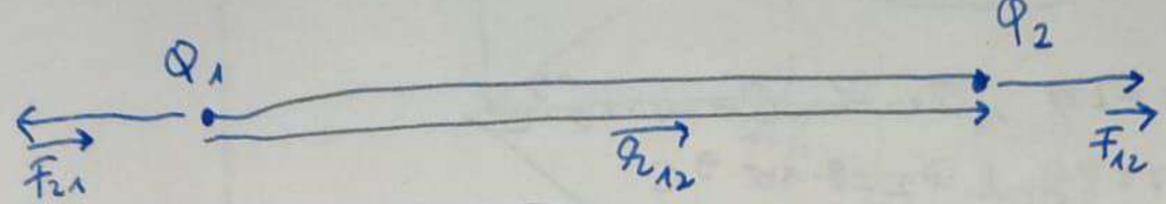
Curs Electricitate (3)

Legea lui Coulomb



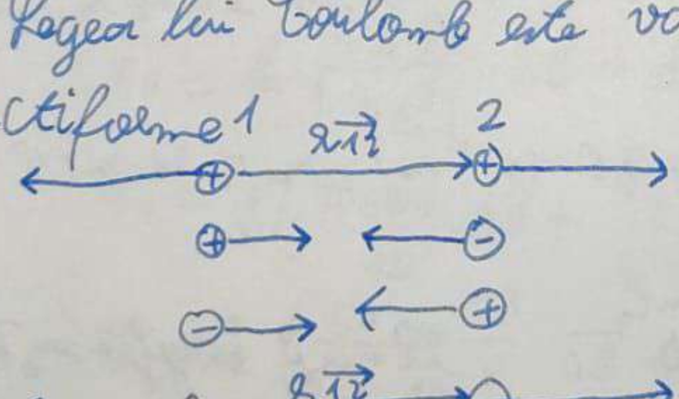
$$\boxed{\vec{F}_{12} = k \cdot \frac{Q_1 Q_2}{|\vec{r}_{12}|^3}\,\vec{r}_{12}}$$ scrierea vectorială

$$\boxed{|\vec{F}_{12}| = k \cdot \frac{|Q_1 Q_2|}{|\vec{r}_{12}|^2}}$$ scrierea scalară

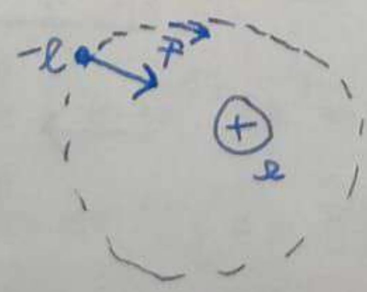
k - constanta lui Coulomb ; $k = \frac{1}{4\pi\varepsilon_0} \simeq 9\cdot 10^{9}\,\frac{Nm^2}{C^2}$

ε_0 - permitivitate electrică a vidului ; $\varepsilon_0 \simeq 8,85\cdot 10^{-12}\,\frac{F}{m}$

OBS Legea lui Coulomb este valabilă doar pentru corpuri punctiforme



Ex



$$|\vec{F}| = k\,\frac{|e(-e)|}{r^2} = \frac{ke^2}{r^2}$$

$$= \frac{9\cdot 10^{9}\cdot(1,6\cdot 10^{-19})^2}{(0,5\cdot 10^{-10})^2}\,N$$

$$= \frac{9\cdot10^{9}\cdot1{,}6^{2}\cdot10^{-38}}{25\cdot10^{-22}}N = \frac{9\cdot1{,}6^{2}}{25}\cdot10^{-7}N = \frac{36\cdot1{,}6^{2}}{10^{2}}\cdot10^{-7}N \simeq$$

$$\simeq 80\cdot10^{-9}N = 8\cdot10^{-8}N$$

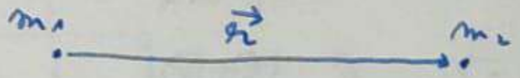
$\boxed{29/746}$ $m_1 = 2g$; $Q_1 = -4nC = -4\cdot10^{-9}C$

$m_2 = 4g$; $Q_2 = 8\cdot10^{-9}C$

$r = \cancel{2\,cm} = 2\cdot10^{-2}m$

$a_1 = ?$

$a_2 = ?$



$$|\vec{F}| = k\frac{Q_1 Q_2}{r^2} = 9\cdot10^{9}\frac{32\cdot10^{-18}}{4\cdot10^{-4}} =$$

