CAMPO ELECTRICO
Distribución continua de cargas

HOJA N°

FECHA

Campo $\vec{E}$ debido a una distribución CONTINUA de cargas

$q_1 q_2 q_3 \ldots q_{5.76}$ $q_{1000000}$ $+ + + + +$

densidad de carga lineal: λ $[\lambda] = \left[\frac{C}{m}\right]$

densidad de carga superficial: σ $[\sigma] = \left[\frac{C}{m^2}\right]$

densidad de carga simetrica: ρ $\left[\frac{C}{m^3}\right]$

$\lambda = \frac{Q}{L}$ ~ carga, → longitud

$\sigma = \frac{Q}{S}$ ~ carga, ~ superficie

$\rho = \frac{Q}{V}$ ~ carga, ~ volumen

ElectroEstatica

$$\boxed{d\vec{E} = \frac{k\, dq}{|\vec{r} - \vec{r}\,'|^3}(\vec{r} - \vec{r}\,')}$$

~ diferencial de carga

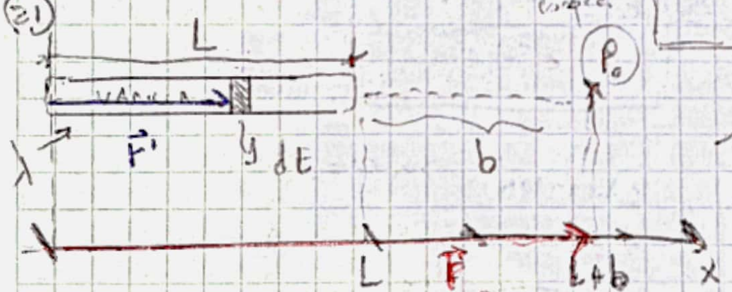
$$k = \frac{1}{4\pi\varepsilon_0} \approx 9.10^9 \left[\frac{Nm^2}{C^2}\right]$$

punto a ocupar.

$$\boxed{E = \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{b} - \frac{1}{L+b}\right)}$$

hay que llegar a eso

21)



$$\boxed{\vec{dl} = dx\,\hat{i} + dy\,\hat{j} + dz\,\hat{k}}$$

$$|\vec{dl}| = dx$$

$\lambda = \frac{dq}{dl}$

$\vec{r}$: vector que va desde el origen al punto que quiero evaluar

$dq = \lambda . dx$

$\vec{r}\,'$: " " " " " " al punto diferencial de carga de la varilla

$\vec{r} = (x, 0)$ → L+b

$\vec{r}\,' = (x', 0)$

$$|\vec{r} - \vec{r}\,'| = \sqrt{(x-x')^2 + 0} = |x - x'|$$

$$\Rightarrow d\vec{E} = \frac{k\lambda\, dx' \,(x-x', 0)}{|x-x'|^3}$$

$$\Rightarrow \vec{E}(x) = \int_0^L \frac{k\lambda\cancel{(x-x')}\, dx}{(x-x')^{\cancel{3}\,2}}$$

$u = x - x'$ $du = -dx'$

$$\int \frac{du}{u^2} = \frac{1}{u} + C$$

$$\Rightarrow \vec{E}(x) = -k\lambda \left.\frac{1}{(x-x')}\right|_0^L$$

$$\Rightarrow \vec{E}(x) = +k\lambda\left[\frac{1}{x-L} - \frac{1}{x}\right]\hat{i}$$

$$\Rightarrow \boxed{\vec{E}(x = L+b) = +k\lambda\left[\frac{1}{b} - \frac{1}{L+b}\right]}$$

NOTA

HOJA N°

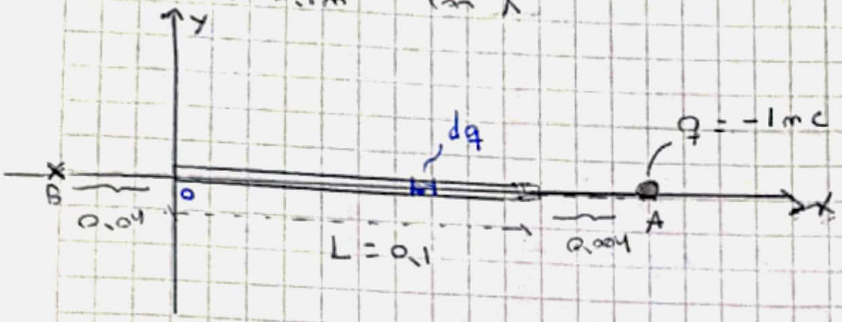
FECHA

② ~~Barra~~ ~~de~~ ~~L=5m~~ ~~se~~ sitúa ,

$\lambda = ?$

$\int \frac{1}{u} \Rightarrow \int u^{-2}\,du \Rightarrow -\frac{1}{u}$

BARRA $L = 0.1m$ con λ



$\frac{dq}{dl} = \lambda \Rightarrow \boxed{dq = \lambda . dx}$

Para que en B $\nexists \vec{E} \Rightarrow \vec{E}_{varilla} + \vec{E}_q = 0$

$\underline{\vec{E}_{varilla}}$

$d\vec{E} = \frac{k\,dq\,(\vec{r}-\vec{r}\,')}{|\vec{r}-\vec{r}\,'|^3}$
$\begin{cases} \vec{r} : (-B, 0) \\ \vec{r}\,' : (x', 0) \\ \vec{r}-\vec{r}\,' : (-B-x', 0) \\ |\vec{r}-\vec{r}\,'| = \sqrt{(-B-x')^2} \\ |\vec{r}-\vec{r}\,'|^3 = (-B-x')^3 \end{cases}$
$\Rightarrow d\vec{E} = \frac{k\lambda\,dx\,\cancel{(-B-x')}}{(-B-x')^{\cancel{3}\,2}} \Rightarrow d\vec{E} = \frac{k\lambda\,dx}{(-B-x')^2}$

$\Rightarrow \vec{E}_{varilla} = k\lambda \int_0^L \frac{dx}{(-B-x')^2}$; $u = -B-x'$ $\quad du = -1\,dx \Rightarrow -k\lambda \int_0^L \frac{-dx}{\underbrace{(-B-x')^2}_{u}}$

