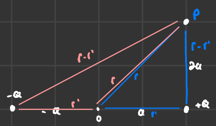
Procedural 1

Exercise 1 :



Charge Q- :

$$\vec{E} = \frac{Q}{4\pi\varepsilon_0 \|\vec{r}-\vec{r}'\|^2} \frac{(r-r')}{\|\vec{r}-\vec{r}'\|}$$

$$\vec{E} = \frac{-Q}{4\pi\varepsilon_0\left(\sqrt{(2a)^2+(2a)^2}\right)^2} \frac{(2a,2a)}{\sqrt{(2a)^2+(2a)^2}} = \frac{-Q}{4\pi\varepsilon_0\, 8a^2} \frac{(2a,2a)}{2\sqrt{2}\, a} = \frac{-Q}{32\pi\varepsilon_0 a^2\sqrt{2}}(1,1)$$

Charge Q+ :

$$\vec{E} = \frac{Q}{4\pi\varepsilon_0 \|\vec{r}-\vec{r}'\|^2} \frac{(r-r')}{\|\vec{r}-\vec{r}'\|}$$

$$\vec{E} = \frac{Q}{4\pi\varepsilon_0\left(\sqrt{(2a)^2}\right)^2} \frac{(0,2a)}{\sqrt{(2a)^2}} = \frac{Q}{4\pi\varepsilon_0\, 4a^2} \frac{(0,2a)}{2a} = \frac{Q}{16\pi\varepsilon_0 a^2}(0,1)$$

$$\vec{E}_{a-} = \frac{-Q}{32\pi\varepsilon_0 a^2\sqrt{2}}(1,1)$$

$$\vec{E}_{a+} = \frac{Q}{16\pi\varepsilon_0 a^2}(0,1)$$

$$\vec{E}_{tot} = \vec{E}_{a-} + \vec{E}_{a+}$$

$$\vec{E}_{tot} = \frac{-Q}{32\pi\varepsilon_0 a^2\sqrt{2}}(1,1) + \frac{Q}{16\pi\varepsilon_0 a^2}(0,1)$$

$$\vec{E}_{tot} = \frac{Q}{16\pi\varepsilon_0 a^2}\left(\left(-\frac{1}{2\sqrt{2}}, -\frac{1}{2\sqrt{2}}\right) + (0,1)\right)$$

$$\vec{E}_{tot} = \frac{Q}{16\pi\varepsilon_0 a^2}\left(\frac{-1}{2\sqrt{2}}, \frac{2\sqrt{2}-1}{2\sqrt{2}}\right)$$

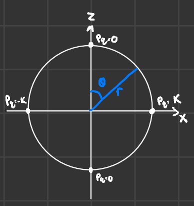
Exercise 2 :

$$\rho_q = K\frac{r^2}{a^2}\sin(\theta)$$

a) $r = a$ Car $\frac{a}{a}$ sera $=1$ donc le maximum parce que tu ne peut pas avoir un $r > a$

$\theta = \pi/2$ Car $\sin(0)=0$ $\sin(\pi)=0$ $\sin(\pi/2)=1$ donc à son maximum

b)



c)

$$Q_{tot} = \int_0^{\pi}\int_0^{2\pi}\int_0^{a} \rho_q \, d\vec{v}$$

$$Q_{tot} = \int_0^{\pi}\int_0^{2\pi}\int_0^{a} \rho_q \, r^2\sin(\theta)\, dr\, d\theta\, d\varphi$$

$$Q_{tot} = \int_0^{\pi}\int_0^{2\pi}\int_0^{a} K\frac{r^2}{a^2}\sin(\theta)\, r^2\sin(\theta)\, dr\, d\theta\, d\varphi$$

$$Q_{tot} = \frac{K}{a^2}\int_0^{\pi}\int_0^{2\pi}\int_0^{a} r^4\sin^2(\theta)\, dr\, d\theta\, d\varphi$$

$$Q_{tot} = \frac{K}{a^2}\int_0^{\pi} \frac{r^5}{5}\Big|_0^a \; \frac{1}{2}\theta - \frac{\sin(2\theta)}{4}\Big|_0^{2\pi} d\varphi$$

$$Q_{tot} = \frac{K}{a^2}\int_0^{\pi} \frac{a^5}{5}\pi \, d\varphi$$

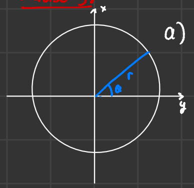
$$Q_{tot} = \frac{K}{a^2}\frac{a^5}{5}\pi\varphi\Big|_0^{\pi}$$

$$Q_{tot} = \frac{Ka^3}{5}\pi^2$$

Charge = Q

Champs = $\vec{E}$

Exercise 3:



$x = a\cos(\theta)$
$y = a\sin(\theta)$
$z = z$

Circonférence $= 2\pi r$
aire $= \pi r^2$
$r =$ du O au point
$r' =$ du O au champ
$\rho_a =$ volume $= dv$ $\quad r^2\sin(\theta)\,dr\,d\theta\,d\varphi$
$\sigma =$ aire $= dA = r^2\sin(\theta)\,d\theta\,d\varphi$
$\lambda =$ ligne $= dl = a\,dl$

sphere aire $= 4\pi r^2$
Volume sphere $\frac{4}{3}\pi r^3$

a) Puisque c'est une courbe on prends $d\vec{l} = a\,d\theta$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_C \lambda_a \frac{(\vec{r}-\vec{r}')}{\|\vec{r}-\vec{r}'\|^3}\,d\vec{l}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\lambda a\int_0^{2\pi}\frac{(\vec{r}-\vec{r}')}{\|\vec{r}-\vec{r}'\|^3}\,d\theta$$ remplacement du dl

$\vec{r} = (0, 0, z')$
$\vec{r}' = (a\cos(\theta), a\sin(\theta), 0)$

$\vec{r}-\vec{r}' = (-a\cos(\theta), -a\sin(\theta), z')$

$$\vec{E} = \frac{\lambda a}{4\pi\varepsilon_0}\int_0^{2\pi}\frac{(-a\cos(\theta), -a\sin(\theta), z')}{\underbrace{\|(-a\cos(\theta), -a\sin(\theta), z')\|^3}}\,d\theta = \frac{\lambda a}{4\pi\varepsilon_0}\int_0^{2\pi}\frac{(-a\cos(\theta), -a\sin(\theta), z')}{(a^2+z'^2)^{3/2}}$$ car on a supprimer voir explication ligne suivante

$$\left(\sqrt{(-a\cos(\theta))^2, -a\sin(\theta)^2, z'^2}\right)^3$$

$$\left(\sqrt{(-a)^2, (z')^2}\right)^3$$ car $\sin(0)=0$ $\sin(2\pi)=0$ et $\cos(0)=1$ et $\cos(2\pi)=1$ simplification

$$\vec{E} = \frac{\lambda a}{4\pi\varepsilon_0(a^2+z'^2)^{3/2}}\int_0^{2\pi}(-a\cos(\theta), \sin(\theta), z')\,d\theta$$ Parce que $(a^2+z'^2)^{3/2}$ c'est une constante

$$\vec{E} = \frac{\lambda a}{4\pi\varepsilon_0(a^2+z'^2)^{3/2}}\underbrace{(-a\sin(\theta), a\cos(\theta), z'\theta)}_{0-0 \quad 1-1 \quad ,\ z'2\pi-0}\Big|_0^{2\pi}$$ On intègre chaque un par un

$$\vec{E} = \frac{\lambda a}{4\pi\varepsilon_0(a^2+z'^2)^{3/2}}(0, 0, z'2\pi)$$

$$\vec{E} = \frac{\lambda a 2\pi z'}{4\pi\varepsilon_0(a^2+z'^2)^{3/2}}(\hat{e}_z)$$

Charge électrique sur toute l'anneau donc

$Q = \int \lambda\,dl$ $\qquad dl = a\,d\theta$

$Q = \int_0^{2\pi}\lambda a\,d\theta$

$Q = \lambda a 2\pi$

$\lambda = \frac{Q}{a2\pi}$

$$\vec{E} = \frac{Q a 2\pi z'}{a4\pi\varepsilon_0(a^2+z'^2)^{3/2}2\pi}(\hat{e}_z)$$

$$\vec{E} = \frac{Qz'}{4\pi\varepsilon_0(a^2+z'^2)^{3/2}}(\hat{e}_z)$$

b) $\vec{F}_{ab} = \vec{E}_a Q_b$ $\qquad Q_b = 1$, $r = 0{,}10$, $z' = 1$

$$\vec{F}_{ab} = \frac{Qz'}{4\pi\varepsilon_0(a^2+z'^2)^{3/2}}(\hat{e}_z)\cdot Q_b$$