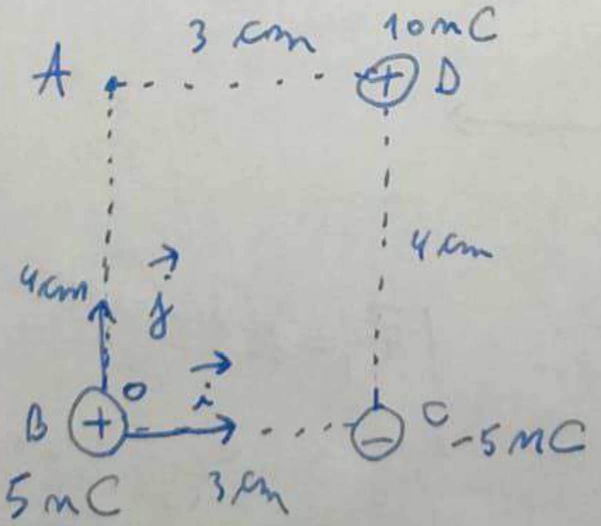
$$\Rightarrow |\vec{F}| = 72\cdot10^{-5}N$$

$$|\vec{F}| = m_2|a|$$

$$a_2 = \frac{|\vec{F}|}{m_2} = \frac{72\cdot10^{-5}}{4\cdot10^{-3}} = 18\cdot10^{-2}m/s^2 = 0{,}18\,m/s^2$$

$$a_1 = \frac{|\vec{F}|}{m_1} = \frac{72\cdot10^{-5}}{2\cdot10^{-3}} = 36\cdot10^{-2}m/s^2 = 0{,}36\,m/s^2$$

$\boxed{37/746}$



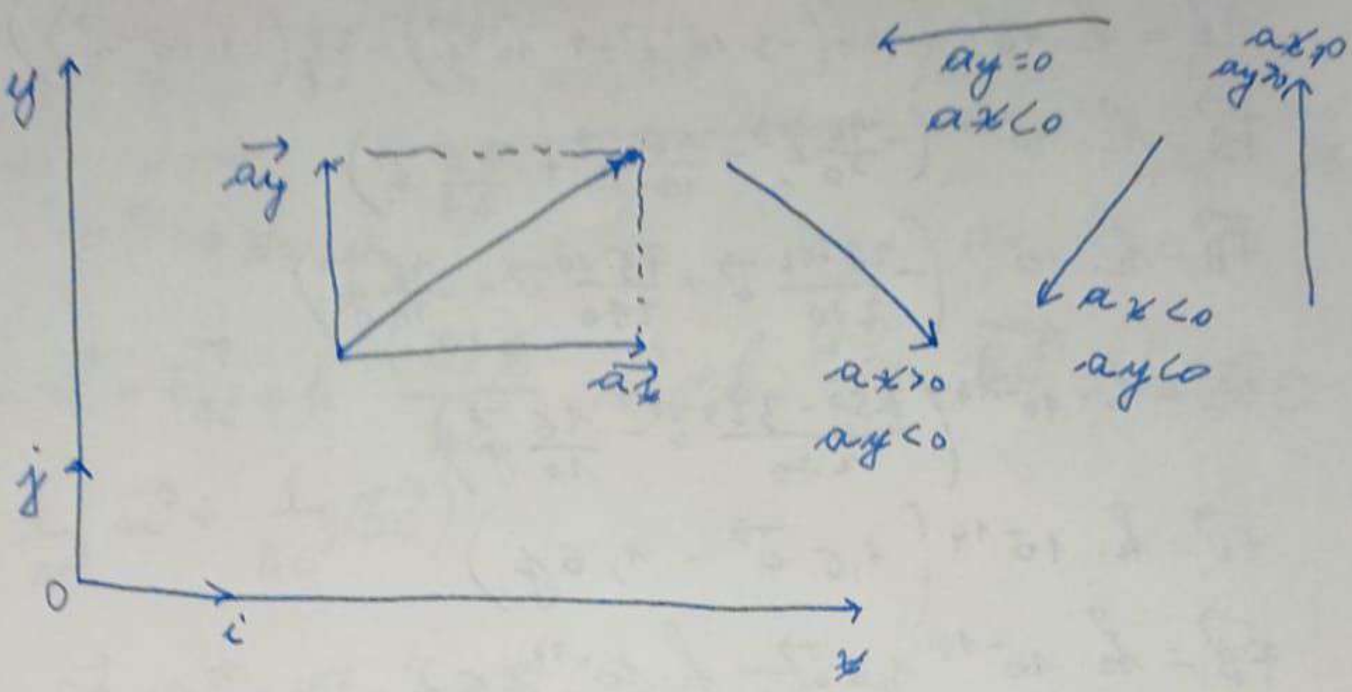
$$\vec{a} = a_x\vec{i} + a_y\vec{j} + a_z\vec{k}$$

$\vec{r}$

$$\frac{\vec{r}}{r} = \hat{r}$$

versor

$\hat{x}, \hat{y}, \hat{z}$



$$a = \vec{a_x} + \vec{a_y} = a_x \vec{i} + b_y \vec{j}$$

$$\boxed{|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}}$$

$$\vec{F_B} = \vec{F_{\Delta B}} + \vec{F_{CB}}$$

$$\vec{F_B} = k \cdot \frac{\varphi_\Delta \varphi_B}{|\Delta B^3|} \cdot \vec{\Delta B} + k \frac{\varphi_C \varphi_B}{|CB^3|} \cdot \vec{CB}$$

$$\vec{F_B} = k\left[\frac{\varphi_\Delta \varphi_B}{\Delta B^3} \cdot \vec{\Delta B} + \frac{\varphi_C \varphi_B}{CB^3} \cdot \vec{CB} \right]$$