$\Rightarrow \vec{E}_{varilla} = -k\lambda \int_0^L \frac{du}{u^2} \Rightarrow -k\lambda \left[-\frac{1}{u} \Big|_0^L \right]$

$\Rightarrow k\lambda \left[\frac{1}{-B-x'} \Big|_0^L \right] \Rightarrow k\lambda \left(\frac{1}{-B-L} + \frac{1}{B} \right) \Rightarrow \vec{E}_{varilla} = k\lambda \underbrace{\left[\frac{1}{-0.14} + \frac{1}{0.04} \right]}_{17.85}$

$\boxed{\vec{E}_{varilla} = \frac{\lambda}{4\pi\varepsilon_0} \cdot 17.85}$

$\underline{\vec{E}_q}^{\,(carga)} = \frac{k \cdot q \cdot r}{|\vec{r}|^2} \Rightarrow \vec{E}_q = \frac{k \cdot q}{(0.18)^2} \Rightarrow \left| \vec{E}_q = \frac{-k \cdot 1mC}{0.0324} \right) (-\hat{x})$

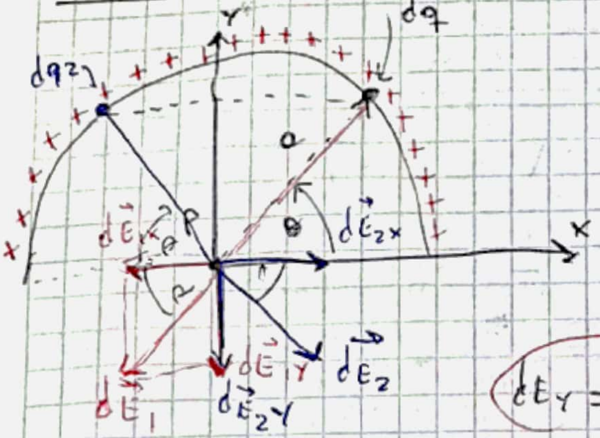
$r: 2d + L \Rightarrow 0.18$

$\Rightarrow \frac{\lambda}{\cancel{4\pi\varepsilon_0}} \cdot 17.85 = \frac{1}{\cancel{4\pi\varepsilon_0}\; 0.0324} \Rightarrow \lambda = \frac{1}{0.0324 \cdot 17.85} \Rightarrow \boxed{\lambda = 1.7290\ \mu C}$

NOTA

IMPORTANTE

ELECTROESTÁTICA: Ej (22) semi-circunferencia cargada



$$\boxed{\vec{dE} = \frac{k.dq}{|\vec r - \vec r\,'|^3}.(\vec r - \vec r\,')}$$

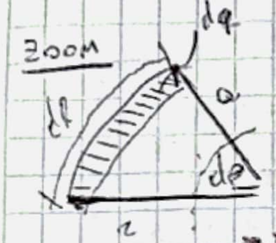
$$\lambda = \frac{dq}{dl} = \frac{q}{\pi a} \rightarrow dq = \lambda . dl$$

$$dE_Y = dE.\mathrm{sen}(\theta) \quad (\#)$$

la distancia a todos los diferenciales de carga hasta el centro es la misma

$$dE = \frac{k.dq}{a^2}.\mathrm{sen}(\theta)$$

ZOOM



longitud de arco

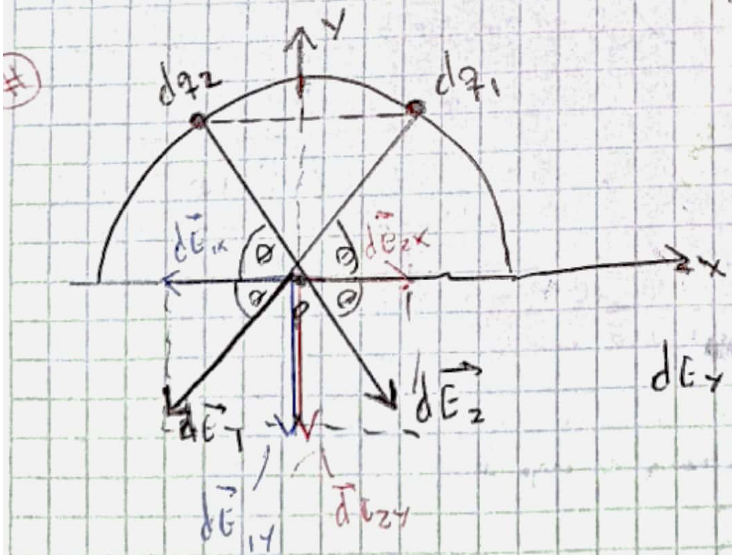
$$\Rightarrow \boxed{dq = \lambda . a . d\theta}$$

$$\Rightarrow \frac{k.\lambda.a.d\theta.\mathrm{sen}(\theta)}{a^2}$$

$$\Rightarrow E_Y = 2\int_0^{\pi/2} \frac{k.\lambda\,\mathrm{sen}(\theta)\,d\theta}{a} = \frac{2k\lambda}{a}\left(-\cos(\theta)\right)\Big]_0^{\pi/2} \Rightarrow \boxed{\frac{2k\lambda}{a}}$$

$$\Rightarrow \vec E = 2.\frac{1}{4\pi\varepsilon_0}.\frac{q}{\pi.a}.\frac{1}{a}\hat r_0 \Rightarrow \boxed{\vec E = \frac{q}{2\varepsilon_0\pi^2a^2}(-\hat j)}$$

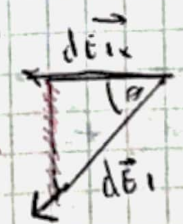
(#)



soh cah toa $\begin{cases} \mathrm{sen}\,\theta = \frac{O}{h} \\ \cos\theta = \frac{A}{h} \\ \mathrm{tg}\,\theta = \frac{O}{A} \end{cases}$

los $d\vec E_2$ y $d\vec E_1$

$$dE_Y = dE.\mathrm{sen}(\theta)$$



Fijate buscas eso ya que tienes en (Y) $\Rightarrow \mathrm{sen}\,\theta = \frac{O}{h} \Rightarrow \mathrm{sen}\,\theta = \frac{dE_Y}{dE_1}$

$$\Rightarrow d\vec E_Y = \mathrm{sen}\,\theta . d\vec E_1$$

NOTA:

