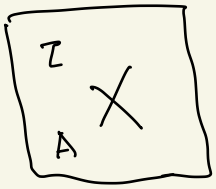
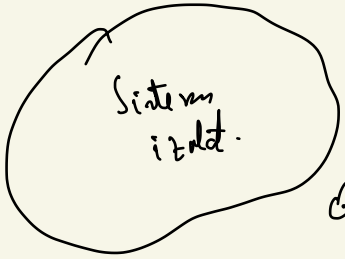
22 Decembrie 2021

3) Sarcina electrică totală a unui sistem izolat se conservă indiferent de natura proceselor care au loc în interiorul sistemului.

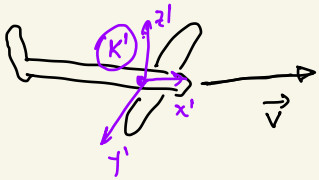


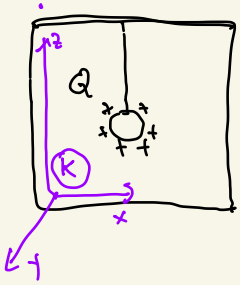
$$Q_{atom} = Z(-e) + Z(e) = 0$$

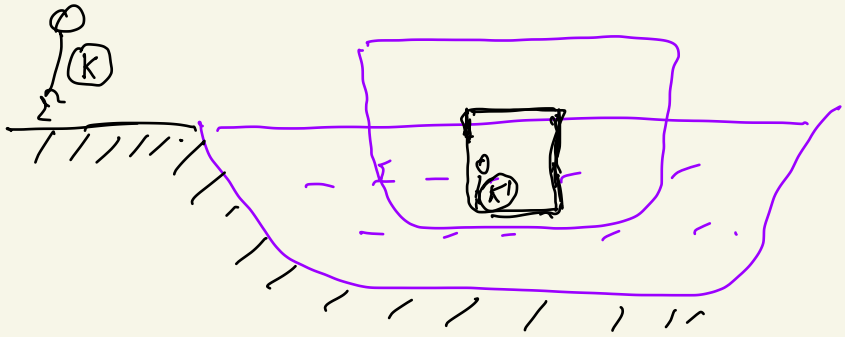


$$Q_i = Q_f = \text{const.}$$

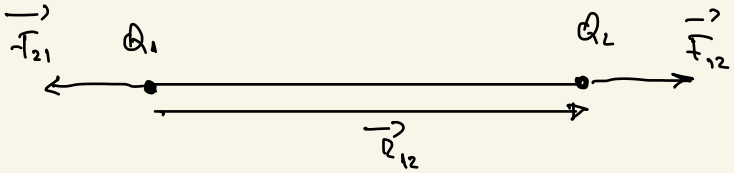
4) Sarcina electrică este un invariant relativist.







Legea lui Coulomb (1785)



$$|\vec{F}_{12}| = |\vec{F}_{21}| = k \frac{|q_1 q_2|}{|\vec{r}_{12}|^2}$$

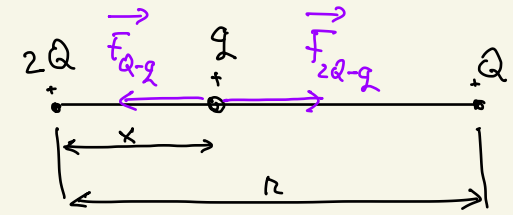
$$\vec{F}_{12} = k \cdot \frac{q_1 q_2}{|\vec{r}_{12}|^3} \vec{r}_{12}$$

$k = \frac{1}{4\pi\varepsilon_0}$, ε_0 permitivitate electrică a vidului.

$$\varepsilon_0 = 8{,}85 \cdot 10^{-12} \frac{F}{m}$$

$$k \approx 9 \cdot 10^9 \frac{N \cdot m^2}{C^2}$$

Ex.



$Q>0$

Aonde ca $\vec{F}_q = 0$.

Unde trebuie amplasată q?

