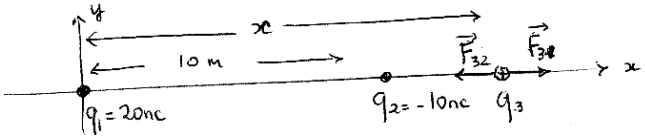
PHYS102.10
Quiz = 5

Name: Key Id#:

Consider two charges q1 = 20 nC located at (0,0) and q2= -10 nC located at (10 m,0). Find the location along the x-axis at which a positive charge q3 will be in equilibrium.



$F_{32} = F_{31}$

$$\frac{k|q_3||q_2|}{(x-10)^2} = \frac{k|q_3||q_1|}{x^2}$$

$$\frac{10}{(x-10)^2} = \frac{20}{x^2}$$

$$10x^2 = 20(x-10)^2$$

$$x\sqrt{10} = (x-10)\sqrt{20}$$

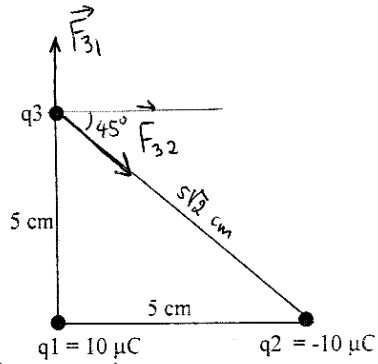
$$x(\sqrt{20}-\sqrt{10}) = 10\sqrt{20}$$

$$x = \frac{10\sqrt{20}}{\sqrt{20}-\sqrt{10}} = 34.1 \text{ m}$$

PHYS102.11
Quiz = 5

Name: Key Id#:

Find the magnitude and direction of the net force on charge q3 = 20 μC due to the other two charges.



$$F_{31} = \frac{k|q_1||q_3|}{r^2} = \frac{9\times10^9 \times 10\times10^{-6} \times 20\times10^{-6}}{(0.05)^2} = 720\ N$$

$$F_{32} = \frac{k|q_2||q_3|}{r^2} = \frac{9\times10^9 \times 10\times10^{-6} \times 20\times10^{-6}}{(0.05)^2\times 2} = 360\ N$$

$$\vec{F}_{31} = 0\,\hat{i} + 720\,\hat{j}\ \ N$$

$$\vec{F}_{32} = 360\cos45^\circ\,\hat{i} - 360\sin45^\circ\,\hat{j} = 255\,\hat{i} - 255\,\hat{j}$$

$$\boxed{\vec{F}_{net} = 255\,\hat{i} + 465\,\hat{j}\ \ N}$$

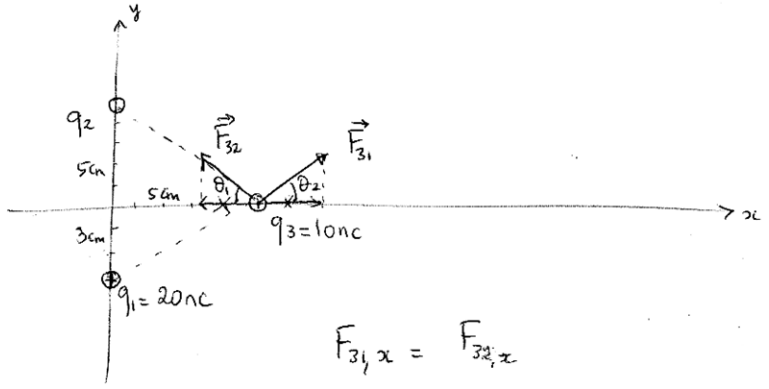
$$|\vec{F}_{net}| = 531\ N$$

$$\theta = \tan^{-1}\left(\frac{465}{255}\right) = 61.3^\circ$$

PHYS102.12
Quiz # 5

Name: Key Id#:

Two particles are fixed on the y-axis. Particle 1 of charge q1 = 20 nC is located at y = -3 cm; particle 2 of charge q2 is located at y = 5 cm. Particle 3 of charge q3 = 10 nC is released from rest on the x-axis at x = 5 cm. What is the sign and value of q2 if the initial acceleration of particle 3 is in the positive y-axis?



$$F_{31,x} = F_{32,x}$$

$$F_{31}\cos\theta_2 = F_{32}\cos\theta_1$$

$\theta_1 = 45°$ $\theta_2 = \tan^{-1}\left(\frac{3}{5}\right) = 30.9°$

$$\frac{k|q_1||q_3|}{(0.05)^2 \times 2}\cos 45° = \frac{k|q_3||q_2|}{[(0.03)^2+(0.05)^2]}\cos 30.9°$$

$$q_2 = q_1 \frac{\cos 45°}{\cos 30.9°} \times \frac{[(0.03)^2+(0.05)^2]}{2\times(0.05)^2}$$

$$q_2 = 20\times10^{-9} \times 0.82 \times 0.68 = 12.5\times10^{-9}$$

Also q_2 must be negative!

$$\boxed{q_2 = -12.5\ nC}$$