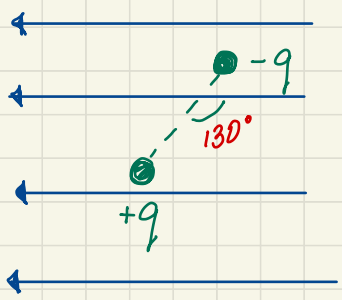


d) $U = -pE\cos\theta$

$U = -2.7\times10^{-4}(5.75\times10^5)\cos 30$

$U = -134.45\,J$

problema 2

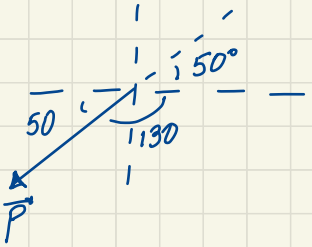


$q = 6 \times 10^{-3} C$

$d = 0.09 m$

$E = 8.5 \times 10^5 \frac{N}{C}$

a y b)



$\vec{P} = qd\,[\cos 50(-\hat{i}) + \text{sen}(50)(-\hat{j})$

$\vec{P} = 6 \times 10^{-3}(0.09)\,[\cos 50(-\hat{i}) + \text{sen } 50(-\hat{j})$

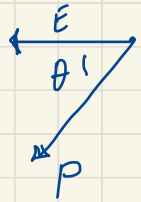
$\vec{P} = -347.1\ \mu C \cdot m\ \hat{i} - 413.66\ \mu C \cdot m\ \hat{j}$

$P_x = -347\ \mu C \cdot m$ $\qquad$ $P_y = -414\ \mu C \cdot m$

b) $|\vec{\tau}| = pE \text{ sen } \theta$

$= 5.4 \times 10^{-4}(8.5 \times 10^5) \text{ sen } 50$

$= 351.6\ N \cdot m$

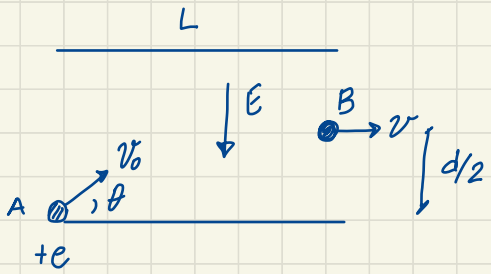


c) $U = -pE\cos\theta$

$= -(5.4 \times 10^{-4})(8.5 \times 10^5)\cos 50$

$= -295.04\ J$

problema 3



$v_0 = 6 \times 10^6 \, m/s$ $\quad \theta = 40°$

$L = 7cm$ $\quad d = 3cm$

en "x" $\quad v_x = v_0 \cos 40$

$v_x = cte.$

$v_x = \frac{\Delta x}{t}$ $\quad t = \frac{L}{v_0 \cos\theta} = \frac{0.07}{6 \times 10^6 \cos 40}$

$t = \frac{0.07}{6 \times 10^6 \cos 40} = 1.523 \times 10^{-8} s$

Forma 1

en "y" de A a B

$v_0 = v_0 \operatorname{sen} \theta$

$v_f = \emptyset$

$t = 1.523 \times 10^{-8} \, s$

$v_{fy} = v_{oy} + a_y t$

$-\frac{v_{oy}}{t} = a_y = -\frac{6 \times 10^6 \operatorname{sen} 40}{1.523 \times 10^{-3}} = -2.53 \times 10^{14} \frac{m}{s^2} \hat{j}$

$\vec{F} = \frac{m\vec{a}}{q} = \frac{1.67 \times 10^{-27} * (-2.53 \times 10^{14})}{1.6 \times 10^{-19}}$

$\vec{E} = -2.64 \frac{N}{C} \hat{j}$ $\quad |E| = 2.64 \frac{N}{C}$

Forma 2

problema 3 (solución 2)