$$\vec{F}_{ab} = \frac{1\cdot 1}{4\pi\varepsilon_0(0{,}1+1^2)^{3/2}}(\hat{e}_z)\cdot 1$$

$$\vec{F}_{ab} = \frac{1}{4\pi\varepsilon_0}\hat{e}_z\cdot 1$$

$$\vec{F}_{ab} = \frac{1}{4\pi\varepsilon_0}\hat{e}_z \text{ ou } \left(0, 0, \frac{1}{4\pi\varepsilon_0}\right)$$

c) $$\vec{V} = \frac{1}{4\pi\varepsilon_0}\int\frac{\lambda}{\|\vec{r}-\vec{r}'\|}\,d\vec{l}$$

$$\vec{V} = \frac{\lambda a}{4\pi\varepsilon_0}\int_0^{2\pi}\frac{1}{\|r-r'\|}\,d\theta$$ ajout de a car $dl = a\,d\theta$

$$\vec{V} = \frac{\lambda a}{4\pi\varepsilon_0}\int_0^{2\pi}\frac{1}{(a^2+z'^2)^{1/2}}\,d\theta$$ Parce que $-a\cos(0) = 1$, $\cos(2\pi) = 1$; $-a\sin(0) = 0$, $\sin(2\pi) = 0$; donc c'est seulement a^2 qu'il reste

$$\vec{V} = \frac{\lambda a}{4\pi\varepsilon_0(a^2+z'^2)^{1/2}}\int_0^{2\pi}1\,d\theta$$

$Q = \int \lambda\,dl$
$Q = \int_0^{2\pi}\lambda a\,d\theta$
$Q = \lambda a 2\pi$
$\lambda = \frac{Q}{a2\pi}$

$$\vec{V} = \frac{\cancel{\lambda} a 2\pi a}{4\pi\varepsilon_0(a^2+z'^2)^{1/2}a2\pi}$$

$$\vec{V} = \frac{Q}{4\pi\varepsilon_0(a^2+z'^2)^{1/2}} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{Q}{\underbrace{(a^2+z'^2)^{1/2}}_{\|\vec{r}-\vec{r}'\|}}$$

Exercise 4:

a) Théorème de Gauss $\oint \vec{E} \cdot da = \dfrac{Q_{in}}{\varepsilon_0}$

$\int da = 2\pi\rho l$ c'est l'aire interne du cable (les murs) Circonference · Longueur crée un tube vide

$$E \cdot 2\pi\rho l = \frac{Q_{in}}{\varepsilon_0}$$

$$E = \frac{Q_{in}}{2\pi\rho l \varepsilon_0}$$

λ est la charge par unite de longuer

$\lambda = \dfrac{Q}{l} \Rightarrow Q = \lambda l$

$$E = \frac{\lambda l}{2\pi\rho l \varepsilon_0} = \frac{\lambda}{2\pi\rho\varepsilon_0}$$

Notes Cours Payé

b)
$$\Delta V = -\int_{P_0}^{P} \vec{E}\, d\vec{l}$$

$$= -\int_{R_1}^{R_2} \frac{\lambda}{2\pi\rho\varepsilon_0}\, d\rho$$

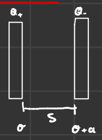
$$= -\frac{\lambda}{2\pi\varepsilon_0} \int_{R_1}^{R_2} \frac{1}{\rho}\, d\rho$$

$$= -\frac{\lambda}{2\pi\varepsilon_0} \ln|R_2| - \ln|R_1|$$

$$= \frac{\lambda}{2\pi\varepsilon_0} \ln|R_1| - \ln|R_2|$$

$$\Delta V = \frac{\lambda}{2\pi\varepsilon_0} \ln\left|\frac{R_1}{R_2}\right|$$

Exercice 5 :



$\sigma(x) = \sigma_0 + \frac{x}{3} a$

$J = \sigma \vec{E} \qquad \sigma = \frac{\vec{J}}{\vec{E}}$

$I = \vec{J} S$

$R = \frac{L}{\sigma a}$

$R = \frac{L}{\frac{J a}{E}} = R \vec{J} a = L \vec{E}$

$R \vec{J} \cdot \vec{s} = L \vec{E}$

$R I = L \vec{E}$

$\vec{E} = \frac{R I}{L}$

$I = \vec{J} \cdot S \quad s : \text{surface}$

Refaire

Exercise 6:

$\vec{E} = -\nabla V$ $\qquad$ α $\tau = \ln|\sigma|$ $\qquad$ Refaire

$\Delta V + \nabla V \cdot \nabla \tau = 0$

$\nabla^2 V + \nabla V \cdot \nabla \tau = 0$

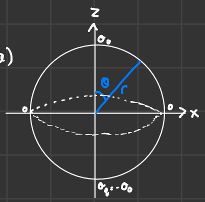
$\frac{-\rho_a}{\varepsilon_0} + \nabla V \cdot \nabla(\ln|\sigma|)$

Procedurale 2:

Exercice 1:

$\sigma_q = \sigma_0 \cos(\theta)$

a)



b) $\vec{p} = \int_v r \cdot \rho_e \, dv$ $\quad [r\sin(\theta)\cos(\varphi),\ r\sin(\theta)\sin(\varphi),\ r\cos(\theta)]$

$$\vec{p} = \int_A [r\sin(\theta)\cos(\varphi),\ r\sin(\theta)\sin(\varphi),\ r\cos(\theta)]\ \sigma_0 \cos(\theta)\ r^2\sin(\theta)\ d\theta\, d\varphi$$

$$\vec{p} = r^3\sigma_0 \int_A \underbrace{\sin^2(\theta)\cos(\theta)\cos(\varphi)\ \hat{e}_x}_{0} + \underbrace{\sin^2(\theta)\cos(\theta)\sin(\varphi)\ \hat{e}_y}_{0} + \cos^2(\theta)\sin(\theta)\ \hat{e}_z \ d\theta\, d\varphi$$

$$\vec{p} = r^3\sigma_0 \int_0^{2\pi}\int_0^{\pi} \cos^2(\theta)\sin(\theta)\ \hat{e}_z \ d\theta\, d\varphi$$

$u = \cos(\theta)$

$du = -\sin(\theta)\, d\theta$

$\underbrace{\cos^2(\theta)}_{u^2}\ \underbrace{\sin(\theta)}_{-du}$

$-u^2\, du$

$-\frac{u^3}{3}\Big|_0^{\pi}$

$-\frac{\cos^3(\theta)}{3}\Big|_0^{\pi}$

$$\vec{p} = r^3\sigma_0 \int_0^{2\pi} -\frac{\cos^3(\theta)}{3}\Big|_0^{\pi}\ d\varphi$$

$$\vec{p} = r^3\sigma_0 \int_0^{2\pi} \frac{1}{3} - -\frac{1}{3} = \frac{2}{3}\ d\varphi$$

$$\vec{p} = \frac{r^3\sigma 2}{3}\ \varphi\Big|_0^{2\pi}$$

$$\vec{p} = \frac{r^3\sigma_0 4\pi}{3}\ \hat{e}_z \qquad r = a$$

$$\vec{p} = \frac{a^3\sigma_0 4\pi}{3}\ \hat{e}_z$$

c) Oui il fait du sens car les dipoles sont seulement sur l'axe des z

Exercises 2:

$$\mathcal{E} = \frac{1}{2}\int_V \rho_e V \, dv \Rightarrow \mathcal{E} = \int_V \frac{\varepsilon_0 E^2}{2} \, dv$$

$$\nabla \cdot \vec{E} = \frac{\rho_e}{\varepsilon_0} \qquad \nabla^2 V = \frac{-\rho_e}{\varepsilon_0}$$

$$\nabla \cdot \vec{E} = -\nabla^2 V$$

a) $\vec{E} = -\nabla V$

$$\nabla \vec{E} = \frac{\rho_e}{\varepsilon_0}$$

b) $\nabla \cdot (V \nabla V) = \nabla V \cdot \nabla V + V \nabla^2 V$

il faut distribué à chaque et additionner

$$\nabla V \nabla V + V \nabla^2 V = \nabla V \nabla V + V \nabla^2 V$$

c) $\rho_e V = \varepsilon_0 \vec{E} \cdot \vec{E} - \varepsilon_0 \nabla \cdot (V \nabla V) = \varepsilon_0 E^2 - \varepsilon_0 \nabla \cdot (V \nabla V)$

