Quiz Average **7.6** **Quiz High Score** **10**

PH 202 **Quiz # 01 (10 pts)** **Name** **Solution**

When the Flash runs super-fast, the friction between the air and him causes him to become charged. After one such run, the Flash has a net charge of $-8.34\ \mu C$. How many electrons does this represent? Were the electrons added to him or removed from him to obtain this net charge?

A. $\mathbf{5.21 \times 10^{13}}$ **electrons Added**

B. 5.21×10^{13} electrons Removed

C. 1.33×10^{14} electrons Removed

D. 1.33×10^{14} electrons Added

Since the net charge is negative, the electrons were added to the Flash!

Total charge is found from:

$$Q = Nq = N(-e)$$

Solve Number:

$$N = \frac{Q}{-e} = \frac{-8.34 \times 10^{-6}\ C}{-1.60 \times 10^{-19}\ C} = 5.21 \times 10^{13}\ electrons$$

So, the correct answer is A !

An object has a net charge of -73.1 mC and a mass of 69.1×10^{-6} kg. The object is acted upon by an electric force which results in an acceleration for the object of $13.7\ {}^{m}/_{s^2}\ (\widehat{South})$. What is the magnitude and direction of the electric force acting on this object?

A. $9.47 \times 10^{-4}\ N\ (\widehat{North})$

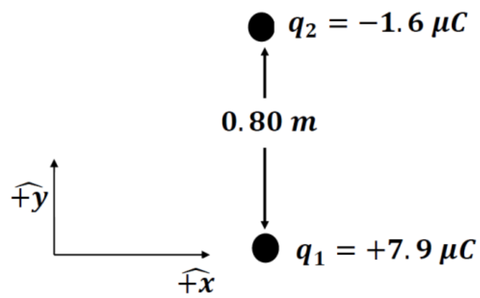
B. $\mathbf{9.47 \times 10^{-4}\ N\ (\widehat{South})}$

C. $6.92 \times 10^{-5}\ N\ (\widehat{North})$

D. $6.92 \times 10^{-5}\ N\ (\widehat{South})$

$$\vec{F_{el}} = m\vec{a} = (69.1 \times 10^{-6}\ kg)\left(13.7\ {}^{m}/_{s^2}\ (\widehat{South})\right) = 9.47 \times 10^{-4}\ N\ (\widehat{South})$$

So, the correct answer is B !



Two charges are located as shown on the left. One charge $q_1 = +7.90\ \mu C$ is 0.800 m below the second charge $q_2 = -1.60\ \mu C$. What is the magnitude and direction of the force the charge q_1 exerts on charge q_2?

A. 1.78×10^{-1} N ($\widehat{+y}$) **C.** **1.78×10^{-1} N ($\widehat{-y}$)**

B. 1.42×10^{-1} N ($\widehat{+y}$) **D.** 1.42×10^{-1} N ($\widehat{-y}$)

Since the charges are oppositely signed, charge (q_1) attracts charge (q_2) so final direction is down or $\widehat{-y}$!

$$F_{el} = k\frac{q_1 q_2}{r_{12}^2} = \left(8.99 \times 10^9\ {Nm^2}/{C^2}\right)\frac{(7.90 \times 10^{-6}\ C)(1.60 \times 10^{-6}\ C)}{(0.800\ m)^2} = 1.78 \times 10^{-1}\ N$$

So, the correct answer is C !

Three identical metal spheres initially have the following charges on them: $Q_1 = -13\ \mu C$, $Q_2 = +11\ \mu C$, and $Q_3 = -6\ \mu C$. Spheres 1 and 2 are brought together. They are allowed to equilibrate their charge and then they are separated. Spheres 1 and 3 are now brought together and allowed to equilibrate. They are then separated. What is the final charge on each sphere?