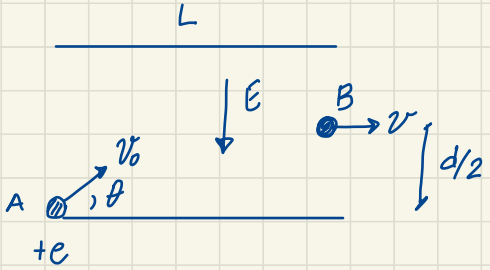
usando $\frac{d}{2} = 0.015\,m$

$$y_f = \cancel{y_0} + v_{0y} t + \frac{1}{2} a_y t^2$$

$$0.015 = + 4\times10^{6} \operatorname{sen} 40 (1.523\times10^{-8}) + \frac{1}{2} a (1.523\times10^{-8})^2$$

$$\vec{a} = -3.80\ m/s^2\ \hat{j}$$

$$\vec{E} = \frac{m\vec{a}}{q} = -3.97\times10^{6}\ \frac{N}{C}\ \hat{j}$$



$v_0 = 7 \times 10^6 \, m/s$ $\quad \theta = 50°$

$L = 9cm$ $\quad d = 3cm$

en "x" $\quad v_x = v_0 \cos 50$

$v_x = cte.$

$v_x = \frac{\Delta x}{t}$ $\quad t = \frac{L}{v_0 \cos\theta} = \frac{0.09}{7 \times 10^6 \cos 50°}$

$t = 2 \times 10^{-8} s$

Forma 1

en "y" de A a B

$v_0 = v_0 \operatorname{sen} \theta$

$v_f = \emptyset$

$t = 2 \times 10^{-8} s$

$v_{fy} = v_{oy} + a_y t$

$-\frac{v_{oy}}{t} = a_y = \frac{-7 \times 10^6 \operatorname{sen} 50}{2 \times 10^{-8}} = -2.68 \times 10^{14} \frac{m}{s^2} \hat{j}$

$\vec{E} = \frac{m\vec{a}}{q} = \frac{1.67 \times 10^{-27} * 2.6812 \times 10^{14}}{1.6 \times 10^{-19}} (-\hat{j})$

$\vec{E} = 2.798 \times 10^6 \frac{N}{C} (-\hat{j})$

$|E| = 2.80 \times 10^6 \frac{N}{C}$

Forma 2

problema 3 (solución 2)

usando $\frac{d}{2} = 0.015\,m$

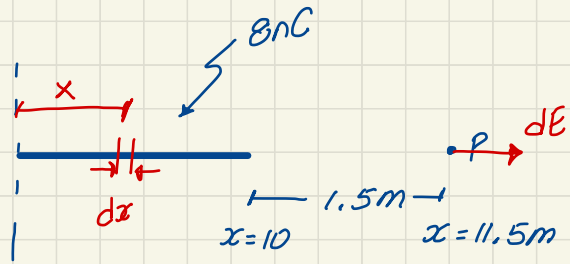
$$y_f = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$$

$$0.015 = +7 \times 10^{6} \operatorname{sen} 50\,(2 \times 10^{-8}) + \frac{1}{2} a\,(2 \times 10^{-8})^2$$

$$\vec{a} = -4.61 \times 10^{-14}\,\hat{j}$$

$$\vec{E} = \frac{m\vec{a}}{q} = -4.814 \times 10^{6}\,\frac{N}{C}\,\hat{j} \qquad |E| = 4.81\,\frac{MN}{C}$$

problema 4.



$$\lambda = \frac{8nC}{10m} = 0.8\,\frac{nC}{m}$$

$$dE = \frac{k\,dq}{r^2} \qquad dq = \lambda\,dx \qquad r = 11.5 - x$$

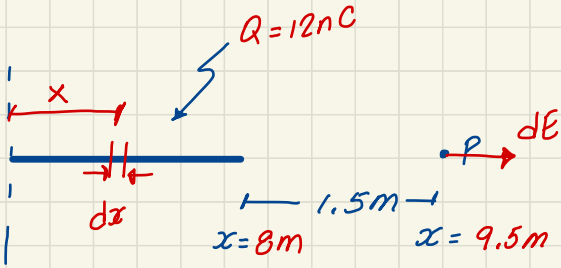
$$dE = \frac{k\lambda\,dx}{(11.5-x)^2}\,\hat{i} \qquad \vec{E} = k\lambda \int_0^{10} \frac{dx}{(11.5-x)^2}$$

$$u = 11.5 - x \qquad du = -dx \qquad \int -\frac{du}{u^2} = \frac{1}{u}$$

$$\vec{E} = 9\times10^9 (0.8\times10^{-9}) \left[\frac{1}{11.5-x} \Big|_0^{10} \right] = 4.17\,\frac{N}{C}\,\hat{i}$$

b) $\vec{F} = q\vec{E}$ $\qquad q = \frac{|\vec{F}|}{|E|} = \frac{0.8}{4.17} = 0.192\,C$ $\qquad 192\,mC$

problema 4.



