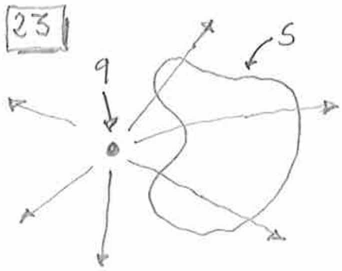
23



$$\underbrace{\oint \vec{E}\cdot d\vec{S}}_{=0} = \frac{\sum q_i}{\varepsilon_0}$$

$\boxed{\sum q_i = 0}$

FLUX = 0
⇒ PAS DE CHARGES !

FLUX = 0
$\not\Rightarrow$ $\vec{E} = 0$
MEME si $\vec{E} = 0$ ⇒ FLUX 0 :-)

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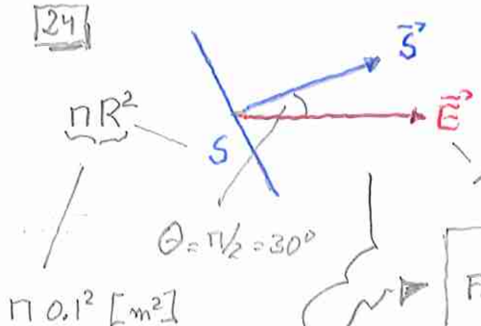
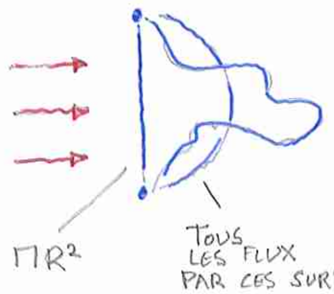


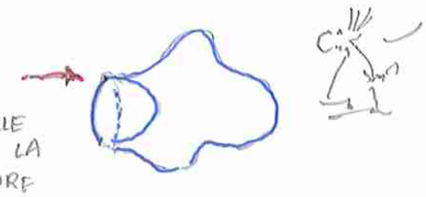
$$\boxed{\text{FLUX} = S E \underbrace{\cos(\varphi)}_{1/2} = \pi/2 \ [N m^2/C]}$$

25



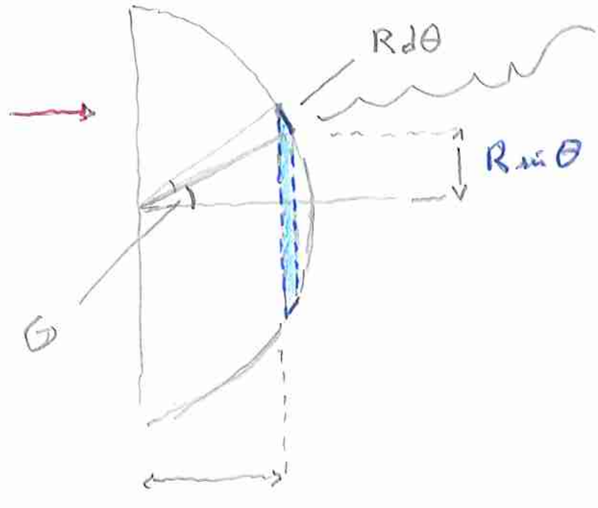
$\boxed{\text{FLUX} = \pi R^2 E}$

TOUS LES FLUX PAR CES SURFACES SONT IDENTIQUES
- LE CERCLE .... OU
LA DEMI-SPHERE ....
OU N'IMPORTE QUELLE SURFACE QUI A LA MEME OUVERTURE



YES SO EASY !

- ET SI TU N'ES PAS CONVAINCU ET QUE TU AIMES L'ALGEBRE !



$$d\text{FLUX} = \overbrace{\underbrace{2\pi R \sin\theta \ R d\theta}_{\text{SURFACE COURONNE } dS \text{ :-)}} \cos(\theta)\, E}^{d\vec{S}\cdot\vec{E}}$$

$$\boxed{\text{FLUX} = 2\pi R^2 E \underbrace{\int_0^{\pi/2} \sin\theta \cos\theta \, d\theta}_{\left[\frac{\sin^2\theta}{2}\right]_0^{\pi/2}} = \pi R^2 E}$$

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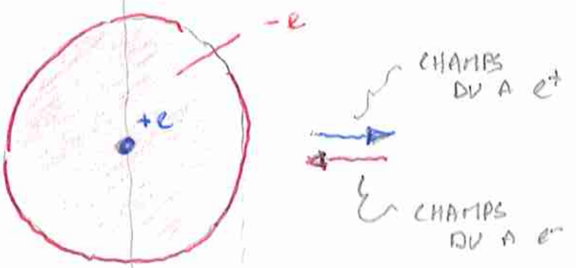