I) $|\vec{F}_{Q-q}| = |\vec{F}_{2Q-q}|$

$$k\frac{|Qq|}{(r-x)^2} = k\frac{|2Qq|}{x^2}$$

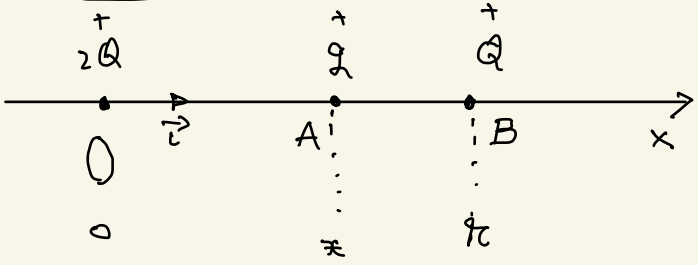
$$\frac{1}{(r-x)^2} = \frac{2}{x^2} \Rightarrow \frac{1}{r-x} = \frac{\sqrt{2}}{x} \Rightarrow$$

$$\Rightarrow x = \sqrt{2}r - x\sqrt{2} \Rightarrow x(1+\sqrt{2}) = r\sqrt{2} \Rightarrow$$

$$\Rightarrow x = \frac{r\sqrt{2}}{1+\sqrt{2}} = \frac{r\sqrt{2}(\sqrt{2}-1)}{(\sqrt{2}-1)(\sqrt{2}+1)} = \frac{r(2-\sqrt{2})}{2-1} = r(2-\sqrt{2})$$

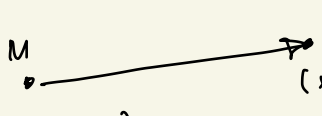
$$\simeq r(2-1{,}41) = r\cdot 0{,}59$$

II) Analitic



$$\vec{F}_q = \vec{F}_{OA} + \vec{F}_{BA} = k\frac{2Q\cdot q}{|\vec{OA}|^3}\vec{OA} + k\frac{Qq}{|\vec{BA}|^3}\cdot\vec{BA}$$

$\vec{OA} = ?$



$$\overrightarrow{MN} = (x_2 - x_1)\vec{i} + (y_2 - y_1)\vec{j} + (z_2 - z_1)\vec{k}$$

$$\begin{cases} O\,(0) \\ A\,(x) \end{cases}$$

$$\vec{OA} = (x - 0)\vec{i} = x\vec{i} \quad \Leftrightarrow \quad |\vec{OA}| = |x\vec{i}| = |x|$$

$\vec{BA} = ?$

$$\begin{cases} B\,(R) \\ A\,(x) \end{cases} \Rightarrow \vec{BA} = (x - R)\vec{i} \Rightarrow |\vec{BA}| = |x - R|$$

$$\vec{F}_q = k\frac{2Qq}{|x|^3} \cdot x\vec{i} + k\frac{Qq}{|x-R|^3} \cdot (x-R)\vec{i}$$

$$\vec{F}_q = kQq\vec{i}\left(\frac{2x}{|x|^3} + \frac{x-R}{|x-R|^3}\right) = 0$$

$$\Rightarrow \boxed{\frac{2x}{|x|^3} + \frac{x-R}{|x-R|^3} = 0}$$

1.) $x < 0$

$$\frac{2x}{(-x)^3} + \frac{x-R}{(R-x)^3} = 0$$

$$\frac{2x}{-x^3} + \frac{x-R}{(R-x)^3} = 0 \Rightarrow -\frac{2}{x^2} - \frac{1}{(R-x)^2} = 0$$

$\Rightarrow$ nu există soluții în intervalul $(-\infty, 0)$

2) $0 < x < R$

$$\frac{2x}{x^3} + \frac{x-R}{(R-x)^3} = 0$$

$$\frac{2}{x^2} - \frac{1}{(R-x)^2} = 0 \Rightarrow \frac{2}{x^2} = \frac{1}{(R-x)^2} \Rightarrow \boxed{x \approx 0{,}59R.}$$

3) $x > R$

$$\frac{2x}{x^3} + \frac{x-R}{(x-R)^3} = 0 \Rightarrow \frac{2}{x^2} + \frac{1}{(x-R)^2} = 0$$

$\Rightarrow$ nu avem soluții pe intervalul (R, ∞)

Lucrare scrisă 3 februarie 2022 ora 10