$$\lambda = \frac{12nC}{8m} = 1.5\frac{nC}{m}$$

$$dE = \frac{k\,dq}{r^2} \qquad dq = \lambda dx \qquad r = 9.5 - x$$

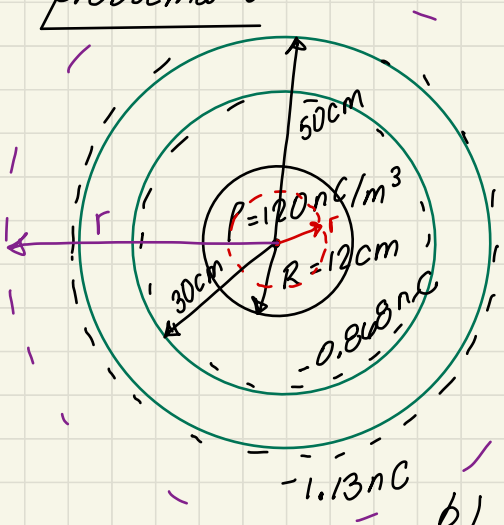
$$dE = \frac{k\lambda dx}{(9.5-x)^2}\,\hat{i} \qquad \vec{E} = k\lambda \int_0^8 \frac{dx}{(9.5-x)^2}$$

$$u = 11.5 - x \qquad du = -dx \qquad \int -\frac{du}{u^2} = \frac{1}{u}$$

$$\vec{E} = 9\times10^9 (1.5\times10^{-9}) \left[\frac{1}{9.5-x} \right]_0^8 = 7.58\frac{N}{C}\,\hat{i}$$

b) $\vec{F} = q\vec{E}$ $\qquad q = \frac{|\vec{F}|}{|E|} = \frac{1.5}{7.58} = 0.198\ C$ $\qquad 198\ mC$

problema 5



$Q_{CORTEZA} = -2nC$

$q_{aislante} = \rho \frac{4}{3}\pi (0.12)^3 = 0.8686nC$

a) $\oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$ $\quad r = 10cm$

$E(4\pi r^2) = \frac{\rho \frac{4}{3}\pi r^3}{\varepsilon_0} \rightarrow \vec{E} = \frac{\rho r}{3\varepsilon_0} = 451.97 \frac{N}{C}\hat{r}$

$|E| = 452 \frac{N}{C}$

b) $\oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$ $\quad r = 20cm$

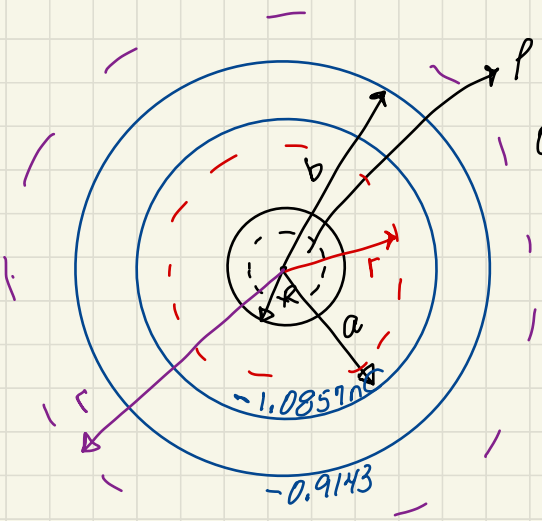
$E(4\pi r^2) = \frac{\rho \frac{4}{3}\pi R^3}{\varepsilon_0} \rightarrow \vec{E} = \frac{\rho R^3}{3\varepsilon_0 r^2} = 195.2 \frac{N}{C}\hat{r}$

$|E| = 195.2 \frac{N}{C}$

c) $r = 80\,cm$ $\quad \oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

$E(4\pi r^2) = (-2nC + 0.8686nC)/\varepsilon_0 \Rightarrow |E| = 15.9 \frac{N}{C}$

problema 5



$\rho = 150 \frac{nC}{m^3}$

$Q = \rho * \frac{4}{3}\pi R^3 =$

$Q = 1.0857\,nC$

$R = 0.12m$

conductor

$a = 0.3m$

$b = 0.5m$

$q_{COND} = -2nC$ { sup. int. $-1.0857nC$; sup. ext $-0.9143nC$

a) $E\,(r = 0.08m)$

$\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

$E\,(4\pi r^2) = \frac{\rho \frac{4}{3}\pi r^3}{\varepsilon_0}$

$\vec{E}\,(r = 0.08m) = \frac{\rho r}{3\varepsilon_0}\hat{r}$

$|E| = \frac{150 \times 10^{-9} * 0.08}{3\varepsilon_0} = \underline{452\ \frac{N}{C}}$

b) $E\,(r = 25cm) \Rightarrow \oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