$$\nabla V \nabla V + V \nabla^2 V = \nabla \cdot (V \nabla V)$$

$$\vec{E} = -\nabla V$$

$$\nabla \vec{E} = \frac{\rho_e}{\varepsilon_0}$$

$$-\vec{E} \cdot -\vec{E} + V(\nabla^2 V) = \nabla \cdot (V \nabla V)$$

$$\nabla E = -\nabla^2 V$$

$$\frac{\rho_e}{\varepsilon_0} = -\nabla^2 V$$

$$\frac{-\rho_e}{\varepsilon_0} = \nabla^2 V$$

$$\vec{E}^2 + V\left(-\frac{\rho_e}{\varepsilon_0}\right) = \nabla \cdot (V \nabla V)$$

$$\varepsilon_0 \nabla (V \nabla V) - \varepsilon_0 \vec{E}^2 = -V \rho_e$$

$$\varepsilon_0 \vec{E}^2 - \varepsilon_0 \nabla (V \nabla V) = V \rho_e$$

c) $\mathcal{E} = 0$ à ∞

$$\mathcal{E} = \frac{1}{2}\int_V \varepsilon_0 E^2 - \varepsilon_0 \nabla (V \nabla V) \, dv$$

$$\mathcal{E} = \frac{1}{2}\int_V \varepsilon_0 E^2 \, dv - \frac{1}{2}\int \varepsilon_0 \nabla (V \nabla V) \, dv$$

$$\mathcal{E} = \frac{1}{2}\int_V \varepsilon_0 E^2 \, dv - \underbrace{\frac{1}{2}\varepsilon_0 \oint_S V \nabla V \cdot \hat{n} \, dA}_{\text{0, car il a seulement du potentiel à la surface le reste c'est infini}}$$

Exercise 3:

$$\mathcal{E} = \frac{1}{2}\sum_{i=1}^{N} Q V_i$$

$$V_{Q_1}(Q_2) = \frac{Q_2}{4\pi\varepsilon_0 s} = \frac{-Q}{4\pi\varepsilon_0 s}$$

à la position Q_2 c'est quoi la force senti de Q_1

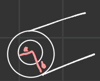
$$V_{Q_2}(Q_1) = \frac{Q_1}{4\pi\varepsilon_0 s} = \frac{Q}{4\pi\varepsilon_0 s}$$

$$\mathcal{E}_{tot} = \frac{1}{2}\left(\frac{Q \cdot -Q}{4\pi\varepsilon_0 s} + \frac{-Q \cdot Q}{4\pi\varepsilon_0 s}\right) = \frac{1}{2}\left(\frac{-Q^2}{2\pi\varepsilon_0 s}\right)$$

$$\mathcal{E}_{tot} = \frac{-Q^2}{4\pi\varepsilon_0 s}$$

où s est la distance entre les deux

Exercise 4:



$$\lambda = \frac{Q}{l}$$

$$Q = \lambda l$$

$$\oint \vec{E} \cdot da = \frac{Q_{in}}{\varepsilon_0}$$ Gauss

$$\oint \vec{E} \cdot da = \frac{\lambda l}{\varepsilon_0}$$

$$\int da = 2\pi \rho l$$

$$E \cdot 2\pi\rho l = \frac{\lambda l}{\varepsilon_0}\hat{e}_\rho$$

$$\vec{E} = \frac{\lambda l}{2\pi\rho l\varepsilon_0}\hat{e}_\rho$$

$$\vec{E} = \frac{\lambda}{2\pi\rho\varepsilon_0}\hat{e}_\rho$$

$$\vec{E} = -\nabla V \qquad \nabla f = \frac{\partial f}{\partial \rho}\hat{\rho} + \frac{1}{\rho}\frac{\partial f}{\partial \theta}\hat{\theta} + \frac{\partial f}{\partial z}\hat{z}$$

$$\vec{E} = -\frac{\partial V}{\partial \rho}\hat{e}_\rho$$

$$-\frac{\partial V}{\partial \rho}\hat{e}_\rho = \frac{\lambda}{2\pi\rho\varepsilon_0}\hat{e}_\rho$$

$$\frac{\partial V}{\partial \rho}\hat{e}_\rho = \frac{-\lambda}{2\pi\rho\varepsilon_0}\hat{e}_\rho$$

$$\int \frac{\partial V}{\partial \rho}\hat{e}_\rho\, d\rho = \int -\frac{\lambda}{2\pi\rho\varepsilon_0}\hat{e}_\rho\, d\rho$$

$$V = \frac{-\lambda}{2\pi\varepsilon_0}\int_a^b \frac{1}{\rho}\, d\rho$$

$$V = \frac{-\lambda}{2\pi\varepsilon_0}\left(\ln|b| - \ln|a|\right) = \frac{\lambda}{2\pi\varepsilon_0}\left(\ln|b| - \ln|a|\right)$$

