Potencial electrostático

Potencial electroestático (en un punto P)

$$\boxed{V_P = \frac{U_P}{q_0}}$$

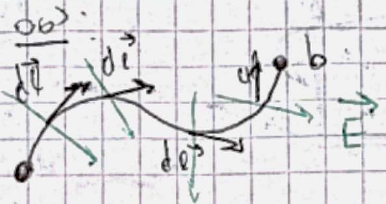
V_P: potencial U_P: energía en el punto P

$$\Delta V_{ab} = \frac{\Delta U_{ab}}{q_0} \Rightarrow \boxed{\Delta V_{ab} = V_b - V_a}$$ dif. potencial entre a y b

es independiente de la magnitud de la carga q_0

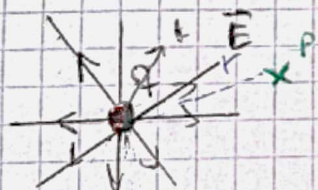
$$\Rightarrow \Delta V_{ab} = -\frac{1}{q_0}\underbrace{\int_a^b \vec{F}\cdot d\vec{l}}_{W_{el}} \Rightarrow -\frac{1}{q_0}\int_a^b q_0\,\vec{E}\cdot d\vec{l}$$

$$\Rightarrow \boxed{-\int_a^b \vec{E}\cdot d\vec{l}}$$



$$[V] = \frac{[J]}{[C]} = [V] \text{ (volt)}$$

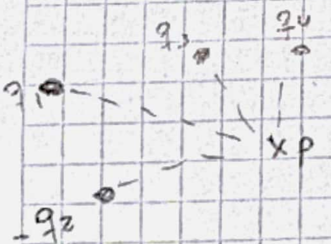
Cálculo del potencial V debido a una carga puntual



$$V_P = ? \qquad \vec{E} = \frac{k\,q}{r^2}\hat{r}$$

$$\Delta V_{\infty,P} = -\int_{r_\infty}^{r_P} \frac{k\,q}{r^2}\hat{r}\cdot d\vec{l} = kq\left[\frac{1}{r} - \frac{1}{\infty}\right]$$

$$\Rightarrow \boxed{\Delta V_{\infty,P} = V_P - \underbrace{V_\infty}_{0} = \frac{k\,q}{r}} \Rightarrow \boxed{V_P = \frac{k\,q}{r}}$$ } solo si en el infinito no hay carga)



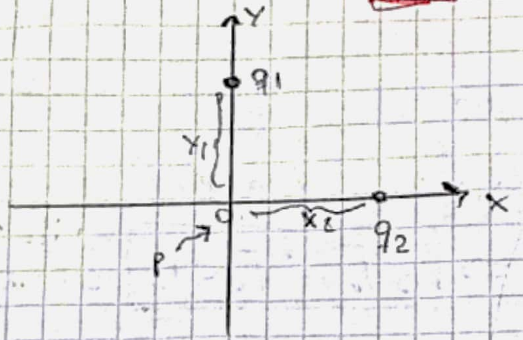
$$\boxed{V_P = ? \Rightarrow V_P = \sum_{i=1}^{n} V_i = \sum_{i=1}^{n} \frac{k\cdot q_i}{r_i}}$$ } si en hay cargas área

$$\boxed{V_P = \frac{k q_1}{r_1} + \frac{k q_2}{r_2} + \frac{k q_3}{r_3} + \frac{k q_4}{r_4}}$$

NOTA

calcular V_P en (0,0)   IMPORTANTE

(47)



$V_{O_{\text{origen}}} = ?$ $\Rightarrow V = f(x, y, z)$

$\vec{r}_2 = (x_2, 0)$

$\vec{r}_1 = (0, y_1)$

$\vec{r} = \vec{0}$

$$\Rightarrow V_{(0,0)} = \frac{k \cdot q_1}{\underbrace{Y_1}_{\vec{r}_1 - \vec{0}}} + \frac{k \cdot q_2}{\underbrace{X_2}_{\vec{r}_2 - \vec{0}}}$$

Rta

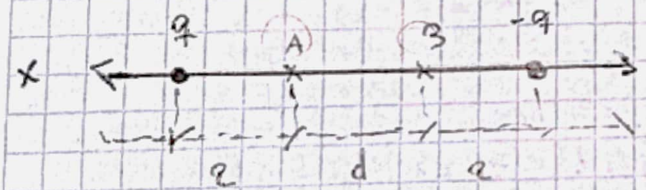
$$\boxed{V_{(0,0)} = k\left[\frac{q_1}{Y_1} + \frac{q_2}{X_2}\right]}$$

clase 4°

1:39

(50)

(I) deduzca $V_A - V_B = ?$



$V_A = ?$ $\Rightarrow$ se calcula c/u

$V_B = ?$

(superpos.)

$\Rightarrow V_A = V_A' + V_A''$, con $V_A' = \dfrac{kq}{a}$, $V_A'' = \dfrac{k(-q)}{d+a}$

$\Rightarrow V_B = V_b' + V_b''$, con $V_b' = \dfrac{kq}{d+a}$, $V_b'' = \dfrac{k(-q)}{a}$

$$\Rightarrow V_A - V_B = kq\left\{\left[\frac{1}{a} - \frac{1}{d+a}\right] - \left[\frac{1}{d+a} - \frac{1}{a}\right]\right\}$$