$E\,(4\pi r^2) = \frac{\rho \frac{4}{3}\pi R^3}{\varepsilon_0}$

$\vec{E} = \frac{\rho R^3}{3\varepsilon_0 r^2}\hat{r}$

$|E| = \frac{150 \times 10^{-9}\,(0.12)^3}{3\varepsilon_0\,(0.25)^2} = \underline{156.2\ \frac{N}{C}}$

c) $E\,(r = 0.7m)$

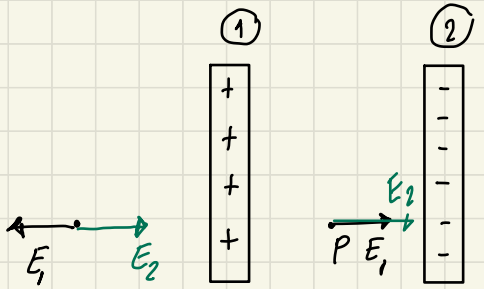
$\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0} \Rightarrow$

$E\,(4\pi r^2) = \frac{Q + q_{COND}}{\varepsilon_0}$

$\vec{E} = \frac{k\,(Q + q_{cond})}{r^2}\hat{r} \Rightarrow$

$|E| = \frac{9 \times 10^9\,(0.9143 \times 10^{-9})}{0.7^2} = \underline{16.8\ \frac{N}{C}}$

problema 6



$\sigma_1 = 3\,\frac{\mu C}{m^2}$ $\quad \sigma_2 = -5\,\frac{\mu C}{m^2}$

a) $\vec{E}_p = \frac{|\sigma_1|}{2\varepsilon_0}\hat{\imath} + \frac{|\sigma_2|}{2\varepsilon_0}\hat{\imath}$

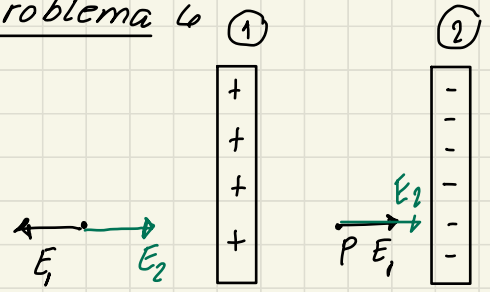
$= \frac{+3\times10^{-6}}{2(8.85\times10^{-12})}\hat{\imath} + \frac{5\times10^{-6}}{2(8.85\times10^{-12})}\hat{\imath} = 452\,\frac{kN}{C}\hat{\imath}$

$|\vec{E}_p| = 452\,\frac{kN}{C}$

b) $\vec{E}_{p_0} = \frac{3\times10^{-6}(-\hat{\imath})}{2(8.85\times10^{-12})} + \frac{5\times10^{-6}}{2(8.85\times10^{-12})}\hat{\imath} = +112{,}994\,\frac{N}{C}\hat{\imath}$

$|E_{p_0}| = 113\,\frac{kN}{C}$

problema 6



$\sigma_1 = 6 \frac{\mu C}{m^2}$ $\sigma_2 = -10 \frac{\mu C}{m^2}$

a) $\vec{E}_p = \frac{|\sigma_1|}{2\varepsilon_0}\hat{i} + \frac{|\sigma_2|}{2\varepsilon_0}\hat{i}$

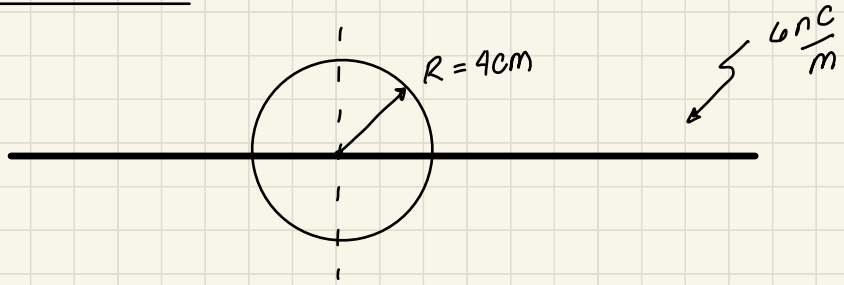
$= \frac{6\times10^{-6}}{2(8.85\times10^{-12})}\hat{i} + \frac{10\times10^{-6}}{2(8.85\times10^{-12})}\hat{i} = 903.9 \frac{kN}{C}\hat{i}$