A. $Q_1 = -13\ \mu C, Q_2 = +11\ \mu C$, and $Q_3 = -6\ \mu C$

B. $Q_1 = -2.67\ \mu C, Q_2 = -2.67\ \mu C$, and $Q_3 = -2.67\ \mu C$

C. $Q_1 = -3.5\ \mu C, Q_2 = +1\ \mu C$, and $Q_3 = -3.5\ \mu C$

D. **$Q_1 = -3.5\ \mu C, Q_2 = -1\ \mu C$, and $Q_3 = -3.5\ \mu C$**

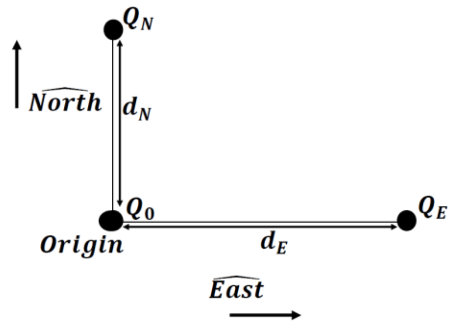
When the spheres 1 and 2 touch they equilibrate their charge and the remaining total charge is

$$Q_{Total} = Q_1 + Q_2 = -13\ \mu C + 11\ \mu C = -2\ \mu C$$

When Separated they become $-1\ \mu C$ each
Joining Spheres 1 and 3 now creates $Q_{Total} = Q_1 + Q_3 = -1\ \mu C + (-6\ \mu C) = -7\ \mu C$
When Separated they become $-3.5\ \mu C$ each

So, the correct answer is D !

As pictured to the right, there are three charges placed as shown. At the origin a charge $Q_0 = +10.1\ \mu C$ exists. Looking East a distance of $d_E = 0.187\ m$ finds a second charge $Q_E = +37.9\ \mu C$. Going north of the origin a distance $d_N = 0.103\ m$ finds a third charge $Q_N = +60.6\ \mu C$. What is the net electrical force acting on the charge at the origin due to the presence of the other two charges?



A. $528.\ N\ @\ 79.3°\ (\widehat{North\ of\ East})$

B. $528.\ N\ @\ 79.3°\ (\widehat{North\ of\ West})$

C. $528.\ N\ @\ 79.3°\ (\widehat{South\ of\ East})$

D. $\mathbf{528.\ N\ @\ 79.3°\ (\widehat{South\ of\ West})}$

We use the Law of Superposition since we have two Coulomb forces acting here. Dealing with the sign of the charges, since Q_N is positive and Q_0 is also positive, they repel so the force due to the North charge is in the South direction. Since Q_E is positive, and Q_0 is positive, the force due to the East charge is in the West direction. Writing out the two Coulomb forces we get:

$$\overrightarrow{F_{Origin}} = \overrightarrow{F_{N\to 0}} + \overrightarrow{F_{E\to 0}} = \frac{kQ_N Q_0}{d_N^2}(\widehat{South}) + \frac{kQ_E Q_0}{d_E^2}(\widehat{West})$$

$$\overrightarrow{F_{Origin}} = \frac{\left(8.99\ x\ 10^9\ {Nm^2}/{C^2}\right)(60.6\ x\ 10^{-6}\ C)(10.1\ x\ 10^{-6}\ C)}{(0.103\ m)^2}(\widehat{South}) + \frac{\left(8.99\ x\ 10^9\ {Nm^2}/{C^2}\right)(37.9\ x\ 10^{-6}\ C)(10.1\ x\ 10^{-6}\ C)}{(0.187\ m)^2}(\widehat{West})$$

$$\overrightarrow{F_{Origin}} = 5.187\ x\ 10^2 N\ (\widehat{South}) + 9.841\ x\ 10^1 N\ (\widehat{West})$$

Now use Pythagorean Theorem

$$\left|\overrightarrow{F_{Origin}}\right| = \sqrt{(5.187\ x\ 10^2\ N)^2 + (9.841\ x\ 10^1\ N)^2} = 5.280\ x\ 10^2\ N$$

And the angle

$$\theta = \tan^{-1}\left(\frac{F_{N\to 0}}{F_{E\to 0}}\right) = \tan^{-1}\left(\frac{5.187\ x\ 10^2\ {N}/{C}}{9.841\ x\ 10^1\ {N}/{C}}\right) = \tan^{-1}(5.271) = 79.3°$$

So, Electric force is

$$\overrightarrow{F_{Origin}} = 528.\ N\ @\ 79.3°(\widehat{South\ of\ West})$$

So, the correct answer is D !

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