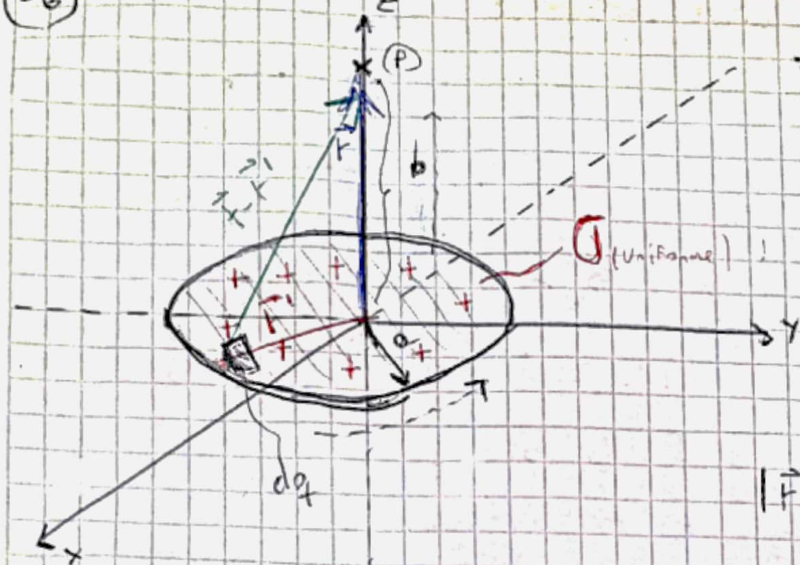
$$\Rightarrow V_A - V_B = kq\left[\frac{2}{a} - \frac{2}{d+a}\right]$$

Rta

$$\Rightarrow \boxed{V_A - V_B = 2kq\left[\frac{1}{a} - \frac{1}{d+a}\right]}$$

INTEGRAL Doble

(56)



$V_P = ?$ es decir $V(z=b) = ?$

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

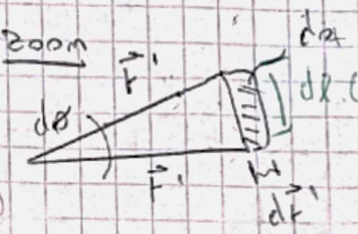
$\vec{r}' = (x', y', 0)$

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

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

$V(z) = \int \frac{k\,dq}{|\vec{r}-\vec{r}'|}$

Zoom



Aprox

Obs: $\approx$ b

$\sigma = \frac{dq}{ds}$ $\Rightarrow$ $\boxed{dq = \sigma \cdot ds}$

Cambio de Area

$\Rightarrow ds = \underbrace{dl}_{r'\,d\theta} \cdot dr'$ $\Rightarrow$ $ds = r'\,d\theta\,dr'$

Cambio Coordenadas A Polar

$\Rightarrow \boxed{dq = \sigma \cdot r' \cdot d\theta \cdot dr'}$ $\Rightarrow dV(z) = \frac{k\,\sigma\,d\theta \cdot r' \cdot dr'}{\sqrt{x'^2+y'^2+z^2}}$

$x' = r' \cdot \cos(\theta')$

$y' = r' \cdot \operatorname{sen}(\theta')$

$dV = \frac{k \cdot \sigma \cdot d\theta' \cdot r' \, dr'}{(r'^2\underbrace{[\cos^2(\theta') + \operatorname{sen}^2(\theta')]}_{1} + z^2)^{1/2}}$

Límites $\begin{cases} 0 \leq \theta' \leq 2\pi \\ 0 \leq |\vec{r}'| \leq a \to \text{radio} \end{cases}$

$\Rightarrow V(z) = \int_0^a \int_0^{2\pi} \frac{k\,\sigma\,\vec{r}'\,d\vec{r}'\,d\theta'}{\sqrt{r'^2+z^2}}$ $\Rightarrow V(z) = \int_0^a \frac{k\,\sigma\,\vec{r}\,dr'\;2\pi}{\sqrt{r'^2+z^2}}$

$\Rightarrow k\,\sigma\,\frac{2\pi}{2} \int_0^a \frac{2r'\,dr'}{(r'^2+z^2)^{1/2}}$ $\Rightarrow V(z) = \frac{1}{4\pi\varepsilon_0}\,\sigma\,\pi\,2\sqrt{(r'^2+z^2)}\Big|_0^a$

$\Rightarrow \boxed{V(z) = \frac{\sigma}{2\varepsilon_0}\left[\sqrt{a^2+z^2} - z\right]}$

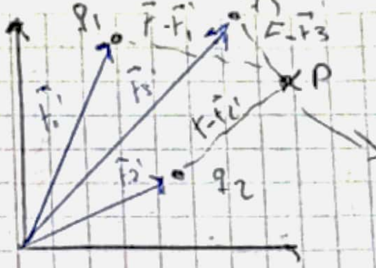
C.A $\quad u \Rightarrow du = 2r'\,dr$

$\int_a^? x^{-1/2}\,dx \Rightarrow 2x^{1/2}$

NOTA

Clase 5

Potencial cargas puntuales: $V_p = \sum_{i=1}^{m} \frac{k q_i}{|\vec{r}_{i,p}|}$ → $|\vec{r}-\vec{r}_i|$

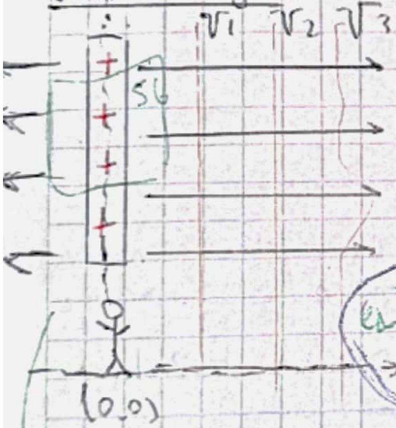


V en este punto

Potencial carga distribuida: $V_p = \int_{\Omega} \frac{k\, dq}{|\vec{r}_{i,p}|}$ → $|\vec{r}-\vec{r}'|$ ⇒ No $\nexists$ cargas en el ∞