$|\vec{E}_p| = 904 \frac{kN}{C}$

b) $\vec{E}_{p_0} = \frac{6\times10^{-6}(-\hat{i})}{2(8.85\times10^{-12})} + \frac{10\times10^{-6}}{2(8.85\times10^{-12})}\hat{i} = 225.99 \frac{N}{C}\hat{i}$

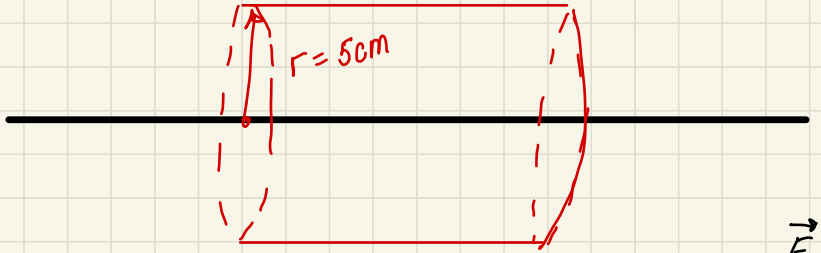
$|E_{p_0}| = 226 \frac{kN}{C}$

problema 7



a) $\Phi_E = \frac{q_{enc}}{\varepsilon_0} = \frac{\lambda(2R)}{\varepsilon_0} = \frac{6\times10^{-9} * (0.08)}{\varepsilon_0} = 54.2 \frac{N}{C}\cdot m^2$

b)



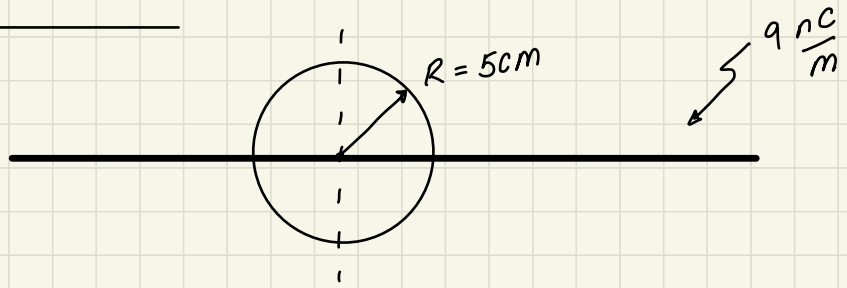
$\oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

$E(2\pi r \cancel{h}) = \frac{\lambda \cancel{h}}{\varepsilon_0}$

$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{6\times10^{-9}}{2\pi\varepsilon_0(0.05)} = 2158 \frac{N}{C}\hat{r}$

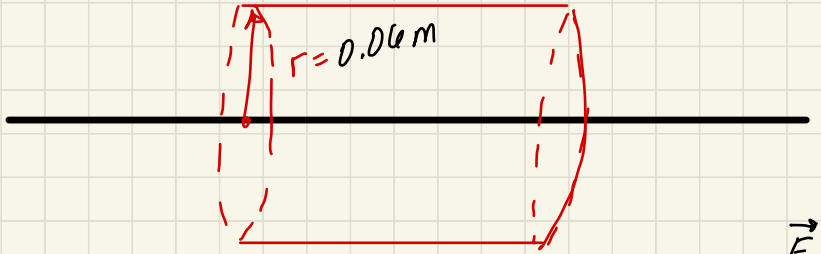
$|E| = 2.16\ k\frac{N}{C}$

problema 7



a) $\Phi_E = \frac{q_{enc}}{\varepsilon_0} = \frac{\lambda(2R)}{\varepsilon_0} = \frac{9\times10^{-9} * 0.1}{\varepsilon_0} = 101.7 \frac{N}{C}\cdot m^2$

b)



$\oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\varepsilon_0}$

$E(2\pi r k) = \frac{\lambda k}{\varepsilon_0}$

$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{9\times10^{-9}}{2\pi\varepsilon_0(0.06)} = 2.70 \frac{kN}{C}\hat{r}$

$|E| = 2.70 \frac{kN}{C}$