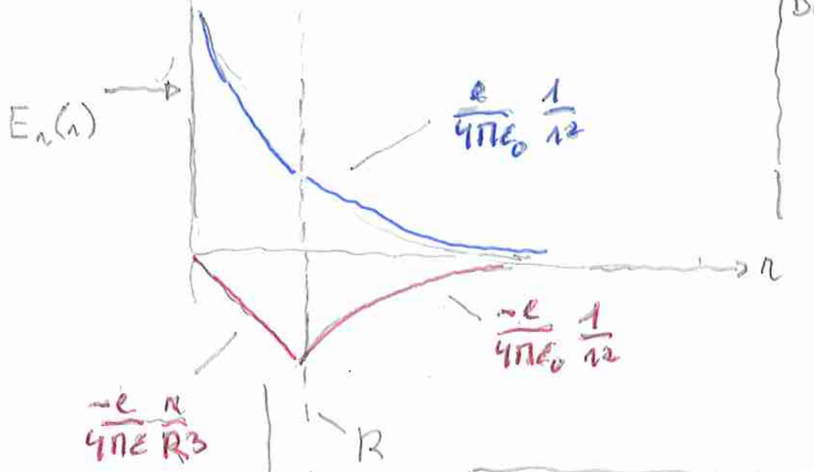

IL SUFFIT DE <u>SUPERPOSER</u> LES CHAMPS D'UNE CHARGE PONCTUELLE $+e$ ET D'UNE CHARGE $-e$ RÉPARTIE SUR LA SPHÈRE

APPLICATION CAS PARTICULIER #1

$$\boxed{E(r) = \frac{e}{4\pi\varepsilon_0}\left[\frac{1}{r^2} - \frac{r}{R^3}\right]}$$

APPLICATION CAS PARTICULIER #2

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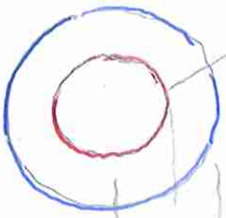


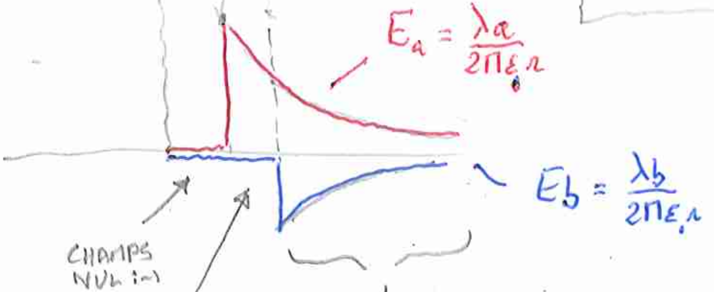
$\lambda_a = \sigma_a 2\pi R_a$

$\lambda_b = \underbrace{\sigma_b 2\pi R_b}$

ON <u>SUPERPOSE</u> LES CHAMPS DE DEUX LIGNES CHARGÉES !

ASTUCE ! $\sigma \to \lambda$

OUUUPSSS :-)



CHAMPS NUL À L'EXTÉRIEUR

$\lambda_a = -\lambda_b$

$$\boxed{R_a \sigma_a = -\sigma_b R_b}$$

$r \in [R_a, R_b]$

$$E(r) = \frac{1}{2\pi\varepsilon_0}\frac{R_a}{r}\sigma_a$$

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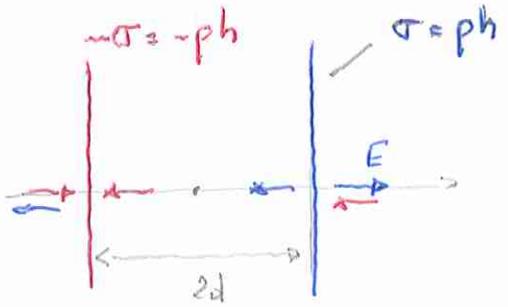
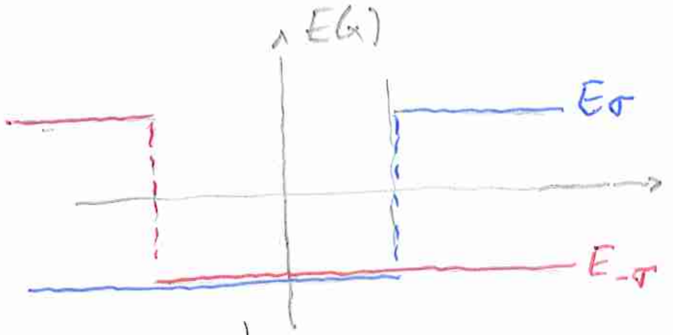
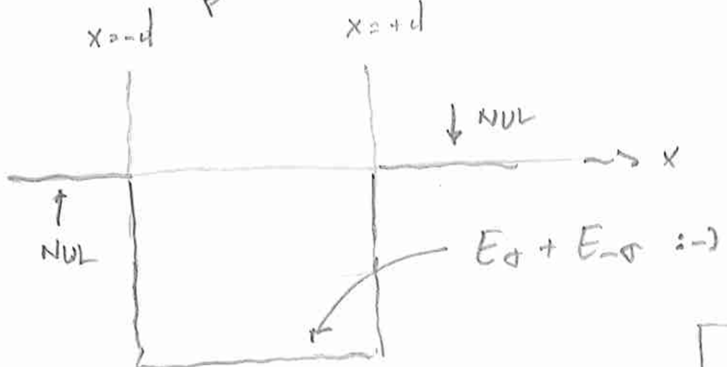