$V_{a,b} = -\int_a^b \vec{E}\cdot d\vec{l}$ | $\vec{E} = -\vec{\nabla} V$ | $\vec{\nabla} = \left(\frac{\partial V}{\partial x}, \frac{\partial V}{\partial y}, \frac{\partial V}{\partial z}\right)$

Plano cargado $V_1 \neq V_2 \neq V_3 \Rightarrow V_3 < V_2 < V_1$



planos equipotenciales

$\boxed{\vec{E} = \frac{\sigma}{2\varepsilon_0}\hat{i}}$

caso $\vec{E}$ en plano cargado (plano infinito)

el V disminuye a medida que me alejo

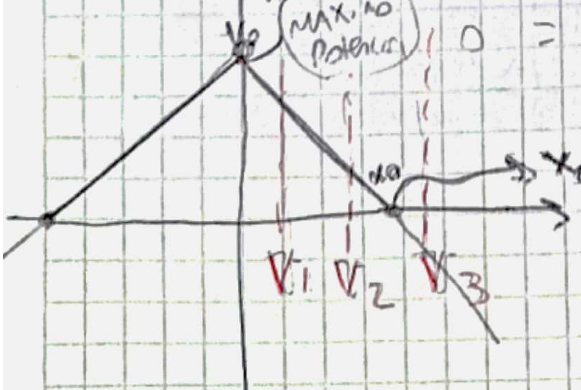
$V(x) = ?$

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

$\Rightarrow -\frac{\sigma}{2\varepsilon_0} x \Big|_0^x \Rightarrow \boxed{V(x) = V_0 - \frac{\sigma x}{2\varepsilon_0}}$ $(x > 0)$

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

Mapa de $V(x)$



x_0: se anula el V

Inicio de clase 15:00

Sábado

IMPORTANTE

Dif. Potencial

Ejercicio Final

HOJA Nº

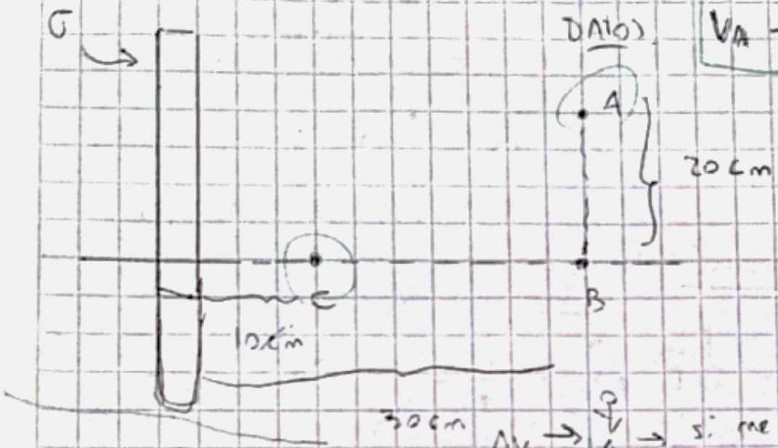
FECHA

Es de final → Plano conductor infinito

Datos

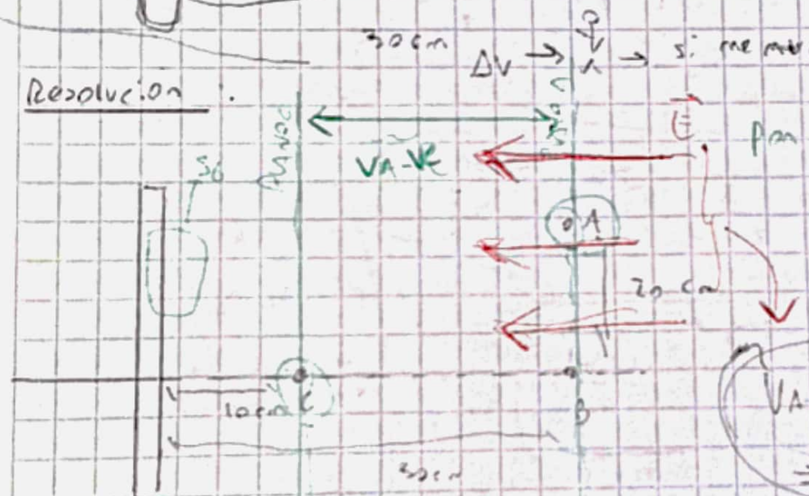
$V_A - V_C = 11,3\ kV$

Calcular el signo y el valor de σ



Resolución

si me muevo para acá, el V crece, entonces el $\vec{E}$ va a la izquierda



Por gauss, sabemos

$$\boxed{\vec{E} = \frac{\sigma}{\varepsilon_0}\hat{u}}$$ ~ plano conductor

$V_A - V_C = 11,3\ kV$ ⇒ $V_A > V_C$

esto significa que hacia →

⇒ $\sigma < 0$ → el plano fue cargado con (-)

⇒ $V_A - V_C = 11,3\ kV = |\vec{E}|.(30cm - 10cm)$

⇒ $|\vec{E}|.(20cm)$ ⇒ $\frac{11,3\ kV}{0,2m} = \frac{\sigma}{\varepsilon_0}$ ⇒ $|\sigma| = \frac{11,3\ kV}{0,2m}\ 8,85 \cdot 10^{-12}$

