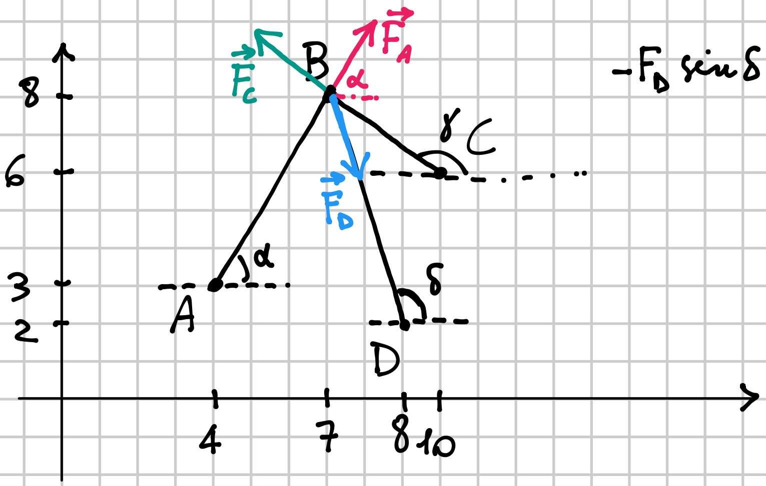
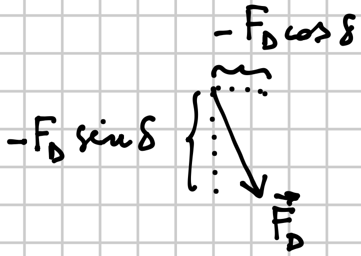
5/10/2022

80 Le cariche puntiformi $Q_A = 7{,}1$ nC, $Q_B = 3{,}5$ nC, $Q_C = 11$ nC e $Q_D = -4{,}6$ nC sono poste su un piano rispettivamente nei vertici $A(4{,}0$ cm; $3{,}0$ cm$)$, $B(7{,}0$ cm; $8{,}0$ cm$)$, $C(10{,}0$ cm; $6{,}0$ cm$)$ e $D(8{,}0$ cm; $2{,}0$ cm$)$ di un quadrilatero.

- Determina le componenti cartesiane delle forze esercitate da Q_A, Q_C e Q_D da su Q_B.
- Determina il modulo della forza risultante che agisce su Q_B.

[34 μN; 56 μN; –0,22 mN; 0,15 mN; 6,4 μN; –39 μN; 0,25 mN]





Forza dovuta alla carica Q_A $\quad F_A = k_0 \dfrac{|Q_A||Q_B|}{\overline{AB}^2} \quad \vec{F}_A = (F_A \cdot \cos\alpha,\ F_A \cdot \sin\alpha)$

coeff. angolare di AB

$$\tan\alpha = \frac{8-3}{7-4} = \frac{5}{3} \qquad \begin{cases} \dfrac{\sin\alpha}{\cos\alpha} = \dfrac{5}{3} \\ \sin^2\alpha + \cos^2\alpha = 1 \end{cases} \qquad \begin{cases} \sin\alpha = \dfrac{5}{3}\cos\alpha \\ \dfrac{25}{9}\cos^2\alpha + \cos^2\alpha = 1 \end{cases}$$

$$\begin{cases} // \\ \cos^2\alpha = \dfrac{9}{34} \end{cases} \qquad \begin{cases} \sin\alpha = \dfrac{5}{\sqrt{34}} \\ \cos\alpha = \dfrac{3}{\sqrt{34}} \end{cases}$$

$$F_A = \left(8{,}99 \times 10^9 \ \frac{N \cdot m^2}{C^2}\right) \frac{(7{,}1 \times 10^{-9}\ C)(3{,}5 \times 10^{-9}\ C)}{(5{,}0^2 + 3{,}0^2) \times 10^{-4}\ m^2} = 6{,}570632.. \times 10^{-5}\ N$$

$$F_{Ax} = F_A \cdot \cos\alpha = (6{,}570632\ldots \times 10^{-5}\ N)\ \frac{3}{\sqrt{34}} = 3{,}380562\ldots \times 10^{-5}\ N \simeq \boxed{34\ \mu N}$$

$$F_{Ay} = F_A \cdot \sin\alpha = (6{,}570632\ldots \times 10^{-5}\ N)\frac{5}{\sqrt{34}} = 5{,}63427\ldots \times 10^{-5}\ N \simeq \boxed{56\ \mu N}$$

