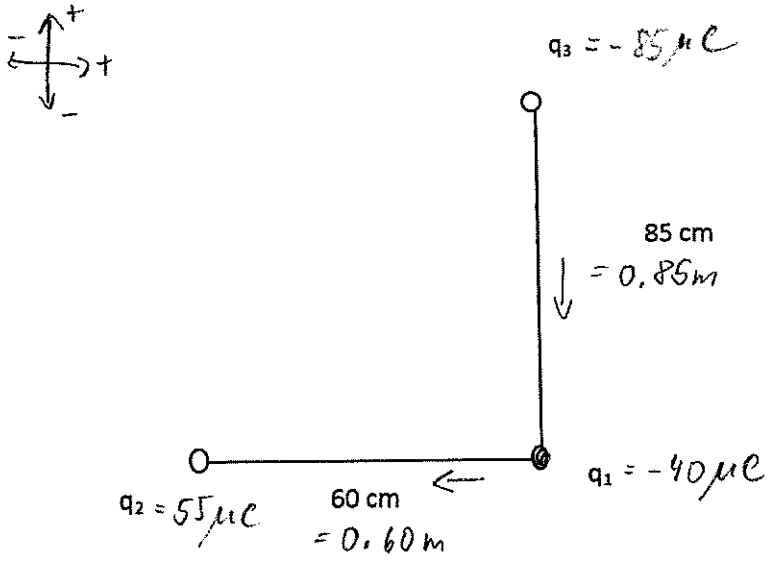
KEY

Electric Force - Practice

1. Determine the electric force (magnitude and direction) on a point charge q_1 (-40 μC) due to q_2(+55μC) and q_3 (-85 μC).



$$\vec{F}_{13} = -\frac{k|q_1||q_3|}{r^2}$$

$$= -\frac{(9.00\times10^9)(40\times10^{-6})(85\times10^{-6})}{0.85^2}$$

$$= -42.3529\,N$$

$$\therefore \vec{F}_{13} = 42\,N\,[D]$$

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

$$= -\frac{(9.00\times10^9)(40\times10^{-6})(55\times10^{-6})}{0.60^2}$$

$$= -55\,N$$

$$\therefore \vec{F}_{12} = 55\,N\,[L]$$

$$\Rightarrow \vec{F}_{\text{on charge 1}} = \vec{F}_{12} + \vec{F}_{13}$$

$$= [-55, -42]\,N$$

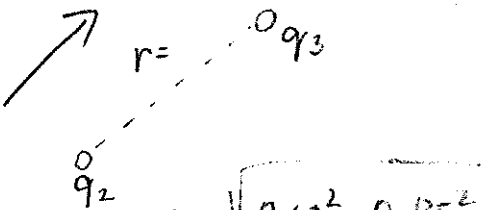
$$= \sqrt{(-55)^2 + (-42)^2}$$

$$= 69\,N$$

$$\theta = \tan^{-1}\left(\frac{42}{55}\right)$$

$$\theta = 37°$$

∴ The electric force on charge one is 69 N [L 37° D].



2. Determine the electric force (magnitude and direction) on q_2 due to q_1 and q_3.

$r = \sqrt{0.60^2 + 0.85^2}$

$r \doteq 1.0404\ m$

$\vec{F}_{21} = -\vec{F}_{12}$

$\therefore \vec{F}_{21} = 55N\,[R]$

$\|\vec{F}_{23}\| = \frac{k|q_2||q_3|}{r^2}$

$= \frac{(9.00\times10^9)(55\times10^{-6})(85\times10^{-6})}{1.0404^2}$

$\doteq 38.8708\ N$

$\theta = \tan^{-1}\left(\frac{0.85}{0.60}\right)$

$\theta = 54.7824^\circ$

$\theta \doteq 55^\circ \Rightarrow \vec{F}_{23} = 38.8708\,[\cos 55^\circ, \sin 55^\circ$

$= [22.2954, 31.8411]$

$\vec{F}_{\text{on } q_2} = \vec{F}_{21} + \vec{F}_{23}$

$= [55, 0] + [22.2954, 31.8411]$

$= [77.2954, 31.8411]\ N$

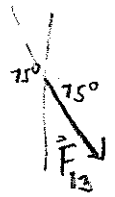
$= \sqrt{(77.2954)^2 + 31.8411^2}$

$\doteq 83.5969\ N$

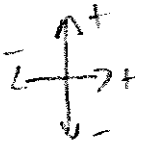
$\theta = \tan^{-1}\left(\frac{31.8411}{77.2954}\right)$

