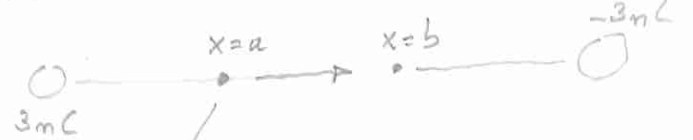
S1



AVANT: $K = 0$, $U = q_0 V_a$ → **APRES**: $K = \frac{1}{2} m v^2$, $U = q_0 V_b$

$$V_a = \underbrace{\frac{1}{4\pi\varepsilon_0}}_{9\,10^9} \left[\frac{3\,\cancel{10^{-9}}}{10^{-2}} - \frac{3\,\cancel{10^{-9}}}{2\,10^{-2}} \right]$$

$$\underbrace{9\,\cancel{10^9} \quad 300 - 150}_{1350\ \text{Volt}}$$

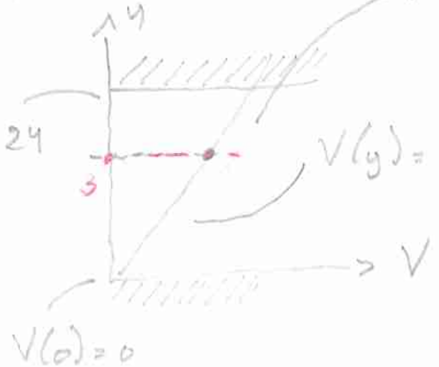
$V_b = -1350$ Volt — PAR SYMETRIE !

$$\frac{1}{2} m v^2 = 2700\ q_0$$

$m = 5\,\cancel{10^{-9}}$, $q_0 = 2\,\cancel{10^{-9}}$

$$\boxed{v = \underbrace{\sqrt{2160}}_{46,47}\ [m/s]}$$

S2

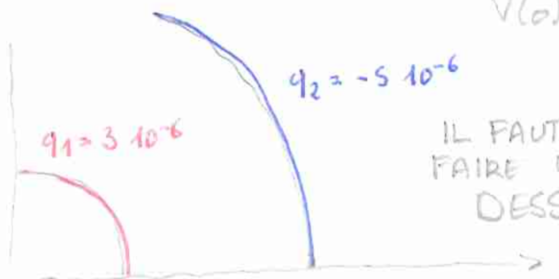


$$V(y) = \frac{24}{4.5}\,y$$

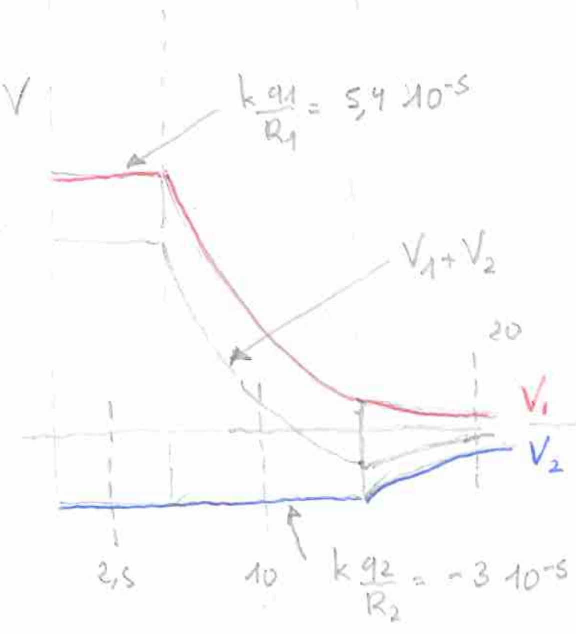
$$\boxed{V(y=3) = \underbrace{\frac{2}{3}\,24}_{16\ \text{Volt}}}$$

IMMEDIAT !