$$\tan\gamma = \frac{y_B - y_C}{x_B - x_C} = \frac{8-6}{7-10} = -\frac{2}{3}$$

coeff. angolare di BC

$$\begin{cases} \dfrac{\sin\gamma}{\cos\gamma} = -\dfrac{2}{3} \\ \sin^2\gamma + \cos^2\gamma = 1 \end{cases} \quad \begin{cases} \sin\gamma = -\dfrac{2}{3}\cos\gamma \\ \dfrac{4}{9}\cos^2\gamma + \cos^2\gamma = 1 \end{cases} \quad \begin{cases} // \\ \cos^2\gamma = \dfrac{9}{13} \end{cases} \quad \begin{cases} \sin\gamma = \dfrac{2}{\sqrt{13}} \\ \cos\gamma = -\dfrac{3}{\sqrt{13}} \end{cases}$$

$$F_C = K_0 \frac{|Q_B||Q_C|}{\overline{BC}^2} = \left(8{,}99\times10^9\ \frac{N\cdot m^2}{C^2}\right)\frac{(3{,}5\times10^{-9}\ C)(11\times10^{-9}\ C)}{(2{,}0^2+3{,}0^2)\times10^{-4}\ m^2} =$$

$$= 26{,}6242307\ldots \times10^{-5}\ N$$

$$F_{Cx} = F_C\cdot\cos\gamma = (26{,}624\ldots\times10^{-5}\ N)\cdot\left(-\frac{3}{\sqrt{13}}\right) = -22{,}1526\ldots\times10^{-5}\ N$$

$$\simeq -22\times10^{-5}\ N = -22\times10^{-2}\times10^{-3}\ N = \boxed{-0{,}22\ mN}$$

$$F_{Cy} = F_C\cdot\sin\gamma = (26{,}624\ldots\times10^{-5}\ N)\cdot\left(\frac{2}{\sqrt{13}}\right) = 14{,}7684\ldots\times10^{-5}\ N$$

$$\simeq \boxed{0{,}15\ mN}$$

$$\tan\delta = \frac{y_B - y_D}{x_B - x_D} = \frac{2-8}{8-7} = -6 \quad \begin{cases} \dfrac{\sin\delta}{\cos\delta} = -6 \\ \sin^2\delta + \cos^2\delta = 1 \end{cases} \quad \begin{cases} \sin\delta = -6\cos\delta \\ 36\cos^2\delta + \cos^2\delta = 1 \end{cases}$$

$$\begin{cases} // \\ \cos^2\delta = \dfrac{1}{37} \end{cases} \quad \begin{cases} \sin\delta = \dfrac{6}{\sqrt{37}} \\ \cos\delta = -\dfrac{1}{\sqrt{37}} \end{cases}$$

$$F_D = K_0\frac{|Q_B||Q_D|}{\overline{BD}^2} = \left(8{,}99\times10^9\ \frac{N\cdot m^2}{C^2}\right)\frac{(3{,}5\times10^{-9}\ C)(4{,}6\times10^{-9}\ C)}{(6{,}0^2+1{,}0^2)\times10^{-4}\ m^2} =$$

$$= 3{,}91186\ldots\times10^{-5}\ N$$

$$F_{Dx} = -F_D \cos\delta = -\left(3{,}91186\ldots \times 10^{-5}\ N\right)\left(-\frac{1}{\sqrt{37}}\right) = 0{,}643106\ldots \times 10^{-5}\ N$$

$$\simeq \boxed{6{,}4\ \mu N}$$

$$F_{Dy} = -F_D \sin\delta = -\left(3{,}91186\ldots \times 10^{-5}\ N\right)\left(\frac{6}{\sqrt{37}}\right) = -3{,}858639\ldots \times 10^{-5}\ N$$

$$\simeq \boxed{-39\ \mu N}$$

$$F_{TOT\,x} = F_{Ax} + F_{Cx} + F_{Dx} = \left(3{,}380\ldots - 22{,}152\ldots + 0{,}643\ldots\right) \times 10^{-5}\ N =$$

$$= -18{,}129\ldots \times 10^{-5}\ N$$

$$F_{TOT\,y} = F_{Ay} + F_{Cy} + F_{Dy} = \left(5{,}634\ldots + 14{,}768\ldots - 3{,}858\ldots\right) \times 10^{-5}\ N =$$

$$= 16{,}544\ldots \times 10^{-5}\ N$$

$$F_{TOT} = \sqrt{F_{TOT\,x}^2 + F_{TOT\,y}^2} = \sqrt{(-18{,}129\ldots)^2 + (16{,}544\ldots)^2} \times 10^{-5}\ N =$$

$$= 24{,}543\ldots \times 10^{-5}\ N \simeq \boxed{0{,}25\ mN}$$