Rta

⇒ $\boxed{|\sigma| = 500\ nC/m^2}$ ⇒ $\boxed{\sigma = -500\ nC/m^2}$

el (-) xq esta cargado negativo

Potencial Eléctrico

$\boxed{\text{Importante}}$ Gradiente + Potencial

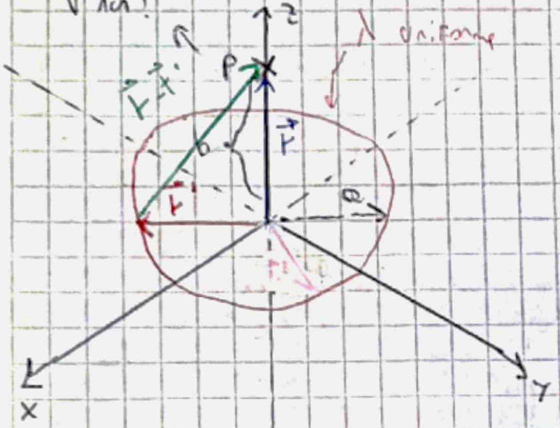
HOJA N°

FECHA

(65) espira de $r = a$ cargada con λ. Calcular V en un punto situado a una altura b del eje de la espira

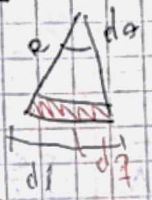
V acá!

λ uniforme



$$V_P = k \int_a \frac{dq}{|\vec r - \vec r'|}$$

zoom



$dq = \lambda \cdot dl \Rightarrow$

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

$\vec r$:
$\vec r'$:
$\vec r - \vec r'$:
$\vec r - \vec r'$:

Acá no tiene mucho sentido trabajar vectorialmente xq las distancias a todos los puntos es la misma

le llamamos R

$\Rightarrow |\vec r - \vec r'| \Rightarrow |\vec r_P| = \vec r - \vec r' = R$

$$\boxed{R = \sqrt{z^2 + a^2}}$$ (Pitágoras)

$$\Rightarrow V_P = k \cdot \int_0^{2\pi} \frac{\lambda a\, d\theta}{\sqrt{z^2+a^2}} \Rightarrow \frac{k\lambda a}{\sqrt{z^2+a^2}}\, \theta \Big|_0^{2\pi} \Rightarrow$$

Rta

$$\boxed{V(z) = \frac{k\lambda a\, 2\pi}{\sqrt{z^2+a^2}}}$$

b) obteniendo el gradiente del potencial verificar a resultado

(b): derivar respecto de z

$$\boxed{-\overrightarrow{\text{grad}}(V) = \vec E} \Rightarrow -\vec\nabla \cdot V(x,y,z) = \left(-\frac{\partial}{\partial x}, -\frac{\partial}{\partial y}, -\frac{\partial}{\partial z}\right) \cdot V(z) \Rightarrow -\frac{\partial}{\partial z} V(z)$$

$$\Rightarrow \vec E(z) = -\frac{\partial}{\partial z}\left\{\frac{k\lambda a 2\pi}{\sqrt{z^2+a^2}}\right\} \Rightarrow -k\lambda a 2\pi \cdot \frac{\partial}{\partial z}\left\{(z^2+a^2)^{-1/2}\right\} \hat k$$

$$\Rightarrow \vec E(z) = -k\lambda a 2\pi \left(-\frac{1}{2}\right) \cdot (z^2+a^2)^{-3/2} \cdot 2z\, \hat k$$ → Acomodo un poco

$$\Rightarrow \boxed{\vec E(z) = \frac{z k\lambda a 2\pi}{(z^2+a^2)^{3/2}} \hat k}$$ $k = \frac{1}{4\pi\varepsilon_0}$ → evalúo

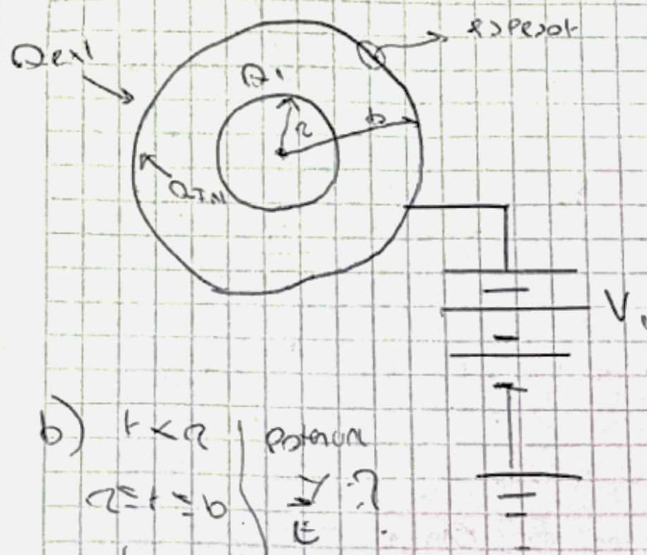
$$\Rightarrow \vec E(z) = \frac{1}{\cancel{2}\cancel{4}\pi\varepsilon_0} \cdot \frac{\lambda a \cancel{\pi} z\, \hat z}{(z^2+a^2)^{3/2}} \Rightarrow$$