S3



IL FAUT FAIRE UN DESSIN !



$$\frac{3 \times 9\,10^3}{5\,10^{-2}} = 5,4\,10^5 \qquad \frac{-5 \times 9\,10^{-3}}{15\,10^{-2}} = -3\,10^5$$

$\boxed{r = 2,5}$ $$V = \frac{k q_1}{R_1} + \frac{k q_2}{R_2} = \boxed{2,4\,10^5\ \text{Volt}}$$

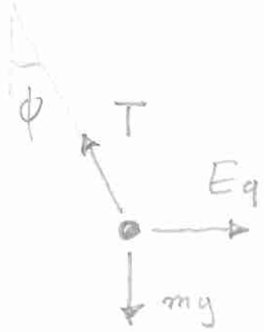
$\boxed{r = 10}$ $$V = \frac{k q_1}{r} + \frac{k q_2}{R_2} = \boxed{-0.3\,10^5\ \text{Volt}}$$

$\frac{k q_1}{r} = 2,7\,10^5$

$\boxed{r = 20}$ $$V = \frac{k q_1}{r} + \frac{k q_2}{r} = \boxed{-0.9\,10^5\ \text{Volt}}$$

$\frac{27}{20}\,10^5 \qquad -\frac{45}{20}\,10^5$

54



$$\boxed{\sum \vec{F} = 0}$$

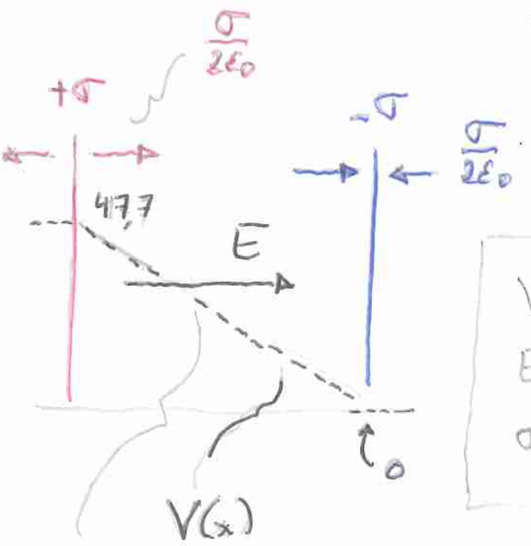
$$mg = T\cos\varphi$$
$$qE = T\sin\varphi$$

$$qE = mg\,\mathrm{tg}\,\varphi$$

$$= \frac{V}{L}$$

$$\boxed{V = \frac{mgL}{q}\,\overbrace{\mathrm{tg}\,\varphi}^{1/\sqrt{3}}}$$

$$\frac{1{,}5\ 10^{-3} \times 9{,}81 \times 5\ 10^{-2}}{8{,}9\ 10^{-6}} = 82{,}669$$



$$\boxed{\begin{aligned} V &= 47{,}7\ [\text{Volt}] \\ E &= 954\ [N/C] \\ \sigma &= 8{,}45\ 10^{-9}\ [C/m^2] \end{aligned}}$$

$$E = -\frac{\Delta V}{L} = \underbrace{\frac{\sigma}{\varepsilon_0}}$$

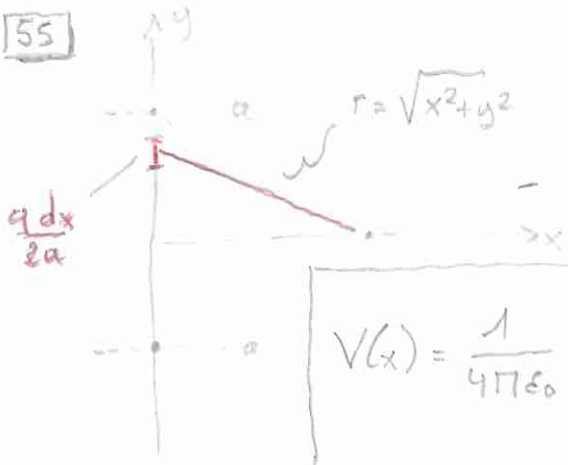
$$\underbrace{\frac{\sigma}{2\varepsilon_0} - \left(-\frac{\sigma}{2\varepsilon_0}\right)} \quad :-)$$

$$\boxed{E_x = -\frac{\partial V}{\partial x}}$$

LE CHAMP ELECTRIQUE
DESCEND LE
POTENTIEL :-)

SUPERPOSITION
DES CHAMPS DES
DEUX PLAQUES

55



ON INTEGRE
LES CHARGES PONCTUELLES
SUR LE SEGMENT

$$\boxed{V(x) = \frac{1}{4\pi\varepsilon_0}\,\frac{q}{2a}\int_{-a}^{a}\frac{dy}{\sqrt{x^2+y^2}}}$$