Cuestionario

Electro estática

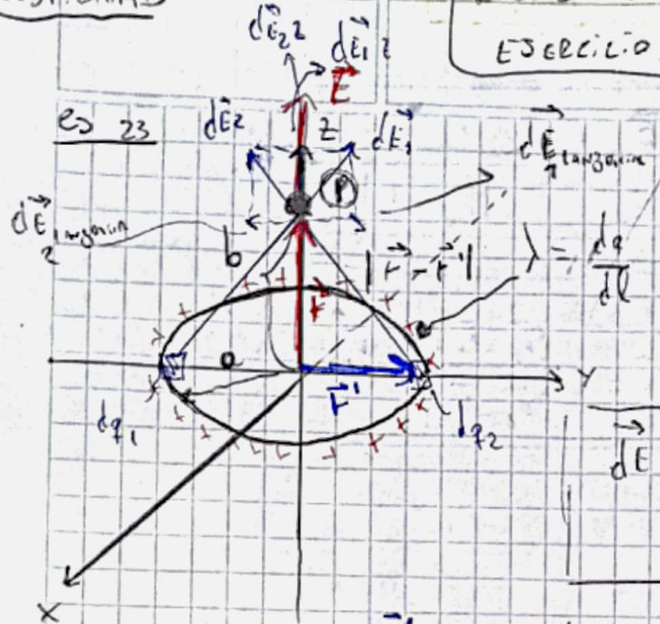
Ejercicios

Importante

HOJA N°

FECHA

Es 23



$\lambda = \frac{dq}{dl}$

Obs: las únicas componentes que me interesan son en Z

$d\vec{E}_{z_2}$ y $d\vec{E}_{1z}$

$\lambda = \frac{dq}{dl}$

$$\boxed{d\vec{E} = \frac{k \cdot dq\,(\vec{r}-\vec{r}')}{|\vec{r}-\vec{r}'|^3}}$$

$\Rightarrow dq = \lambda . dl$

$\vec{r}'$: vector del origen a la ~~carga~~ carga

$\vec{r}$: vector del origen al punto P

$|\vec{r}-\vec{r}'|$: vector de la carga hasta el punto $(\vec{r}_P)$ (resta de anillo)

Res:

$\vec{r} = (0,0,z)$

$\vec{r}' = (x', y', 0)$ (es una espira sin componente en z)

$\vec{r}-\vec{r}' = (-x', -y', z)$

$|\vec{r}-\vec{r}'| = \sqrt{(-x')^2 + (-y')^2 + z^2}$

$|\vec{r}-\vec{r}'|^3 = (x'^2 + y'^2 + z^2)^{3/2}$

zoom

long de arco

$$\boxed{dq = \lambda . dl = \lambda . a . d\theta'}$$

Pasar a polares para integrar

$$\begin{cases} x' = a . \cos(\theta') \\ y' = a . \operatorname{sen}(\theta') \\ z = z \end{cases}$$

$$\Rightarrow d\vec{E} = \frac{k . \lambda . a . d\theta' . (-x', -y', z)}{(x'^2 + y'^2 + z^2)^{3/2}}$$

$$\Rightarrow d\vec{E} = \frac{k . \lambda a . d\theta' (-a . \cos(\theta'), -a \operatorname{sen}(\theta'), z)}{[a^2 \underbrace{(\cos^2\theta' + \operatorname{sen}^2(\theta'))}_{1\ (\text{identidad trigonométrica})} + z^2]^{3/2}}$$

$$\Rightarrow \vec{E} = \frac{k . \lambda a}{(a^2+z^2)^{3/2}} \left[\underbrace{\int_0^{2\pi} -a \cos(\theta') d\theta'}_{0} , \underbrace{\int_0^{2\pi} -a \operatorname{sen}(\theta') d\theta'}_{0} , \int_0^{2\pi} z\, d\theta' \right]$$

$$\vec{E} = \frac{k \lambda a z}{(a^2+z^2)^{3/2}} \cdot \theta' \Big]_0^{2\pi} \Rightarrow \boxed{\vec{E}(z) = \frac{1}{4\pi\varepsilon_0} \cdot \frac{\lambda a . 2\pi z}{(a^2+z^2)^{3/2}} \check{k}}$$

si $z = b$: $\boxed{\vec{E}(z=b) = \frac{\lambda . a . b}{2\varepsilon_0 (a^2+b^2)^{3/2}} \check{k}}$

NOTA

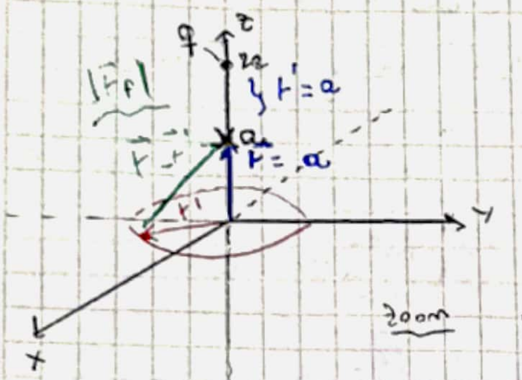
##

② Anillo de $r = a = 2\sqrt{2}$ m, en el origen, cargado con $Q = 16$ mC

en $z = 2a$ hay una $q = 2$ mC

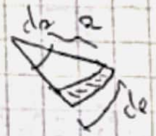
a) Potencial V en el eje z en (0, 0, a)

b) Dibujar el campo E en P = (0, 0, −2a)



$$\boxed{V_{P\,\text{Distr.}} = k \int_\Omega \frac{dq}{|r - r'|}}$$

zoom



$\Rightarrow dq = \lambda\, dl \Rightarrow \boxed{dq = \lambda a \cdot d\theta}$

OJO a revisar

$\Rightarrow V_{P=a} = V_{\text{Anillo}} + V_q$

$\Rightarrow V_{\text{Anillo}} = V_{\text{Anillo}} = k \int_\Omega \frac{dq}{|r - r'|} \rightarrow |\vec{r_P}| = \sqrt{a^2 + a^2} \Rightarrow \sqrt{2a^2} \Rightarrow \sqrt{2} \cdot a$