Rta

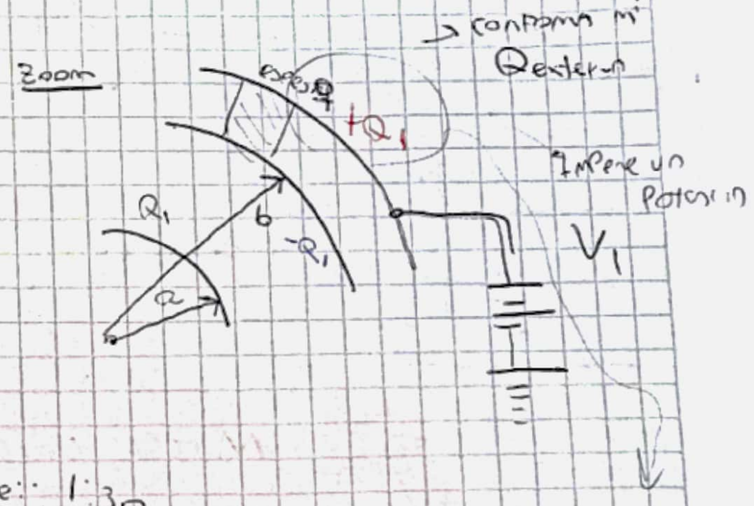
$$\boxed{\vec E(z) = \frac{a z}{2\varepsilon_0 (z^2+a^2)^{3/2}} \hat k}$$

NOTA

(57) Conductor esférico ideal

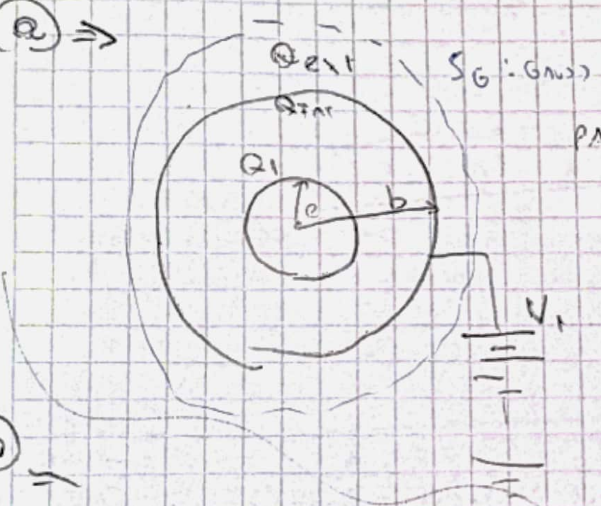


a) $Q_{externa}$ y $Q_{Interna}$??



b) $r<a$ | Potencial
$a\leq r\leq b$ | V ?
$b<r$ | $\vec{E}$

(a) ⇒



$+Q_1 \; -Q_1 \; +Q_1 \; + q$

Para $b<r$: $E = \dfrac{Q_{ext}}{4\pi r^2 \varepsilon_0}$

$$V_{\infty,r} = -\int_{\infty}^{r} \vec{E}\cdot d\vec{l} = -\int_{\infty}^{r} \frac{Q_{ext}}{4\pi r^2 \varepsilon_0}\,dr \Rightarrow \frac{Q_{ex}}{4\pi\varepsilon}$$

$$\Rightarrow \frac{Q_{ext}}{4\pi\varepsilon_0 r} \Rightarrow \boxed{V(r) = \frac{Q_{ext}}{4\pi\varepsilon_0 r}}$$

(b) ⇒

- si: $b<r$:

$\vec{E}(r) = \dfrac{Q_{ext}}{4\pi\varepsilon_0 r^2}\,\hat{r}_0 \Rightarrow$ (*)

- si $r=b$: $V(b) = V_1 = \dfrac{Q_{ex}}{4\pi\varepsilon_0 b}$

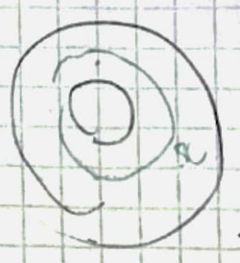
$\Rightarrow \boxed{Q_{ext} = V_1\, 4\pi\varepsilon_0 b}$

(*) $\Rightarrow \boxed{\dfrac{V_1 b}{r^2}\,\hat{r}_0}$

Obs: V_1 impone la dif potencial, entonces la SG con masa $r=b$ toda esa línea queda con ese voltage

- si $a\leq r\leq b$

$E(r) = \dfrac{Q_1}{4\pi r^2 \varepsilon_0}$



$$V_{b,r} = V(r) - V(b) = -\int_{b}^{r} \frac{Q_1}{4\pi\varepsilon_0 r^2}$$

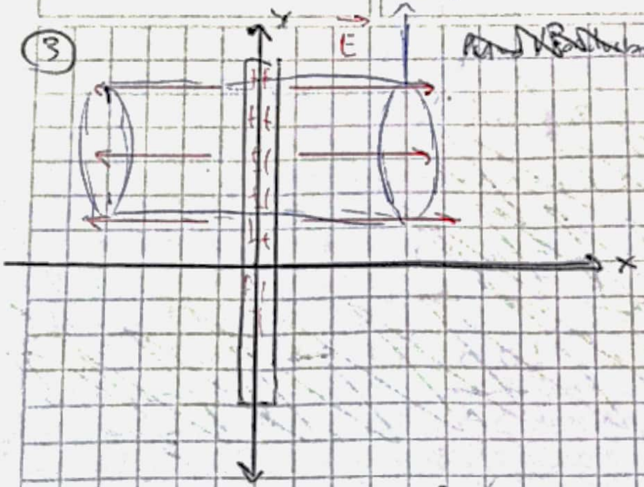
$$\Rightarrow \frac{-Q_1}{4\pi\varepsilon_0}\left(-\frac{1}{r}\right)\Bigg|_{b}^{r} \Rightarrow \boxed{V(r) = \frac{Q_1}{4\pi\varepsilon_0 r} - \frac{Q_1}{4\pi\varepsilon_0 b} + V(b)}$$

- si: $r<a$: $\vec{E} = \vec{0}$

HOJA N°

FECHA

(3)