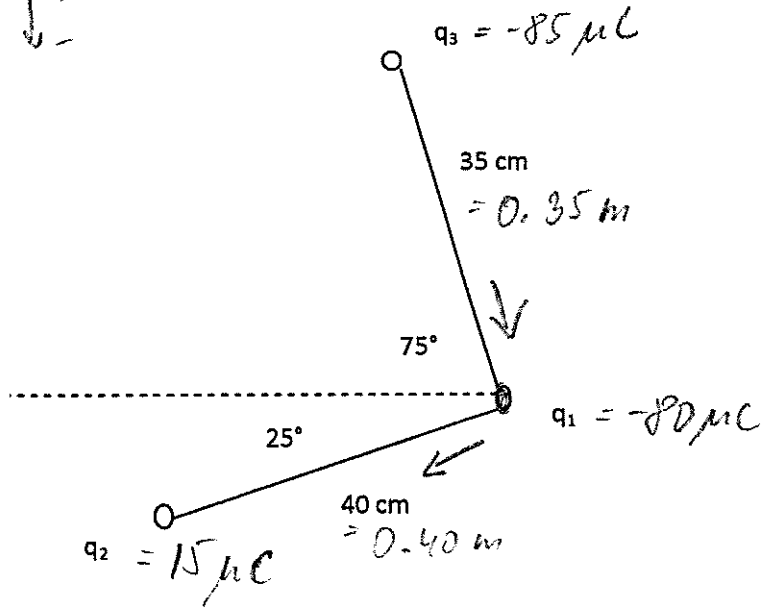
$\theta \doteq 22^\circ$

$\therefore$ The electric force on charge two is 84N [R 22° U].



3. . Determine the electric force (magnitude and direction) on a point charge q_1 (-80 μC) due to q_2(+15μC) and q_3 (-85 μC) :).





$$F_{13} = \frac{k|q_1||q_3|}{r^2}$$

$$= \frac{(9.00\times10^9)(80\times10^{-6})(85\times10^{-6})}{0.35^2}$$

$$= 499.5918\ N$$

$$\vec{F}_{13} = 499.5918\,[\cos 75°, -\sin 75°]$$

$$\therefore \vec{F}_{13} = [129.3039, -482.5686]\ N$$

$$F_{12} = \frac{k|q_1||q_2|}{r^2}$$

$$= \frac{(9.00\times10^9)(80\times10^{-6})(15\times10^{-6})}{0.40^2}$$

$$= 67.5\ N$$

$$\vec{F}_{12} = 67.5\,[-\cos 25°, -\sin 25°]$$

$$\therefore \vec{F}_{12} = [-61.1758, -28.5267]\ N$$

$$\vec{F}_{on\ q_1} = \vec{F}_{12} + \vec{F}_{13}$$

$$= [-61.1758, -28.5267] + [129.3039, -482.5686]$$

$$= [68.1281, -511.0953]\ N$$

$$= \sqrt{265859.8437}$$

$$= 515.6160\ N$$

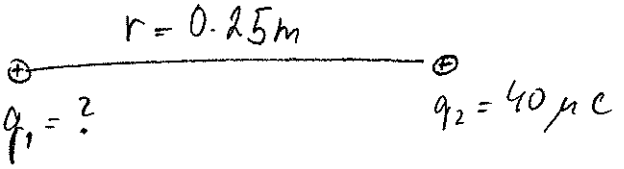
$$\theta = \tan^{-1}\left(\frac{511.0953}{68.1281}\right)$$

$$\theta = 82°$$

∴ The electric force on q_1 is $5.2\times10^2\ N\ [R\ 82°D]$.

4. Find the charge on q_1 provided that q_1 is 25cm away from q_2 (q_2 =40μC)and experiences repulsive electric force of 465N.

⇒ q_1 is (+)



$$F = \frac{k|q_1||q_2|}{r^2}$$

$$\frac{Fr^2}{k|q_2|} = \frac{k|q_1||q_2|}{k|q_2|}$$

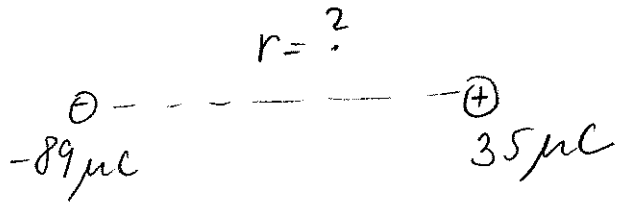
$$q_1 = \frac{Fr^2}{k|q_2|}$$

$$q_1 = \frac{(465)(0.25^2)}{(9.00\times10^9)(40\times10^{-6})}$$

$$q_1 = 8.0729\times10^{-5}\,C$$

∴ The electric charge on q_1 is 81μC or 8.1×10^{-5}C.

5. Consider point charges of 35μC and -89μC. What is the distance of separation between two point charges if the attractive force experienced by one of the charges is 57N?



$$F = \frac{k|q_1||q_2|}{r^2}$$

$$r^2 = \frac{k|q_1||q_2|}{F}$$

$$r = \sqrt{\frac{k|q_1||q_2|}{F}}$$

$$r = \sqrt{\frac{(9.00\times10^9)(35\times10^{-6})(89\times10^{-6})}{57}}$$

$$r = 0.7013\,m$$

∴ The distance between the two point charges is 0.70 m = 70cm.