$$= \frac{\lambda}{2\pi\varepsilon_0}\ln\left|\frac{b}{a}\right|$$

Etude comment partir

IMPORTANT

$$\int dA = 2\pi\rho l\ \hat{e}_\rho$$

$$\lambda = \frac{Q}{l}$$

$$Q = \lambda l$$

$$\vec{E}\int dA = \frac{\lambda l}{\varepsilon_0}$$ loi de Gauss

$$\vec{E}\, 2\pi\rho l = \frac{\lambda l}{\varepsilon_0}$$

$$\vec{E} = \frac{\lambda l}{2\pi\rho l\varepsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi\rho\varepsilon_0}\hat{e}_\rho$$

Champ électrique tout près de la surface d'un conducteur $E = \frac{\sigma}{\varepsilon_0}\hat{n}$

b) $C = \frac{Q}{V}$

$V = \frac{\lambda}{2\pi\varepsilon_0} \ln\left|\frac{b}{a}\right|$

$\lambda = \frac{Q}{l}$ $\quad Q = \lambda l$

$$C = \frac{\lambda l}{\frac{\lambda}{2\pi\varepsilon_0} \ln\left|\frac{b}{a}\right|}$$

$$C = \frac{2\pi\varepsilon_0 \lambda l}{\lambda \ln\left|\frac{b}{a}\right|}$$

$$C = \frac{2\pi\varepsilon_0 l}{\ln\left|\frac{b}{a}\right|}$$

on demande charge par longueur

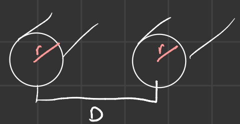
$$\frac{C}{l} = \frac{2\pi\varepsilon_0}{\ln\left|\frac{b}{a}\right|}$$

c) $\mathcal{E} = \frac{CV^2}{2}$

$$\mathcal{E} = \frac{\frac{2\pi\varepsilon_0 l V^2}{\ln\left|\frac{b}{a}\right|}}{2}$$

$$\mathcal{E} = \frac{4\pi\varepsilon_0 l V^2}{\ln\left|\frac{b}{a}\right|} = \frac{\mathcal{E}}{l} = \frac{\pi\varepsilon_0 V^2}{\ln\left|\frac{b}{a}\right|}$$

d)



$$\Delta V = \frac{\lambda}{2\pi\varepsilon_0} \ln\left|\frac{b}{a}\right|$$

$$V_r - V_0 = \frac{\lambda}{2\pi\varepsilon_0}\left(\ln\left|\frac{r}{D}\right| - \ln\left|\frac{D}{r}\right|\right)$$

$$V_1 - V_0 = \frac{\lambda}{2\pi\varepsilon_0}\left(\ln\left|\frac{r}{D}\right| + \ln\left|\frac{r}{D}\right|\right)$$

$$V_1 - V_0 = \frac{\lambda \ln\left|\frac{r}{D}\right|}{\pi\varepsilon_0}$$

$$\underbrace{V_1 - V_0}_{V} = \frac{Q}{l} \cdot \frac{1}{\pi\varepsilon_0} \ln\left|\frac{r}{D}\right)$$

étude comment partir

$$l = \frac{Q}{V} \frac{1}{\pi\varepsilon_0} \ln\left|\frac{r}{D}\right)$$

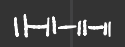
$$l = C \frac{1}{\pi\varepsilon_0} \ln\left|\frac{r}{D}\right)$$

$$\frac{\pi\varepsilon_0}{\ln\left|\frac{r}{D}\right)} = \frac{C}{l}$$

Exercise 5 :

$$C \approx \varepsilon_0 (N-1) \frac{A}{T}$$

$(N-1)$ car on a besoin de deux plaques



ils soient en serie donc on les additionne

$$\vec{E} = \frac{\sigma}{\varepsilon_0} \qquad \sigma = \frac{Q}{A} \qquad \text{donc} \quad \vec{E} = \frac{Q}{\varepsilon_0 A}$$

$$V = \int_p^b E\,dl$$

$$V = \int_0^s \frac{Q}{\varepsilon_0 A}\,dr \; = V = \frac{Qs}{\varepsilon_0 A}$$