UNE
PETITE
INTEGRALE
POUR RIRE :-)

$$\int \frac{dy}{\sqrt{\alpha+y^2}} = \int \underbrace{\frac{1}{\sqrt{\alpha+y^2}} \frac{(y+\sqrt{\alpha+y^2})}{(y+\sqrt{\alpha+y^2})}} \, dy$$

$$\frac{y(\alpha+y^2)^{-1/2}+1}{(\alpha+y^2)^{1/2}+y} \, dy$$

OR $\left((\alpha+y^2)^{1/2}+y\right)' = 2y\,\frac{1}{2}(\alpha+y^2)^{-1/2}+1$:-)

$$= \ln\left(\sqrt{\alpha+y^2}+y\right) + C$$

$$\boxed{V(x) = \frac{1}{4\pi\varepsilon_0}\,\frac{q}{2a}\,\ln\left[\frac{\sqrt{x^2+a^2}+a}{\sqrt{x^2+a^2}-a}\right]}$$

56

$y_b = 3\ 10^{-2}$

$E_y = \alpha + \frac{\beta}{y^2}$

$y_a = 2\ 10^{-2}$

ATTENTION COORDONNEES EN CM :-)

$$V_a - V_b = \int_a^b \alpha + \frac{\beta}{y^2}\, dy$$

$$= \left[\alpha y - \frac{\beta}{y}\right]_{2\ 10^{-2}}^{3\ 10^{-2}}$$

$$= \alpha \underbrace{[3-2]}_{1} 10^{-2} - \beta \underbrace{\left[\frac{1}{3}-\frac{1}{2}\right]}_{-\frac{1}{6}} 10^{2}$$

$$= 6 + \frac{5}{6}\ 10^{2}$$

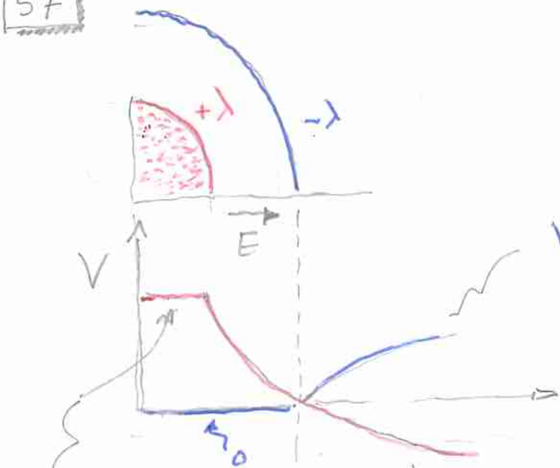
$$= \frac{268}{3} = \boxed{89{,}333 \text{ Volt}}$$

$V_a = 89{,}333 + C$

$V_b = 0 + C$

$V_a > V_b$

57



$$V(r) = \frac{-\lambda}{2\pi\varepsilon} \ln\left(\frac{b}{r}\right)$$

$$V = \frac{\lambda}{2\pi\varepsilon} \ln\left(\frac{b}{a}\right) \qquad V(r) = \frac{\lambda}{2\pi\varepsilon} \ln\left(\frac{b}{r}\right)$$

1

$$V(r) = \frac{\lambda}{2\pi\varepsilon} \ln\left(\frac{b}{r}\right)$$

$V = 0$

$$V = \frac{\lambda}{2\pi\varepsilon} \ln\left(\frac{b}{a}\right)$$

2

$$\boxed{V(a) - V(b) = \frac{\lambda}{2\pi\varepsilon} \ln\left(\frac{b}{a}\right)}$$

$$\boxed{E = \frac{\lambda}{2\pi\varepsilon} \frac{1}{r} = \frac{\Delta V}{\ln(b/a)} \frac{1}{r}}$$

3

$$E = -\frac{\partial V}{\partial r}$$

$$= \frac{\lambda}{2\pi\varepsilon} \frac{1}{r}$$

$\ln\left(\frac{b}{r}\right) = \ln(b) - \ln(r)$:-)