$$\vec{F_B} = k \left(\frac{50 \cdot 10^{-18}}{125 \cdot 10^{-6}} \vec{\Delta B} + \frac{-25 \cdot 10^{-18}}{27 \cdot 10^{-6}} \vec{CB} \right)$$

$$\vec{F_B} = k \left(\frac{50}{125} \cdot 10^{-12} \vec{\Delta B} + \left(-\frac{25}{27} 10^{-12} \vec{CB} \right) \right)$$

$$= k \left(4 \cdot 10^{-13} \vec{\Delta B} + \frac{25}{27} \cdot 10^{-12} \vec{CB} \right)$$

$$= k \cdot 10^{-12} \left(0{,}4 \vec{\Delta B} - \frac{25}{27} \cdot \vec{CB} \right)$$

$$\vec{\Delta B} = -3 \cdot 10^{-2} \vec{i} - 4 \cdot 10^{-2} \vec{j}$$

$$\vec{CB} = -3 \cdot 10^{-2} \vec{i}$$

$$\vec{F_B} = k\cdot 10^{-12}\left(0{,}4\left(-3\cdot10^{-2}\vec{i}-4\cdot10^{-2}\vec{j}\right)-\frac{25}{27}\left(-3\cdot10^{-2}\vec{i}\right)\right)$$

$$\vec{F_B} = k\cdot 10^{-14}\left(-\frac{12}{10}\vec{i}-\frac{16}{10}\vec{j}+\frac{75}{27}\vec{i}\right)$$

$$\vec{F_B} = k\cdot10^{-14}\left(-\frac{27\cdot12}{270}\vec{i}+\frac{75\cdot10}{270}\vec{i}-\frac{16}{10}\vec{j}\right)$$

$$\vec{F_B}=k\cdot10^{-14}\left(\frac{750-324}{270}\vec{i}-\frac{16}{10}\vec{j}\right)$$

$$\vec{F_B}=k\cdot10^{-14}\left(1{,}6\,\vec{i}-1{,}6\,j\right)$$

$$\vec{F_B}=k\cdot10^{-14}\,1{,}6\,\vec{i}-k\cdot10^{-14}\,1{,}6\,j$$

$$\vec{F_B}=9\cdot10^{9}\cdot10^{-14}\cdot1{,}6\,\vec{i}-9\cdot10^{9}\cdot10^{-14}\,1{,}6\,\vec{j}$$

$$\vec{F_B}=9\cdot1{,}6\cdot10^{-5}\,\vec{i}-9\cdot1{,}6\cdot10^{-5}\,\vec{j}$$

$$\begin{cases} F_{Bx}=k\cdot10^{-14}\left(\frac{71}{45}\right)>0 \\ F_{By}=-k\,10^{-14}\,1{,}6<0 \end{cases} \quad \text{proiecții}$$

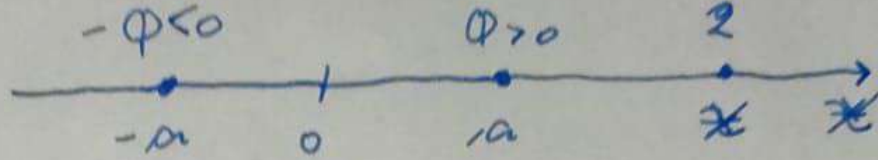
$$|\vec{F_B}|=\sqrt{F_{Bx}^2+F_{By}^2}$$

$$=\sqrt{\left(k\cdot10^{-14}\,\frac{71}{45}\right)^2+\left(k\cdot10^{-14}\cdot1{,}6\right)^2}$$

$$=9\cdot10^{-5}\cdot1{,}6\sqrt{2}=14{,}4\cdot10^{-5}\cdot1{,}4\,N=1{,}44\cdot10\cdot10^{-5}\cdot1{,}4\,N=$$

$$\simeq2\cdot10^{-4}\,N$$

$\boxed{\#5 / 747}$ $Q>0$
$x=a$
$-Q \rightarrow x=-a$



$$\vec{F_C} = \vec{F_{AC}} + \vec{F_{BC}} = k \cdot \frac{(-Q)\,q}{AC^3} \cdot \vec{AC} + k \cdot \frac{Q\,q}{BC^3} \cdot \vec{BC} = k \cdot Qq \cdot \left(-\frac{1}{AC^3}\vec{AC} + \frac{1}{BC^3}\vec{BC}\right)$$

$$\vec{AC} = \vec{OC} - \vec{OA} = x\vec{i} - (-a\vec{i}) = (x+a)\vec{i}$$

$$|\vec{AC}| = |(x+a)\vec{i}| = |x+a|$$

$$\vec{F_C} = kQq\left(\frac{x-a}{|x-a|^3} - \frac{x+a}{|x+a|^3}\right)\vec{i}$$

$$F_{Cx} = kQq\left(\frac{x-a}{|x-a|^3} - \frac{x+a}{|x+a|^3}\right)$$