Savoir $V = \int_p^{b} E\,dL$

$$E = \frac{Q}{\varepsilon_0 A} \qquad V = \frac{Qt}{\varepsilon_0 A}$$

$$C = \frac{Q}{V} = C = \frac{Q}{\frac{Qt}{\varepsilon_0 A}} = C = \frac{\varepsilon_0 A}{t}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{n-1}$$

$$\frac{1}{C_{eq}} = \frac{N-1}{C}$$ car tout les plaques sont pareille

$$C = (N-1)\,C_{eq}$$

$$(N-1)\,C_{eq} = \frac{\varepsilon_0 A}{t} \Rightarrow C_{eq} = \frac{\varepsilon_0 A}{t(N-1)}$$

Exercice 68

a) $\mathcal{E}_{tot} = \dfrac{Q^2}{2C} + \dfrac{Q^2}{2C}$

$\mathcal{E}_{tot\ avant} = \dfrac{Q_1^2}{2C_1} + \dfrac{Q_2^2}{2C_2}$

b)

$Q_{tot} = C \cdot V$

$C_{tot} = C_1 + C_2$

$Q_{tot} = (C_1 + C_2) \cdot V = Q_1 + Q_2$

$\mathcal{E}_{tot\ après} = \dfrac{(Q_1 + Q_2)^2}{2(C_1 + C_2)}$

$\mathcal{E}_{tot\ après} = \dfrac{1}{2} \cdot \dfrac{Q_1^2 + 2Q_1Q_2 + Q_2^2}{C_1 + C_2}$

Procedurale 3:

Exercise 1:

$V = \frac{m}{s}$ $\quad r = m$

a) $f = \frac{V}{r}$ mais en Hz

$w = \frac{V}{2\pi r}$ en rad

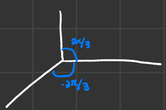
b) $I = \frac{\Delta Q}{t} = \Delta Q \cdot w = \frac{QV}{2\pi r}$

c) $\vec{m} = I \cdot \vec{a} \quad = \vec{m} = I \cdot A\hat{n}$

$\vec{m} = \frac{QV}{2\pi r} \pi r^2$

$\vec{m} = \frac{QVr}{2} \hat{n}$

Exercise 2:



a) $B_{tot} = B_a + B_b + B_c$

$B_a = \hat{a}_x$

$B_b = (\cos(\frac{2\pi}{3}), \sin(2\pi/3))$

$B_c = (\cos(\frac{2\pi}{3}), -\sin(2\pi/3))$

$B_x = B_m \cos(wt) + B_m \cos(wt + \frac{2\pi}{3}) \cos(\frac{2\pi}{3}) + B_m \cos(wt - \frac{2\pi}{3}) \cos(2\pi/3)$

$B_x = B_m (\cos(wt) + \cos(wt) \cos(\frac{2\pi}{3}) \cos(\frac{2\pi}{3}) - \sin(wt) \sin(\frac{2\pi}{3}) \cos(\frac{2\pi}{3}) \ldots)$

$B_x = B_m \cos(wt) (1 + 2\cos^2(\frac{2\pi}{3}))$

$B_y = B_m \cos(wt) + B_m \cos(wt + \frac{2\pi}{3}) \sin(\frac{2\pi}{3}) + B_m \cos(wt - \frac{2\pi}{3}) \sin(2\pi/3)$

$B_y = B_m (\cos(wt) + \cos(wt) \cos(\frac{2\pi}{3}) \sin(\frac{2\pi}{3}) - \sin(wt) \sin(2\pi/3) \sin(\frac{2\pi}{3}) + \cos(wt) \cos(\frac{2\pi}{3}) \sin(2\pi/3) + \sin(wt) \sin(\frac{2\pi}{3}) \sin(2\pi/3))$

$B_y = B_m \cos(wt) (- 2\sin^2(\frac{2\pi}{3}))$

Exercise 3 :

$$B_z = \frac{\mu_0 I a^2}{2(a^2+(z-z_0)^2)^{3/2}}$$

$$\vec{B} = \frac{\mu_0 I}{4\pi}\int_C \frac{d\vec{l} \times (\vec{r}-\vec{r}')}{\|\vec{r}-\vec{r}'\|^3}$$

Exercise 4 :

$$B = \frac{\mu_0 I a^2}{2(a^2+(z-z_0)^2)^{3/2}} + \frac{\mu_0 I a^2}{2(a^2+(z-z_0)^2)^{3/2}}$$