$\boxed{|\vec{r_P}| = \sqrt{2}\, a}$

$\Rightarrow \left[V_{\text{Anillo}} = k \int_0^{2\pi} \frac{\lambda a \cdot d\theta}{\sqrt{2}\, a} \right. \Rightarrow V_{\text{Anillo}} = \frac{k \lambda 2\pi}{\sqrt{2}} = \boxed{36000\,V}$

$V_q = \frac{k \cdot q}{r_{qa}} \Rightarrow \left[V_q = \frac{k \cdot q}{a} \right] = \boxed{6363.96\,V}$

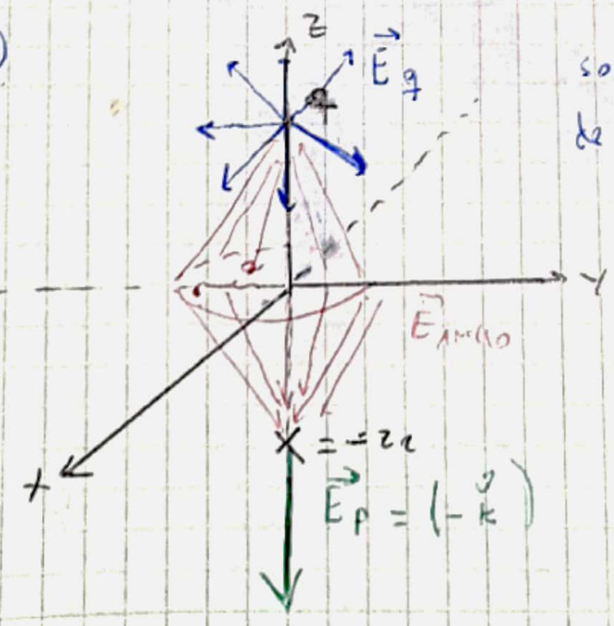
OJO $\lambda = \frac{Q}{2\pi a}$

$V_{PA} = V_{\text{Anillo}} + V_q \Rightarrow \frac{k \lambda 2\pi}{\sqrt{2}} + \frac{k\, q}{a} \Rightarrow k \left[\lambda\pi + \frac{q}{a} \right]$

$\Rightarrow V_{PA} = \frac{1}{4\pi\varepsilon_0} \left[16\text{mC} \cdot \pi + \frac{2\text{mC}}{2\sqrt{2}} \right] \Rightarrow V_{PA} = 9 \times 10^9 \left[50.9725 \right]$

$\Rightarrow \boxed{V_{PA} = 39663.96\,V''}$

b)

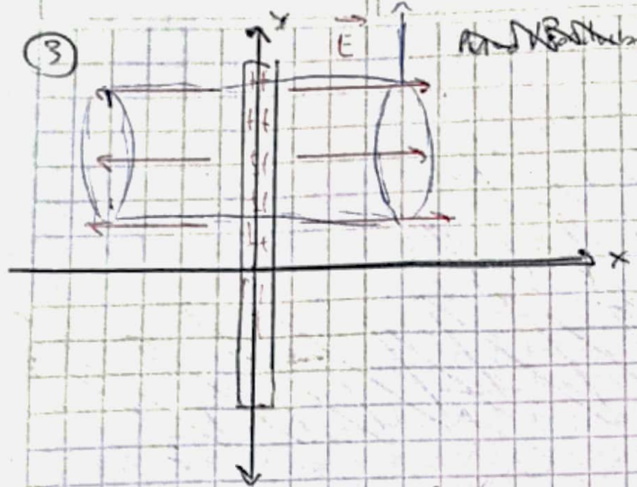


Solamente sabiendo el signo de las cargas de cada elemento, podemos dibujar las líneas de campo y así saber cómo trazar estas líneas al punto P = (0, 0, −2a)

HOJA N°

FECHA

(3)



~~Plano~~ Plano NO conductor cargado con σ

$$\sigma = 0.000000246 \left[\frac{C}{m^2}\right]$$

$$V(x) - V(0) = -1473.5\,V$$

$$\int_{S_1} \vec{E}_1 \cdot \vec{ds}_1 + \int_{S_2} \vec{E}_2 \cdot \vec{ds}_2 + \cancel{\int_{cil} \vec{E} \cdot \vec{ds}_{cil}} = \frac{Q_{encerrada}}{\varepsilon_0} \Rightarrow \vec{E} = \frac{Q_{encerrada}}{2 S \varepsilon_0} \Rightarrow \boxed{\vec{E} = \frac{\sigma}{2\varepsilon_0}\,\hat{i}}$$

$$\underbrace{\vec{E}_1 \cdot S} + \underbrace{\vec{E}_2 \cdot S} \qquad \underbrace{\cos(\vec{E}_{cil} \wedge \vec{ds})}_{0}$$

$$\sigma$$

si: $V(x) - V(0) = -1473.5\,V$

$$V(x) - V_0 = -\int_0^x \vec{E} \cdot d\vec{l} \Rightarrow -\int_0^x \frac{\sigma}{2\varepsilon_0}(\hat{i})\,dx \Rightarrow -\frac{\sigma}{2\varepsilon_0} x \Big|_0^x \Rightarrow$$

$$V(x) - V_0 = -\frac{\sigma x}{2\varepsilon_0} \Rightarrow \boxed{V(x) = V_0 - \frac{\sigma x}{2\varepsilon_0}} \Rightarrow V(x_0 = 0) = 0 = V_0 - \frac{\sigma x_0}{2\varepsilon_0}$$

$$V_0(x=0) = 1473.5\,[V]$$

$$0 = V_0 - \frac{\sigma x_0}{2\varepsilon_0} \Rightarrow \boxed{x_0 = \frac{2\varepsilon_0 V_0}{\sigma}}$$

$$x_0 = \frac{2(8.85 \times 10^{-12})(3259.3)}{0.000000357} \Rightarrow \boxed{0.1615}$$