ON SUPERPOSE
LES CHAMPS DE DEUX
PLANS CHARGÉS :-)

APPLICATION
CAS PARTICULIER # 3

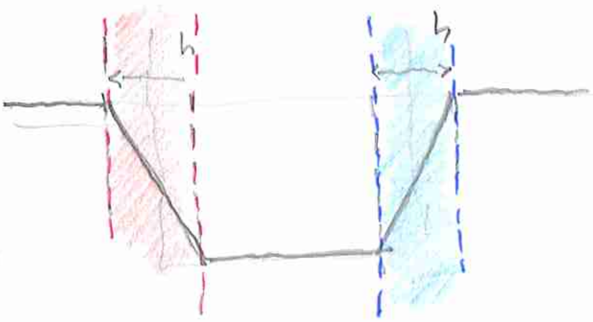


EN
ADDITIONNANT :-)



TOUS
LES EXERCICES
SONT
TOUJOURS
CONSTRUITS SUR
LE MEME
PRINCIPE !

ET POUR TENIR
COMPTE DE L'EPAISSEUR



ASTUCE :-)

CONDUCTEUR
CHAMP
A L'INTERIEUR = 0 :-)

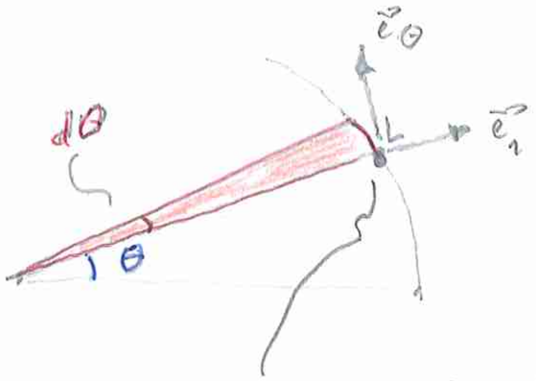
ISOLANT
VARIATION
LINEAIRE
DU CHAMPS :-)

29

$$\oint_S \vec{g} \cdot d\vec{S} = -4\pi G \sum m_i$$

L'ATTRACTION
EST UNE FORCE
ATTRACTIVE :-)

LA FORCE ELECTRIQUE
ENTRE 2 CHARGES IDENTIQUES
EST REPULSIVE



$$\vec{e}_r = \begin{bmatrix} \cos\theta \\ \sin\theta \end{bmatrix}$$

$$\vec{e}_\theta = \begin{bmatrix} -\sin\theta \\ \cos\theta \end{bmatrix}$$

$$\vec{x}(t) = \begin{bmatrix} r(t)\cos(\theta(t)) \\ r(t)\sin(\theta(t)) \end{bmatrix}_{xy} = x_x \vec{e}_x + x_y \vec{e}_y$$

CHAIN'S RULE !

$$\vec{v}(t) = \begin{bmatrix} r'\cos\theta - r\,\theta'\sin\theta \\ r'\sin\theta + r\,\theta'\cos\theta \end{bmatrix}_{xy}$$

$$\vec{a}(t) = \begin{bmatrix} r''\cos\theta - 2r'\theta'\sin\theta - r\cos\theta\,(\theta')^2 - r\sin\theta\,\theta'' \\ r''\sin\theta + 2r'\theta'\cos\theta - r\sin\theta\,(\theta')^2 + r\cos\theta\,\theta'' \end{bmatrix}_{xy}$$

$$= \left[r'' - r(\theta')^2\right]\vec{e}_r + \underbrace{\left[2r'\theta' + r\,\theta'\right]}\vec{e}_\theta$$

oui :-)

COMME L'UNIQUE FORCE EST SELON LA DIRECTION RADIALE !

LA COMPOSANTE a_θ EST NULLE

$$2\,\frac{dr}{dt}\,\frac{d\theta}{dt} + r\,\frac{d^2\theta}{dt^2} = 0$$

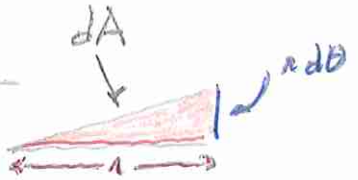
$$\underbrace{2r\,\frac{dr}{dt}\,\frac{d\theta}{dt} + r^2\,\frac{d^2\theta}{dt^2}} = 0$$

$$\frac{d}{dt}\Big[\underbrace{r^2\,\frac{d\theta}{dt}}\Big] = 0$$

CE TERME EST CONSTANT

$= k$

CALCULONS L'AIRE :-)



$$A = \int_{\theta}^{\theta+\Delta t} \frac{1}{2}\, r(\theta)\, r(\theta)\, d\theta$$

$$= \frac{1}{2}\int_{t_1}^{t+\Delta t} \underbrace{r^2(t)\,\frac{d\theta}{dt}(t)}_{=k}\, dt$$

$$= \frac{1}{2}\, k\, \Delta t \qquad \square$$