Plano NO conductor cargado con σ

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

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

$$\int_{①} \vec{E}_1 \cdot \vec{ds}_1 + \int_{②} \vec{E}_2 \cdot \vec{ds}_2 + \cancel{\int_{cilindro} \vec{E} \cdot \vec{ds}_{cil}} = \frac{Q_{neta}}{\varepsilon_0} \Rightarrow \vec{E} = \frac{Q_{neta}}{2 S \varepsilon_0} \Rightarrow \boxed{\vec{E} = \frac{\sigma}{2\varepsilon_0} \hat{i}}$$

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

os: $V(x) - V(0) = -1473.5V$

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

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

$V_0 (x_0) = 1473.5 [V]$

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

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

Bien

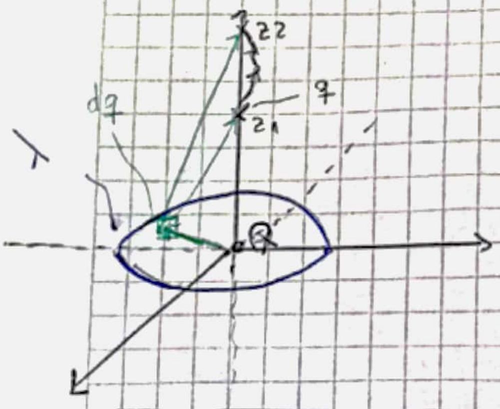
$$x_0 = \frac{2(8.85 \times 10^{-12})(3246.5)}{0.000000390}$$

(5) DATOS

$R = 3.1m$, $\lambda(\theta) = 3.1\cos(\theta)$, $Q = 0.000040[C]$, $q = 0.000000498[C]$

FECHA

$z_1 = 0.39m$, $z_2 = 1.04m$



$W_{A\to B} = -q \cdot \Delta V_{AB}$ → hallar

$V_B - V_A$

$V_B = V_{BQ} + V_{B_{anillo}}$

$V_A = V_{AQ} + V_{A_{anillo}}$

V_{Anillo} A z_1 y z_2

$V_{A_{Anillo}} =$

$dq = \lambda \cdot R \cdot d\theta \Rightarrow \boxed{dq = 3.1\cos(\theta) \cdot R \cdot d\theta}$

$|\vec{r}-\vec{r}'| = |\vec{r}z_0|$

$V(z_1) = \int \frac{k\,dq}{|\vec{r}-\vec{r}'|} \Rightarrow dV = \frac{k \cdot R \cdot 3.1\cos(\theta)\,d\theta}{}$

$= R = \sqrt{z_1^2 + R^2}$

$V_{z_1} = k\int_0^{2\pi} \frac{R \cdot 3.1\cos(\theta)\,d\theta}{\sqrt{z_1^2+R}} \Rightarrow 3.1\,k\,R \int_0^{2\pi} \frac{\cos(\theta)}{\sqrt{z_1^2+R}}\,d\theta$

$\Rightarrow V_{z_1} = \frac{3.1 \cdot k \cdot R}{\sqrt{z_1^2+R}} \cdot \underbrace{\operatorname{sen}(2\pi)}_{0} = \boxed{0}$? → V_{z_2} también es 0

xq λ es VARIABLE

V_Q A z_1 y z_2

$V_{z_1} = \frac{k \cdot Q}{z_1}$ $\qquad V_{z_2} = \frac{k\,Q}{z_2}$

?

$V_B - V_A = \left(0 + \frac{kQ}{z_2}\right) - \left(0 + \frac{kQ}{z_1}\right)$

$W_{A\to B} = -q \cdot \Delta V_{AB}$

$\boxed{k = \frac{1}{4\pi\varepsilon_0}}$

$W_{A\to B} = -q \cdot \Delta V_{AB}$ RTA ?

$\Delta V_{AB} = \frac{kQ}{r_{z_2}} - \frac{kQ}{r_{z_1}}$

$\Delta V_{AB} = k\left[\frac{Q}{r_{z_2}} - \frac{Q}{r_{z_1}}\right]$

$\Delta V_{AB} = \cancel{8.85\times10^{-12}}\left[\frac{0.000040}{1.87} - \frac{0.000040}{0.49}\right]$

$\Delta V_{AB} = -5.3314\times10^{-16}$

$W_{AB} =$

Anda a saber xq ta mal

	PARCIAL - PROFE	HOJA N°
		FECHA

PARCIAL - Octubre 2016

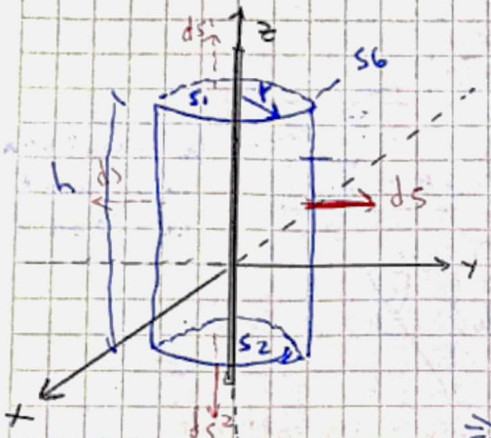
DATOS

1) hilo infinito cargado con λ $\quad \varepsilon_0 = 8.85 \cdot 10^{-12}$, $\lambda = 80 \left[\frac{\mu C}{m}\right]$

a) campo E a una distancia r del hilo. $\quad q = 3\mu C$, $A = (5,0,0)$, $B = (0,20,0)$

b) Graficar el campo en esa dirección.

c) W del $\vec{E}$ para mover una q de A hasta B



a) Por Gauss $\Rightarrow \displaystyle\int_{SG} \vec{E} \cdot \vec{ds} = \frac{Q_{NETA}}{\varepsilon_0}$