$$x_0 = \frac{2(8.85 \times 10^{-12})(3246.5)}{0.000000390}$$

Bien

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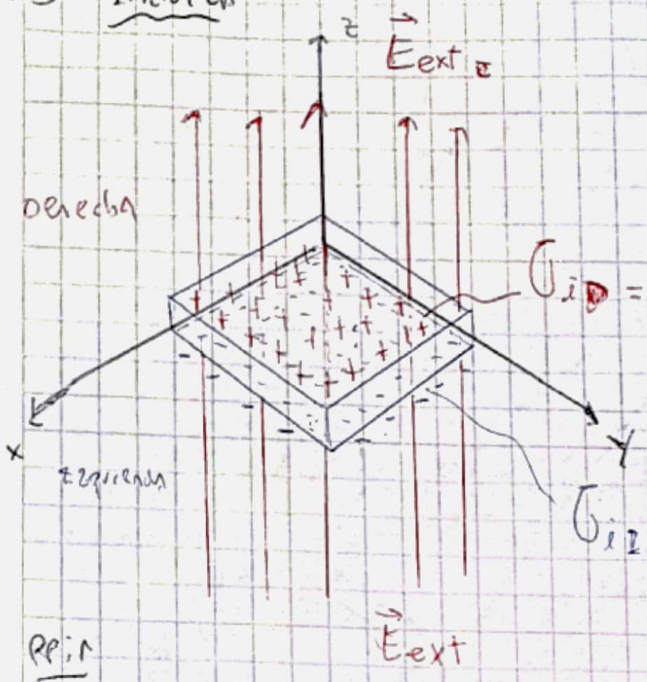
(7) Inducción



$q = 0.000176\ [C]$

$\vec{E}_{ext} = 590415\ (\hat{k})\left[\frac{N}{C}\right]$

Obs: hacen 8avis

Placa

$$\sigma_{placa_D} = \frac{\frac{q_{placa}}{2}}{S} \Rightarrow \boxed{\sigma_{cara\ superior\ total} = \sigma_{iD} + \sigma_{placa_D}}$$

?

S = Area del cuadro = base x altura (lado x lado)

$$\sigma_{placa_D} = \frac{\frac{q_{placa}}{2}}{b \cdot h}, \quad \sigma_{iD} = \vec{E}_{ext}\,\varepsilon_0$$

$$\sigma_{total\ superior} = \frac{\frac{q_{placa}}{2}}{b \cdot h} + \vec{E}_{ext} \cdot \varepsilon_0$$

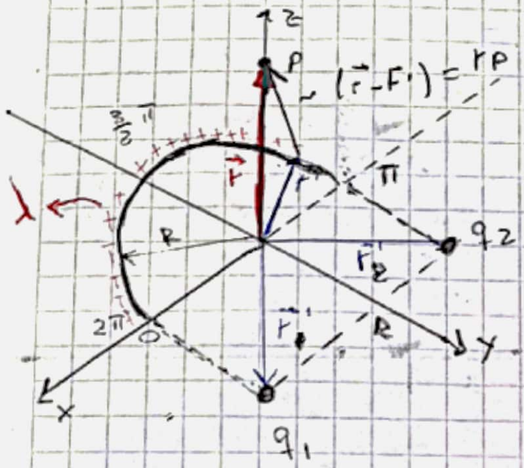
$$= \frac{\frac{0.000116}{2}[C]}{13 \cdot 13\ [m]} + 595203\left[\frac{N}{C}\right] \cdot 8.85 \times 10^{-2}\left[\frac{F}{m}\right]$$

$$\boxed{Rta = 5.6107 \times 10^{-6}}$$

HOJA N°

FECHA

(18) $q = 1\,\mu C$; $\lambda = 2\,\mu C/m$



$$\boxed{d\vec E = \frac{k\,dq}{|\vec r - \vec r\,'|^3}(\vec r - \vec r\,')}$$

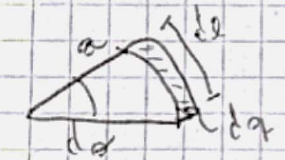
$\vec E = (0, 0, z)$ $\qquad r_P = r - r'$

$\vec r\,' = (x', y', 0)$

$\vec r - \vec r\,' = (-x', -y', z)$

$|\vec r - \vec r\,'| = \sqrt{(-x')^2 + (-y')^2 + z^2}$

$|\vec r - \vec r\,'|^3 = (x'^2 + y'^2 + z^2)^{3/2}$



$dq = \lambda \cdot d\ell = \lambda \cdot a \cdot d\varnothing'$

$$d\vec E = \frac{k\lambda a\, d\varnothing' \cdot (-x', -y', z)}{(x'^2 + y'^2 + z^2)^{3/2}} \Rightarrow d\vec E = \frac{k\lambda a\, d\varnothing' \left(-a\cos(\varnothing'), -a\,\mathrm{sen}(\varnothing'), z\right)}{\left(a^2\left(\cos^2(\varnothing') + \mathrm{sen}^2(\varnothing')\right) + z^2\right)^{3/2}}$$

$$\Rightarrow \vec E = \frac{k\lambda a}{(a^2+z^2)^{3/2}}\left[\int_\pi^{2\pi} -a\cos(\varnothing')\,d\varnothing' \; , \int_\pi^{2\pi} -a\,\mathrm{sen}(\varnothing')\,d\varnothing' \; ; \int_\pi^{2\pi} z\cdot d\varnothing'\right]$$

$$\Rightarrow \vec E(x, y, z) = \frac{-k\lambda a^2}{(a^2+z^2)^{3/2}}\left[\underbrace{\cancel{-a\,\mathrm{sen}(\varnothing')\Big|_\pi^{2\pi}}}_{=0} \; ; \; a\cos(\varnothing')\Big|_\pi^{2\pi} \; , \; z\varnothing'\Big|_\pi^{2\pi}\right]$$

$$\Rightarrow \boxed{\vec E(z) = \frac{k\lambda a}{(a^2+z^2)^{3/2}}\left(0 \, , \, a\left[1-(-1)\right] , \, z\pi\right)}$$

a en realidad es R

a = R

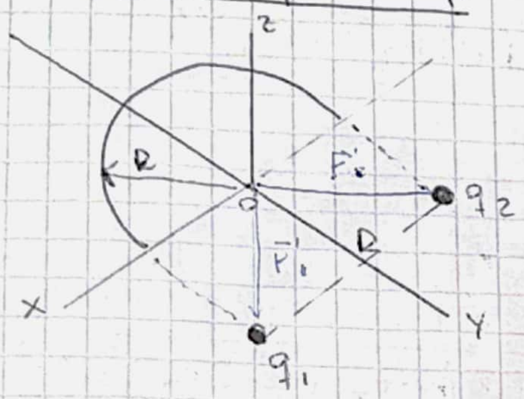
$$\Rightarrow \boxed{\vec E(z) = \frac{2k\lambda R^2}{(R^2+z^2)^{3/2}}\,\vec j + \frac{k\lambda R z \pi}{(R^2+z^2)^{3/2}}\,\vec k}$$

