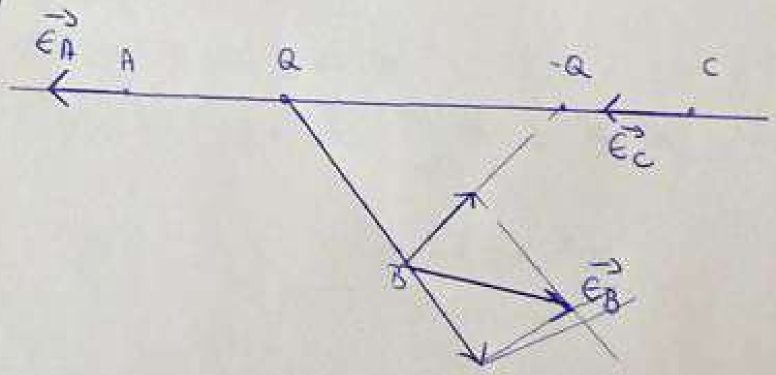
Vartopeanu Sebastian - Filip 03.02.2022

Grupa 164

Examen Electricitate

1)



2) $m_{Al} = 0,1\ kg$

$^{13}_{27}Al$ $\quad Z = 13 \Rightarrow$ 13 e^- (electroni), 13 p^+ (protoni) $\Big| \Rightarrow$ neutru

$A = 27 \Rightarrow \mu = 27 \cdot 10^{-3}\ kg/mol$

$\nu = \frac{m}{\mu} = \frac{N}{N_A}$

$\Rightarrow Q_{protoni} = N_{protoni} \cdot e = 13 \cdot 1,6 \cdot 10^{-19}\ C = 20,8 \cdot 10^{-19}\ C$

$N_A = 6,023 \cdot 10^{23}$

$\frac{m}{\mu} = \frac{N}{N_A} \Rightarrow N = \cancel{0,1 \cdot 10^{3}}\ \frac{0,1 \cdot 6,023 \cdot 10^{23}}{27 \cdot 10^{-3}} = 0,223 \cdot 10^{19}$ atomi

$N = \frac{m \cdot N_A}{\mu}$

$\Big| \Rightarrow Q_{Al} = 0,223 \cdot 10^{19} \cdot 20,8 \cdot 10^{-19} = 4,6384\ C$

$= N \cdot Q_{protoni}$

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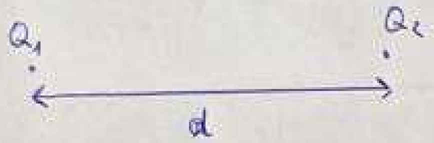
3.



$d = 30\,cm = 0{,}3\,m$

$Q_1 = Q_2 = 80\,nC = 80 \cdot 10^{-9}\,C$

$|\vec{F}_{12}| = |\vec{F}_{21}| = k \cdot \frac{Q_1 \cdot Q_2}{d^2} = 9 \cdot 10^9 \cdot \frac{64 \cdot 10^{-16}}{3^2 \cdot 10^{-2}} = \cancel{576 \cdot 10^{-5}}\,N$

$= 64 \cdot 10^{-5}\,N$

4.

$E = k \cdot \frac{Q}{r^2} = 9 \cdot 10^9 \cdot \frac{90 \cdot 10^{-9}}{2^2 \cdot 10^{-2}} = \frac{40{,}5}{2} \cdot 10^3\,\frac{N}{C}$

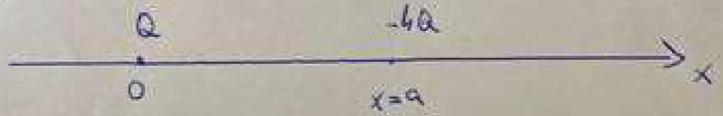
$Q = 90\,nC = 90 \cdot 10^{-9}\,C$

$d = r = 20\,cm = 2 \cdot 10^{-1}\,m$

$\frac{810}{4} \cdot 10^2\,\frac{N}{C}$

$20{,}25 \cdot 10^3\,\frac{N}{C}$

5)



Notez $x=a$ cu A
x_0 cu C

$\vec{F}_q = \vec{F}_{qQ} + \vec{F}_{-4Qq}$

$F_{qQ} = k \cdot \frac{Qq}{|\vec{OC}|^3} \cdot \vec{OC}$

$F_{-4Qq} = k \cdot \frac{-4Qq}{|\vec{AC}|^3} \cdot \vec{AC}$

$\vec{F}_q = \vec{F}_{qQ} + \vec{F}_{4Qq}$

$\vec{F}_q^{\,2} = (\vec{F}_{qQ} + \vec{F}_{4Qq})^2$

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$$|\vec{F_q}|^2 = |\vec{F_{qQ}}|^2 + |\vec{F_{-4Qq}}|^2 + 2\,\vec{F_{qQ}}\,\vec{F_{4Qq}}$$

$$|\vec{F_q}| = \sqrt{|\vec{F_{qQ}}|^2 + |\vec{F_{-4Qq}}|^2 + 2|\vec{F_{qQ}}|\,|\vec{F_{-4Qq}}|\cos 0^\circ}$$

$$|\vec{F_q}| = \sqrt{\left(|\vec{F_{qQ}}| + |\vec{F_{-4Qq}}|\right)^2} = |\vec{F_{qQ}}| + |\vec{F_{-4Qq}}|$$