$\Rightarrow E \cdot \displaystyle\int_{SG} ds = \frac{Q_{NETA}}{\varepsilon_0} \Rightarrow$

$\Rightarrow E \cdot 2\pi \cdot r \cdot h = \dfrac{Q_{NETA}}{\varepsilon_0} \Rightarrow E = \dfrac{Q_{NETA}}{2\pi \cdot r \cdot h \cdot \varepsilon_0}$ λ

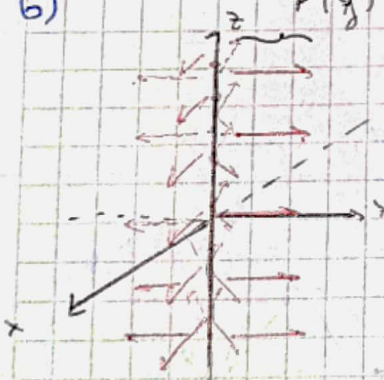
$\Rightarrow \boxed{E_{hilo} = \dfrac{\lambda}{2\pi r \varepsilon_0}}$

$\vec{E} \perp \vec{ds_1} \wedge \vec{E} \perp \vec{ds_2}$

$\Rightarrow \underbrace{\displaystyle\int_{S_1} \vec{E} \cdot \vec{ds_1}}_{0} + \underbrace{\displaystyle\int_{S_2} \vec{E} \cdot \vec{ds_2}}_{0}$ debido a $\underbrace{\cos(\vec{E} \wedge \vec{ds})}_{0}$

c) $\boxed{W_{A \to B} = -q \cdot \Delta V_{AB}}$

b) $r(\hat{j})$ R genérico

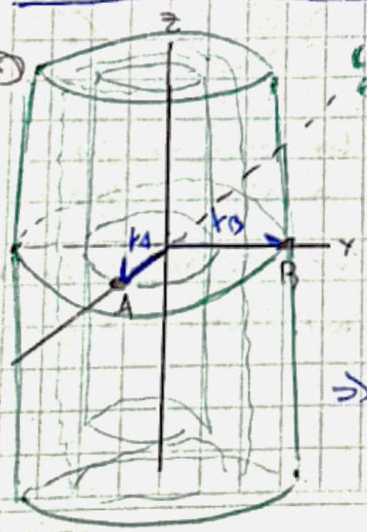


$\Delta V_{AB} = -\displaystyle\int_A^B \vec{E} \cdot \vec{dr} \Rightarrow -\int_A^B \frac{\lambda}{2\pi \varepsilon_0 r} \cdot dr$

$\Rightarrow \dfrac{-\lambda}{2\pi\varepsilon_0} \cdot \ln\left(\dfrac{r_B}{r_A}\right)$, $r_B = ?$, $r_A = ?$ (#)

$\Rightarrow \Delta_{AB} = \dfrac{-80}{2\pi\varepsilon_0} \cdot \ln\left(\dfrac{20}{5}\right)$

(#)



cilindros equipotenciales

$\hat{i}\ \hat{j}\ \hat{k}$

$r_A = (5, 0, 0)$

$r_B = (0, 20, 0)$

$\Rightarrow \boxed{V_A \text{ tiene mayor potencial}}$

$\Rightarrow \Delta_{AB} = -1.4386 \cdot \ln(4)$

$\Rightarrow \boxed{\Delta V_{AB} = -1.9943} = V_B - V_A$

$W_{A \to B} = -q \cdot (-1.9943)$

Rta

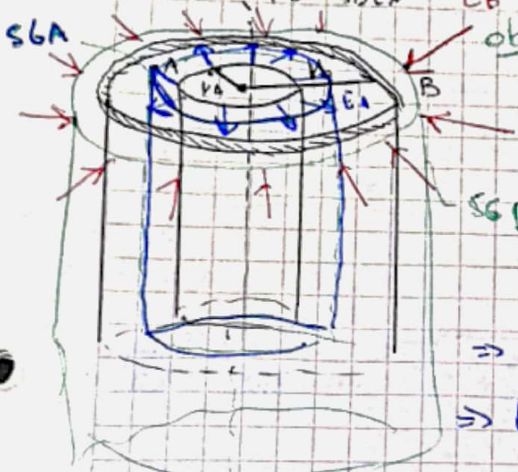
$\boxed{W_{A \to B} = 5.9829}$

NOTA

a) hallar la densidad de carga lineal en el alambre λ_A y $\lambda_B = ?$
b) " " " " " " " " cilindro

(1) Alambre metálico coaxial con cilindro de longitud finita
se sabe que $|E_B| = 1000 \frac{N}{C}$ hacia adentro y $|E_A| = 2000 \frac{N}{C}$ hacia afuera

$r_A = 10cm$, $r_b = 30cm$



a) Tomo 2 sup gaussianas que pasen x los puntos A y B

$$\oint_{SGA} \vec{E_A} \cdot \vec{ds} = \frac{Q_A}{\varepsilon_0}$$

$\vec{ds}$; $\cos(0°) = 1$

$$E_A \int_{SGA} ds \cdot 1 = \frac{G_A \cdot 2\pi \cdot r_a \cdot h}{\varepsilon_0}$$

si $G = \frac{dq}{ds} \Rightarrow dq = G \cdot ds$
$\Rightarrow q = G \cdot \int ds$
$\Rightarrow \boxed{q = G\, 2\pi\, r_a \cdot h}$

$$\Rightarrow E_A \cdot 2\pi \cdot r_A \cdot h = \frac{G_A \cdot 2\pi \cdot r_a \cdot h}{\varepsilon_0}$$