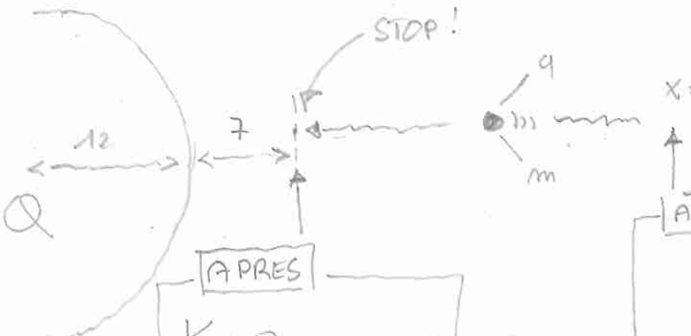
$\frac{\partial}{\partial r}\left(\ln\left(\frac{b}{r}\right)\right) = -\frac{1}{r}$:-)

4 RIEN NE CHANGE !

LE POTENTIEL TOTAL DANS L'ISOLANT NE DEPEND QUE DU POTENTIEL DU CYLINDRE INTERIEUR :-)

SO EASY :-)

58



AVANT

$K = \frac{1}{2} m v^2$

$U = 0$

APRES

$K = 0$

$U = k \frac{qQ}{r}$

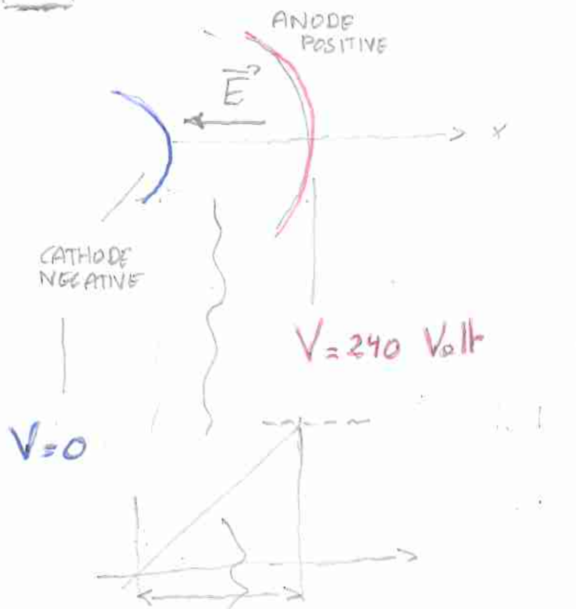
$r = 0{,}19$ m

$$\boxed{v = \sqrt{\frac{2kqQ}{mr}}}$$

VALEUR NUMERIQUE

$$\boxed{v = 112 \text{ m/s}}$$

59



$d = 13\ 10^{-3}$

$V(x) = C\, x^{4/3}$

$$\overbrace{V(d)}^{240\ \text{Volt}} = C\,(13\ 10^{-3})^{4/3}$$

1

$$\boxed{\begin{aligned} C &= 240 \times 13^{-4/3}\ 10^{4} \\ &= \underbrace{78515}_{7{,}8\ 10^{4}}\ [\text{Volt}/m^{4/3}] \end{aligned}}$$

2

$$\boxed{E_x = -\frac{\partial V}{\partial x} = -\frac{4}{3}\,C\,x^{1/3}} \simeq -10^{5}\,x^{1/3}$$

SIGNE NEGATIF CAR $\vec{E}$ EST BIEN ORIENTÉ DANS LE SENS OPPOSÉ DE x !

3

$$\boxed{F_x = \frac{4}{3}\,e\,C\,x^{1/3}}$$

CHARGE DE L'ELECT

$x = 6{,}5\ 10^{-3}$ A MI-CHEMIN

L'ELECTRON EST ATTIRE PAR L'ANODE .... ET REPOUSSÉ PAR LA CATHODE !

$F_x \simeq 3{,}13\ 10^{-15}\ [N]$

60

$\overbrace{\dfrac{8 \times (8-1)}{2}}^{28\ :-)}$ PAIRES :-)

12 PAIRES $q/-q$ SEPAREES DE d
12 PAIRES q/q $-q/-q$ SEPAREES DE $\sqrt{2}\,d$
4 PAIRES $q/-q$ SEPAREES DE $\sqrt{3}\,d$

Si Si :-)

LES IONS PREFERENT FORMER LE CRISTAL QUE RESTER SEPARÉS...

$$\boxed{U = k q^2 \left[-\frac{12}{d} + \frac{12}{\sqrt{2}d} - \frac{4}{\sqrt{3}d}\right] = \underbrace{-1{,}46}\ \frac{q^2}{4\pi\varepsilon_0 d}}$$

L'ENERGIE POTENTIELLE EST INFERIEURE A ZERO