CAMPO debido A la semi circunferencia

FALTA el $\vec E$ debido A q_1 y q_2

#

Campo debido a q_1 y q_2



$$\begin{cases} \vec{r}_1' = (R, R) \\ \vec{r}_2' = (-R, R) \end{cases}$$

$$\vec{E}_{q_1 q_2} = \frac{k \cdot q_1 (\vec{r} - \vec{r}_1')}{|\vec{r} - \vec{r}_1'|^3} + \frac{k \cdot q_2 (\vec{r} - \vec{r}_2')}{|\vec{r} - \vec{r}_2'|^3}$$

$$\Rightarrow \vec{E}_{q_1 q_2} = \frac{kq}{(2R^2 + z^2)^{3/2}} \left[(0-R, 0-R, z-0) + (0+R, 0-R, z-0) \right]$$

$$\Rightarrow \vec{E}_{q_1 q_2} = \frac{kq}{(2R^2 + z^2)^{3/2}} \left[(-R, -R, z) + (R, -R, z) \right]$$

$$\vec{E}_{q_1 q_2} = \frac{kq}{(2R^2 + z^2)^{3/2}} (0, -2R, 2z)$$

Ahora $\Rightarrow$ sumo o (superpongo) con el $\vec{E}$ (semicircunferencia)

$$\vec{E}_{\text{semicircunferencia}}(z) = \frac{2k\lambda R^2}{(R^2+z^2)^{3/2}} \hat{j} + \frac{k\lambda R z \pi}{(R^2+z^2)^{3/2}} \hat{k}$$

$\Rightarrow$ RTA

$$\vec{E}(z) = \left(\frac{2k\lambda R^2}{(R^2+z^2)^{3/2}} - \frac{2kqR}{(2R^2+z^2)^{3/2}} \right) \hat{j} + \left(\frac{k\lambda R z \pi}{(R^2+z^2)^{3/2}} + \frac{2kqz}{(2R^2+z^2)^{3/2}} \right) \hat{k}$$

NOTA

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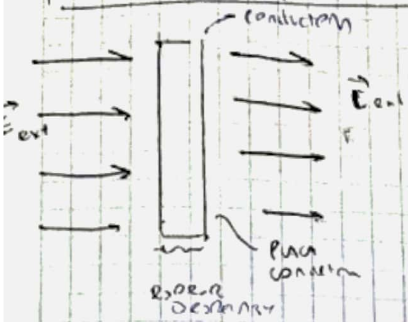
Placa conductora, entendiendo como infinita, inmersa en campo $\vec{E}_{ext}$



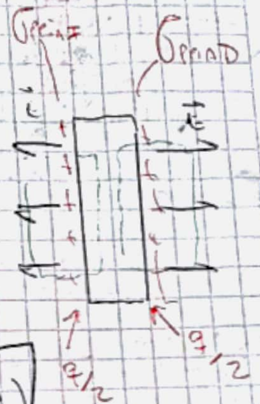
$$\boxed{\vec{E}_{Resultante} = \vec{E}_{propio} + \vec{E}_{ext}}$$

Clase 4: 0:30:00

Cálculo del campo $\vec{E}$ a la izquierda de la placa debido a la carga propia

$$\oint_{SG} \vec{E}_{propio} \cdot d\vec{s} = \frac{Q_{neta}}{\varepsilon_0} \quad \text{(Gauss)}$$

$$\Rightarrow E_{propio} \cdot S \cdot 1 = \frac{q_{propia}/2}{\varepsilon_0}$$



$$\Rightarrow E_{propio} = \frac{q_{propia}/2}{S\,\varepsilon_0} \qquad \sigma_{propia} = \frac{q_{propia}/2}{S}$$

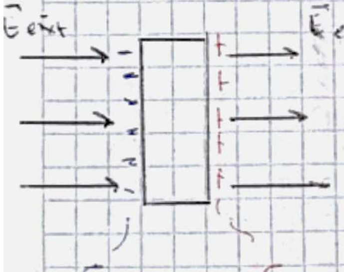
$$\Rightarrow E_{propio} = \frac{\sigma_{propia}}{\varepsilon_0}$$

$$\Rightarrow \boxed{\vec{E}_{propio_I} = \frac{\sigma_{propia}}{\varepsilon_0}(-\hat{i})} \qquad \boxed{\vec{E}_{propio_D} = \frac{\sigma_{propia\,D}}{\varepsilon_0}(\hat{i})}$$

Obs: si la q propia fuera negativa se invierten los vectores

Cálculo del ~~campo externo~~ a la carga inducida sobre c/cara debido a un $\vec{E}_{externo}$

Obs: (se asume que no ∄ q propia x el princip. de superposición)



$$\boxed{\sigma_{iI} = -E_{ext} \cdot \varepsilon_0} \rightarrow \text{nota que } \vec{E}_{ext} = \frac{-\sigma_{iI}}{\varepsilon_0}\hat{i} \quad \frac{q_{iI}}{S_I} = \sigma_{iI}$$

es negativa → $-(-) = +$ y la dirección → es igual [illegible]

$$\boxed{\sigma_{iD} = E_{ext} \cdot \varepsilon_0} \rightarrow \text{nota que } \vec{E}_{ext} = \frac{\sigma_{iD}}{\varepsilon_0}(\hat{i}) \quad \frac{q_{iD}}{S_D} = \sigma_{iD}$$