$$|\vec{F_{qQ}}| = k \cdot \frac{q \cdot Q}{x_0^2}$$

$$|\vec{F_{-4Qq}}| = k \cdot \frac{q \cdot -4Q}{(x - x_0)^2}$$

$$|\vec{F_q}| = \underbrace{k\,\frac{q \cdot Q}{1}}_{\neq 0}\left(\frac{1}{x_0^2} - \frac{4}{(x - x_0)^2}\right) = 0 \quad \Big| \Rightarrow$$

$$\frac{1}{x_0^2} - \frac{4}{(x - x_0)^2} = 0$$

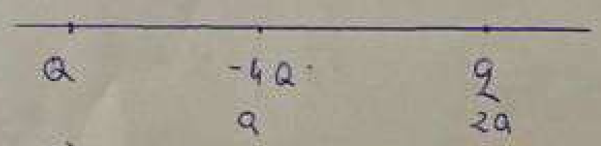
$$\frac{(x - x_0)^2 - 4x_0^2}{x_0^2\,(x - x_0)^2} = 0 \quad \Big| \Rightarrow$$

$$\cancel{-4 + 2x_0 - 5x_0^2 = 0} \quad \cancel{5x_0^2 + 2ax_0 - a^2 = 0} \quad \cancel{x_0 = \frac{2 + \sqrt{4 + 20a^2}}{-10}} \quad \cancel{\frac{2 - \sqrt{4 + 20a^2}}{-10}}$$

$$-3x_0^2 - 2x_0 a + a^2 = 0 \Rightarrow$$

$$x_0 = \left\langle \begin{array}{l} \frac{-2a + 4a}{6} = \frac{a}{3} \\ -a \end{array} \right.$$

b)



$$\vec{F_q} = \vec{F_{-4Qq}} + \vec{F_{-4Qq}}$$

$$\vec{F_q} = k \cdot \frac{-4Qq}{a^3} \cdot a\vec{i} + k \cdot \frac{Qq}{(2a)^3} \cdot 2a\vec{i}$$

$$\vec{F_q} = k\,\frac{Qq}{a^3}\left(-4a\vec{i} + \frac{a}{4}\vec{i}\right)$$

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$$\vec{F_q} = k\frac{Qq}{a^3} \cdot \frac{-15}{4}\,\vec{i} = \vec{F_{qx}}$$

$$|\vec{F_q}| = k\,\frac{-15}{4}\frac{Qq}{a^3} \; N$$

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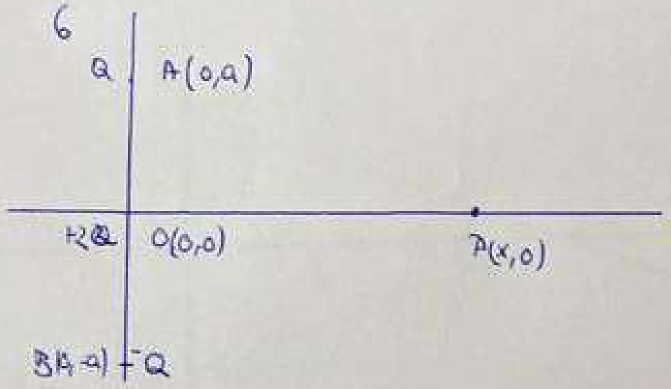

$$\vec{F_P} = \vec{F_{AP}} + \vec{F_{OP}} + \vec{F_{BP}}$$

$$\vec{F_{AP}} = k \cdot \frac{Qq}{(x^2+a^2)^{\frac{3}{2}}}\left(x\vec{i} + a\vec{j}\right)$$

$$\vec{F_{OP}} = k \cdot \frac{2Qq}{x^3} \cdot x\vec{i}$$

$$\vec{F_{BP}} = k \cdot \frac{-Qq}{(x^2+a^2)}\left(x\vec{i} - a\vec{j}\right)$$

$$\vec{F_P} = kQq\left(\left(\cancel{\frac{x}{(x^2+a^2)^{\frac{3}{2}}}} + \frac{2x}{x^3} + \left(-\cancel{\frac{x}{(x^2+a^2)^{\frac{3}{2}}}}\right)\right)\vec{i} + \left(\frac{a}{(x^2+a^2)^{\frac{3}{2}}} - \left(-\frac{a}{x^2+a^2}\right)\right)\vec{j}\right)$$

$$\vec{F_P} = kQq\left(\frac{2}{x^2}\,\vec{i} + \frac{2a}{(x^2+a^2)^{\frac{3}{2}}}\,\vec{j}\right)$$

$$\vec{F_{Px}} = \frac{kQq2}{x^2}\,\vec{i} \Rightarrow \vec{E_{Px}} = \frac{2kQ}{x^2}\,\vec{i}$$

$$\vec{F_{Py}} = \frac{2kQqa}{(x^2+a^2)^{\frac{3}{2}}}\,\vec{j} \Rightarrow \vec{E_{Py}} = \frac{2akQ}{(x^2+a^2)^{\frac{3}{2}}}\,\vec{j}$$

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b) Dacă sarcina $-Q$ din B devine pozitivă observăm intuitiv că din cauza simetriei celor două puncte A și B față de Ox și a sarcinii electrice egale că $\vec{E_{Py}}$ devine nul, iar $\vec{E_{Px}}$ devine mai mare.

++ Resping astfel încât formează un φ_{α}