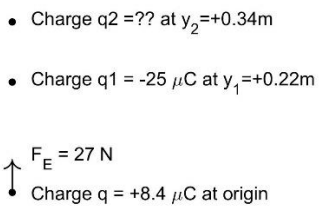
8. Two point charges are fixed on the *y* axis: a negative point charge q_1 = -25 μC at y_1 = +0.22 m and a positive point charge q_2 at y_2 = +0.34 m. A third point charge q = +8.4 µC is fixed at the origin. The net electrostatic force exerted on the charge q by the other two charges has a magnitude of 27 N and points in the +y direction. Determine the magnitude of q_2.



$$\overrightarrow{F_{E-Total}} = \overrightarrow{F_{E-q1}} + \overrightarrow{F_{E-q2}}$$

$$\overrightarrow{F_{E-Total}} = 27\ N\ \widehat{Up}$$

$$\overrightarrow{F_{E-q1}} = k\frac{q_1 q}{y_1^2}\widehat{Up} = \left(8.99\ x\ 10^9\ Nm^2/C^2\right)\frac{(25.0\ x\ 10^{-6}C)(8.4\ x\ 10^{-6}C)}{(0.22m)^2}\widehat{Up}$$

$$\overrightarrow{F_{E-q1}} = 39.01\ N\ \widehat{Up}$$

Since the force from charge 1 is greater than the total force, the charge q_2 must be positive and create a repulsive or down force on q.

$$\overrightarrow{F_{E-q2}} = k\frac{q_2 q}{y_2^2}\widehat{Up}$$

$$\overrightarrow{F_{E-Total}} = \overrightarrow{F_{E-q1}} + \overrightarrow{F_{E-q2}}$$

$$27\ N\ \widehat{Up} = 39\ N\ \widehat{Up} - k\frac{q_2 q}{y_2^2}\widehat{Up}$$

$$k\frac{q_2 q}{y_2^2}\widehat{Up} = 39\ N\ \widehat{Up} - 27\ N\ \widehat{Up} = 12\ N\ \widehat{Up}$$

$$q_2 = \frac{(12\ N)y_2^2}{kq}$$

$$q_2 = \frac{(12\ N)(0.34\ m)^2}{\left(8.99\ x\ 10^9\ {Nm^2}/{C^2}\right)(8.4\ x\ 10^{-6} C)} = \frac{1.3872\ Nm^2}{7.5516\ x\ 10^4\ {Nm^2}/{C}} = 1.837\ x\ 10^{-5} C$$

$$q_2 = 1.837\ x\ 10^{-5} C = 18.4\ \mu C$$

$$\boxed{q_2 = +1.8\ x\ 10^{-5} C = +18\ \mu C}$$

Dr. Donovan's Classes Page	Dr. Donovan's PH 202 Homework Page
NMU Physics Department Web Page	NMU Main Page

Please send any comments or questions about this page to ddonovan@nmu.edu

This page last updated on January 7, 2021