σ_{iI} inducida $\quad \sigma_{iD}$ inducida

es decir $|\sigma_{iI}| = |\sigma_{iD}|$

⇒ Aplicando superposición

el campo no se debilita

Cara izquierda

$$\vec{E}_{RI} = \vec{E}_{ext} + \vec{E}_{propio_I}$$

$$= \frac{-\sigma_{iI}(\hat{i})}{\varepsilon_0} + \frac{\sigma_{propia}(-\hat{i})}{\varepsilon_0}$$

el campo se debilita

Cara derecha

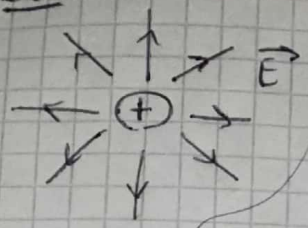
$$\vec{E}_{RD} = \vec{E}_{ext} + \vec{E}_{propio_D}$$

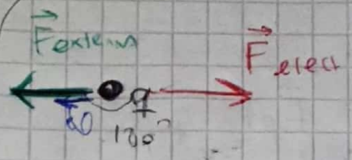
(¡dirección →)

$$= \frac{\sigma_{iD}(\hat{i})}{\varepsilon_0} + \frac{\sigma_{propia\,D}(\hat{i})}{\varepsilon_0}$$

Notar que cada σ va con su signo

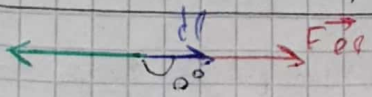
obs campo positivo





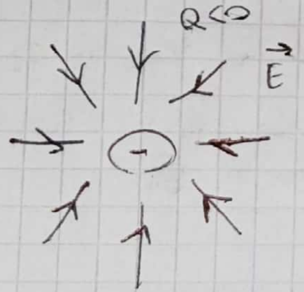
Importante: las fuerzas son variables, esos problemas se resuelven x energía

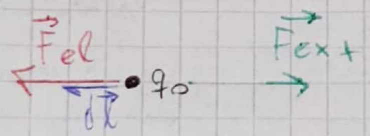
• Si me voy para la izquierda ← $\Delta U > 0$, $W_{eléc} < 0$



• Si voy para la derecha → $\Delta U < 0$, $W_{eléc} > 0$

obs (II) campo negativo





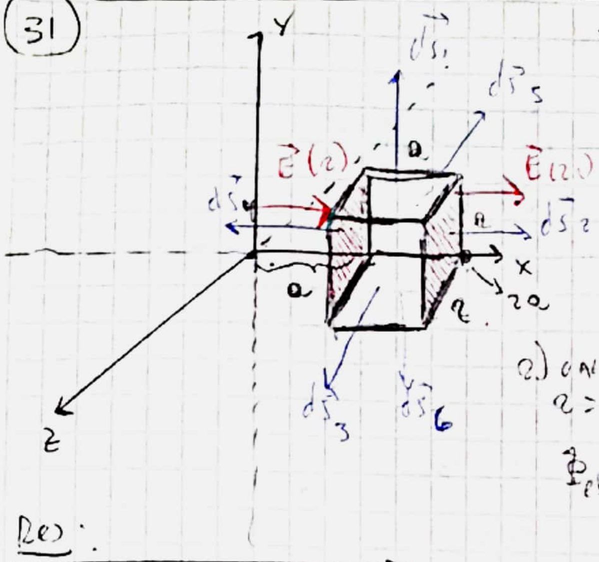
voy ⇐ A favor de $\vec{E}$ ⇒ pierdo energía potencial = $\Delta U < 0$; $W_{el} > 0$

⇒ en contra de $\vec{E}$ ⇒ $\Delta U > 0$; $W_{el} < 0$

obs: es como un resorte

ejercicio - cubo con carga - flujo

(31)



Datos

SAPIADO

Arista : a

Se tiene un $\vec{E}(x) = b \cdot x^{1/2}\ \hat{i}$

$E_z = E_y = 0$

$b = 800\ \frac{N}{C} \cdot m^{1/2} \Rightarrow \left(\frac{1}{\sqrt{m}}\right) = m^{1/2}$

a) calcular flujo eléctrico a través del cubo con $a = 10cm$

$\Phi_{el} = ?$

Res:

$$\boxed{\Phi = \oint_{S6} \vec{E} \cdot \vec{ds} = \frac{Q_m}{\varepsilon_0}}$$

$$\cancel{\int_1} + \int_2 + \cancel{\int_3} + \int_4 + \cancel{\int_5} + \cancel{\int_6} = \frac{Q_m}{\varepsilon_0}$$

xq $E_Y = E_Z = 0$ sobreviven las que están en X

$$\Rightarrow \int_{S_2} \vec{E}(2a) \cdot \vec{ds}_2 + \int_{S_4} \vec{E}(a) \cdot \vec{ds}_4 = \frac{Q_m}{\varepsilon_0}$$

$\cos(\vec{E}(a) \wedge \vec{ds}_4)$ (cambia bien. xq $\vec{E}(a)$ es distinta dirección a $\vec{ds_4}$)

$$\Rightarrow |\vec{E}(2a)| \cdot a^2 + |\vec{E}(a)| \cdot a^2 \cdot (-1) = \frac{Q_m}{\varepsilon_0}$$

Dato

$$\Rightarrow -b\sqrt{a} \cdot a^2 + b\sqrt{2} \cdot \sqrt{a} \cdot a^2 = \frac{Q_m}{\varepsilon_0} \Rightarrow b \cdot a^{5/2}\left[\sqrt{2} - 1\right] = \frac{Q_m}{\varepsilon_0}$$

$$\Rightarrow 800\ \frac{N}{C}\ (0{,}1m)^{5/2}\left[\sqrt{2} - 1\right] = 1{,}04\ \frac{N}{C} \cdot m^2 \Rightarrow \boxed{\Phi = 1{,}04\ \frac{N}{C} \cdot m^2}$$

b) carga dentro del cubo ? $\Phi_{el} = \frac{Q_m}{\varepsilon_0}$

$$\Rightarrow Q_m = \Phi_{el} \cdot \varepsilon_0$$

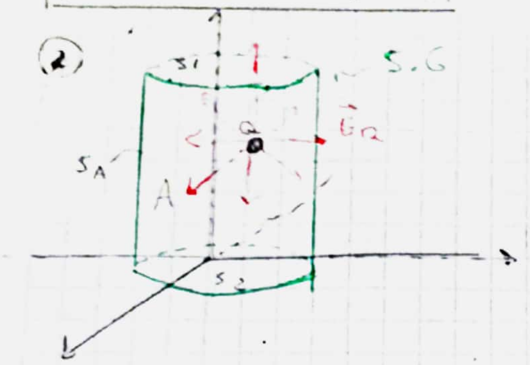
$$Q_m = 1{,}04\ \frac{N}{C} \cdot m^2 \cdot \varepsilon_0 \Rightarrow \boxed{Q_{neta} = 9{,}3 \cdot 10^{-12}}$$