$$\Rightarrow E_A \cdot \varepsilon_0 \cdot r_A = G_A \cdot r_a \longrightarrow E_A \cdot \varepsilon_0 \cdot r_A = \frac{\lambda_A}{2\pi \cdot r_a} \cdot r_a$$

$$\lambda = \frac{Q}{h} \Rightarrow \frac{G_A\, 2\pi \cdot r_A\, \cancel{h}}{\cancel{h}} \Rightarrow \lambda_A = G_A\, 2\pi \cdot r_A \Rightarrow G_A = \frac{\lambda_A}{2\pi \cdot r_A}$$

$$\Rightarrow \boxed{\lambda_A = 2\pi\, \varepsilon_0 \cdot E_A \cdot r_A} \Rightarrow \lambda_A = 2\pi \cdot 2000 \cdot 8{,}85 \times 10^{-12} \cdot 0{,}1m = 1{,}112 \frac{C^2}{N \cdot m} \cdot \frac{N}{C} \left[\frac{C}{m}\right]$$

$$\boxed{\lambda_A = 1{,}112 \left[\frac{C}{m}\right]} \sim \varepsilon r A$$

b)
$$\oint_{SGB} \vec{E_B} \cdot \vec{ds} = \frac{Q_m}{\varepsilon_0}$$

$\Rightarrow$ $\cos(180) = -1$ $\Rightarrow -E_B \int_{SGB} ds = \frac{Q_m}{\varepsilon_0}$

$Q_A \rightarrow$ inducida por el cilindro de adentro

$Q_m = Q_A + Q_B$

$$\Rightarrow -E_B \cdot 2\pi \cdot r_B \cdot h \cdot \varepsilon_0 = Q_A + Q_B \Rightarrow -E_B \cdot 2\pi \cdot r_B \cdot \varepsilon_0 = \underbrace{\frac{Q_A}{h}}_{\lambda_A} + \underbrace{\frac{Q_B}{h}}_{\lambda_B}$$

$$\Rightarrow \lambda_B = -E_B \cdot 2\pi \cdot r_B \cdot \varepsilon_0 - \lambda_A \Rightarrow$$

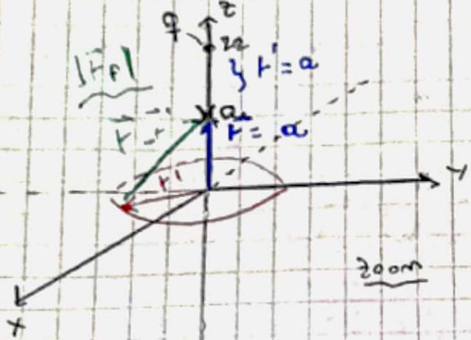
$$\Rightarrow \boxed{\lambda_B = -1{,}67 \cdot 10^{-8} - \lambda_A = -2{,}76 \times 10^{-3}}$$

NOTA

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

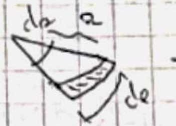
a) Potencial V en a en z en $(0,0,a)$

b) dibujar el campo E en $P = (0,0,-2a)$



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

zoom



$\Rightarrow dq = \lambda\, d\ell \Rightarrow \boxed{dq = \lambda a\, d\alpha}$

OJO q nuevas

$\Rightarrow V_{P=a} = V_{anillo} + V_q$

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

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

$\Rightarrow \left[V_{anillo} = k\int_0^{2\pi} \frac{\lambda a\, d\alpha}{\sqrt{2}\,a} \right] \Rightarrow V_{anillo} = \frac{k\lambda 2\pi}{\sqrt{2}} = \boxed{36000\,V}$

$V_q = \frac{k\cdot q}{r_{qa}} \Rightarrow \left[V_q = \frac{k\cdot q}{a} \right] = \boxed{6363{,}96\,V}$

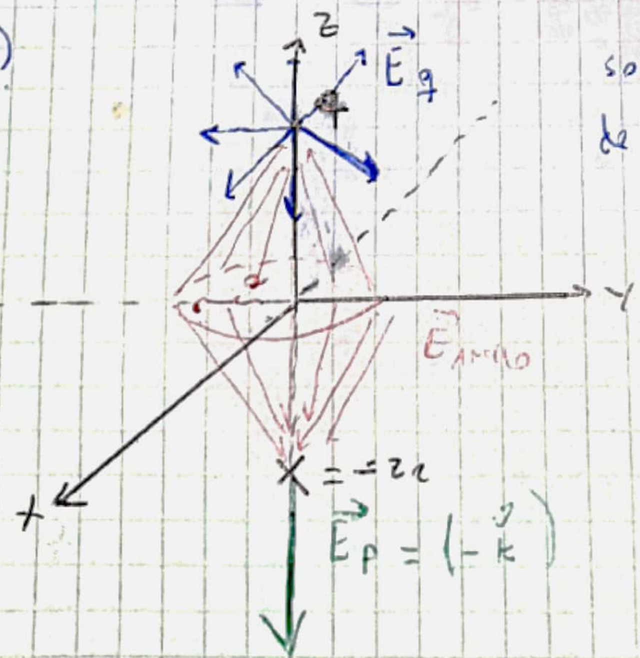
OJO $\lambda = \frac{Q}{2\pi a}$

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

$\Rightarrow V_{PA} = \frac{1}{4\pi\varepsilon_0}\left[16\,mC\cdot\pi + \frac{2\,mC}{2\sqrt{2}}\right] \Rightarrow V_{PA} = 9\times10^9\left[50{,}9725\right]$

$\Rightarrow \boxed{V_{PA} = 39663{,}96\,V}$

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 nivel $P = (0,0,-2a)$