Cuestionario Gauss 2

Datos: $Q = 0.000000114\ [C]$

$\Phi_A = 318.5 \left[\frac{Nm^2}{C}\right]$

(2)



Resolución

$$\Phi_{neto} = \frac{Q_{neta}}{\varepsilon_0} \quad \wedge \text{ tmb } \Phi_{neto} = \Phi_A + \Phi_{t_1} + \Phi_{t_2} \Rightarrow$$

$$\boxed{\Phi_A + \Phi_{t_1} + \Phi_{t_2} = \Phi_{neto} = \frac{Q_{neta}}{\varepsilon_0}} \Rightarrow \Phi_{t_1} + \Phi_{t_2}$$

$$\left\{ \begin{array}{l} \Phi_{t_1} = \oint_{S_1} \vec{E} \cdot d\vec{S}_1 \Rightarrow E \cdot \pi \cdot r^2 \\ \Phi_{t_2} = \oint_{S_2} \vec{E} \cdot d\vec{S}_2 \Rightarrow E \cdot \pi \cdot r^2 \end{array} \right\} \Rightarrow 2\vec{E}\pi \cdot r^2 + \Phi_A = \frac{Q_{neta}}{\varepsilon_0}$$

$$\Rightarrow \boxed{\Phi_{restante} = \frac{Q_{neta}}{\varepsilon_0} - \Phi_A} \Rightarrow$$

$$\Phi_{t_1} + \Phi_{t_2} \Rightarrow \Phi_{restante} = \frac{0.000000714\ [C]}{8.85 \times 10^{-12} \left[\frac{F}{m}\right]} - 318.5 \left[\frac{Nm^2}{C}\right]$$

$$\Rightarrow \boxed{0.08035 \times 10^6}$$

Intento dos

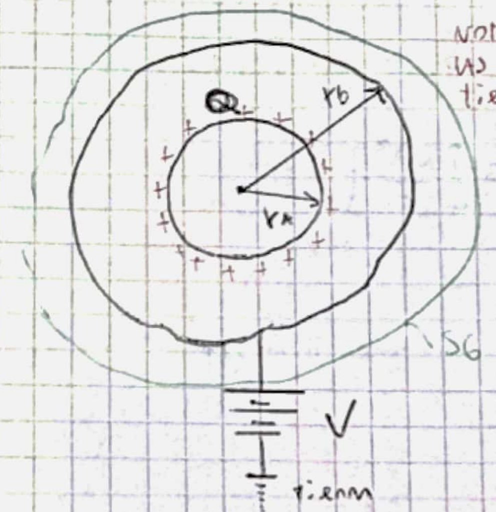
$$\Phi_{restante} = \frac{Q_{neta}}{\varepsilon_0} - \Phi_{A\ calculado}$$

$$\Phi_{restante} = \frac{0.000000378\ [C]}{8.85 \times 10^{-12} \left[\frac{F}{m}\right]} - 787.2 \left[\frac{Nm^2}{C}\right]$$

FIN

$$\boxed{\Phi_{restante} = 41924.66}$$

③ Dos esferas conductoras



Datos:

$rb = 0,2\,[m]$

$r_A = 0,04\,[m]$

de la esfera A → $Q = 0,000000155\,[C]$

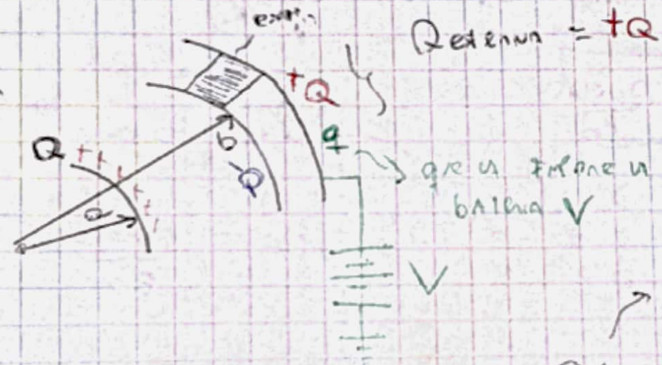
$V = 2431\,[V]$

1) carga total sobre la superficie exterior de la esfera de radio rb?

Resolución:

$Q_{externa} = +Q$ y q

Zoom



es toda la carga que encierra gauss

$\Rightarrow \cancel{+Q} \cancel{-Q} +Q + q$

Uso Gauss con $r > b$ (gaussiana) $\Rightarrow \vec{E} = \dfrac{Q_{ext}}{4\pi r^2 \varepsilon_0}$ Acá $r>b$

$\Rightarrow$ tenemos el valor de V $\Rightarrow V_{\infty,r} = -\int_{\infty}^{r} \vec{E}\cdot d\vec{l} \Rightarrow -\int_{\infty}^{r} \dfrac{Q_{ext}}{4\pi r^2 \varepsilon_0}\, dr$

$\Rightarrow -\dfrac{Q_{ext}}{4\pi\varepsilon_0}\left[-\dfrac{1}{r}\right]_{\infty}^{r} \Rightarrow +\dfrac{Q_{ext}}{4\pi\varepsilon_0 r} \Rightarrow V(r) = \dfrac{Q_{ext}}{4\pi\varepsilon_0 r}$

reemplazo

entonces si: $r = b \Rightarrow V(b) = V_{batería} = \dfrac{Q_{ext}}{4\pi\varepsilon_0 b} \Rightarrow$

2.1.a

$$\boxed{Q_{ext} = V_{batería} \cdot 4\pi\varepsilon_0 \cdot b}$$

Rta

$Q_{ext} = 5357\,[V] \cdot 4\pi\varepsilon_0 \cdot 0,29\,[m] \Rightarrow 1,7233 \times 10^{-7}$

NOTA