**Quiz Average** **7.2** **Quiz High Score** **10**

**PH 221** **Quiz # 01 (10 pts)** **Name** **Solution**

While walking across a shag carpet, your shoes gain $1.39 \times 10^{13}$ extra electrons. What is the net charge on your shoe?

**A.** $+2.22 \times 10^{-6}$ C **B.** $\mathbf{-2.22 \times 10^{-6}\ C}$ **C.** $-1.15 \times 10^{-6}$ C **D.** $+1.15 \times 10^{-6}$ C

**Since it is extra electrons, the net charge will be negative.**

$$\boldsymbol{Q = Ne = (1.39\ x\ 10^{13})(1.60\ x\ 10^{-19}\ C) = 2.22\ x\ 10^{-6}\ C}$$

**So, the correct answer is B !**

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Object A has a net charge of $-45.9$ μC on it. Object B has a net charge of $+35.6$ μC and it is located 2.09 m to the south of object A. What is the electric force object B exerts on object A?

**A.** $\mathbf{3.36\ N\ (\widehat{South})}$ **C.** $7.03\ \text{N}\ (\widehat{\text{South}})$

**B.** $3.36\ \text{N}\ (\widehat{\text{North}})$ **D.** $7.03\ \text{N}\ (\widehat{\text{North}})$

**Since the charges are oppositely signed, the force will be attractive. Since B is South of A, it will draw A towards it or to the South!**

$$\boldsymbol{F_{B\to A} = \frac{Q_A Q_B}{4\pi\varepsilon_0 r_{AB}^2} = \frac{(45.9\ x\ 10^{-6} C)(35.6\ x\ 10^{-6} C)}{4\pi\left(8.85\ x\ 10^{-12}\ C^2/_{Nm^2}\right)(2.09\ m)^2} = \frac{1.63\ x\ 10^{-9} C^2}{4.86\ x\ 10^{-10}\ C^2/_N}}$$

$$\boldsymbol{\vec{F}_{B\to A} = 3.36\ N\ (\widehat{South})}$$

**So, the correct answer is A !**

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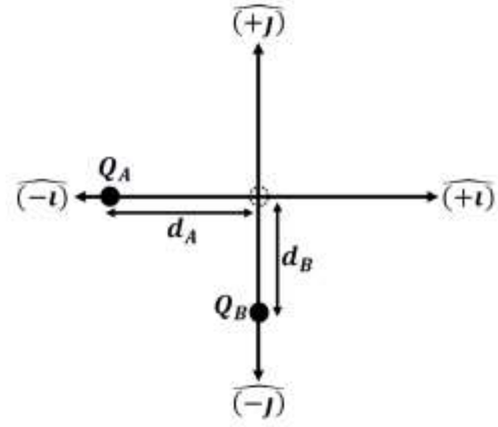
Two charges ($Q_A = -23.8 \text{ mC}$) and ($Q_B = +41.3 \text{ mC}$) are located as shown on the right. The distances are ($d_A = 8.43 \text{ x } 10^{-2} \text{ m}$) and($d_B = 6.72 \text{ x } 10^{-2} \text{ m}$). What is the magnitude and direction of the electric field at the origin as a result of these two charges?




**A.** $8.75 \text{ x } 10^{10} \text{ N}/\text{C}$ @ 69.9° Above $\widehat{(+\imath)}$

**B.** $8.75 \text{ x } 10^{10} \text{ N}/\text{C}$ @ 69.9° Below $\widehat{(+\imath)}$

**C.** $\mathbf{8.75 \text{ x } 10^{10} \text{ N}/\text{C}}$ **@ 69.9° Above** $\widehat{(-\imath)}$

**D.** $8.75 \text{ x } 10^{10} \text{ N}/\text{C}$ @ 69.9° Below $\widehat{(-\imath)}$

$$\overrightarrow{E_{Net}} = \overrightarrow{E_A} + \overrightarrow{E_B} = \frac{Q_A}{4\pi\varepsilon_0 d_A^2}\widehat{(-\imath)} + \frac{Q_B}{4\pi\varepsilon_0 d_B^2}\widehat{(+\jmath)}$$

**Since charge $Q_A$ is negative, a positive test charge would be pulled in the -x direction and since charge $Q_B$ is positive, a positive test charge would be pushed in the +y direction.**

$$\frac{Q_A}{4\pi\varepsilon_0 d_A^2} = \frac{23.8 \text{ x } 10^{-3} C}{4\pi\left(8.85 \text{ x } 10^{-12}\, C^2/_{Nm^2}\right)(8.43 \text{ x } 10^{-2}\, m)^2} = \frac{23.8 \text{ x } 10^{-3} C}{7.90 \text{ x } 10^{-13}\, C^2/_N}$$

$$\frac{Q_A}{4\pi\varepsilon_0 d_A^2} = 3.01 \text{ x } 10^{10}\, N/_C$$

$$\frac{Q_B}{4\pi\varepsilon_0 d_B^2} = \frac{41.3 \text{ x } 10^{-3} C}{4\pi\left(8.85 \text{ x } 10^{-12}\, C^2/_{Nm^2}\right)(6.72 \text{ x } 10^{-2}\, m)^2} = \frac{41.3 \text{ x } 10^{-3} C}{5.02 \text{ x } 10^{-13}\, C^2/_N}$$

$$\frac{Q_B}{4\pi\varepsilon_0 d_B^2} = 8.22 \text{ x } 10^{10}\, N/_C$$

$$\overrightarrow{E_{Net}} = 3.01 \text{ x } 10^{10}\, N/_C\,\widehat{(-\imath)} + 8.22 \text{ x } 10^{10}\, N/_C\,\widehat{(+\jmath)}$$

**Use Pythagorean Theorem**

$$E_{Net} = \sqrt{\left(3.01 \text{ x } 10^{10}\, N/_C\right)^2 + \left(8.22 \text{ x } 10^{10}\, N/_C\right)^2} = 8.75 \text{ x } 10^{10}\, N/_C$$

$$\theta = tan^{-1}\left(\frac{8.22\ x\ 10^{10}\ N/_C}{3.01\ x\ 10^{10}\ N/_C}\right) = tan^{-1}(2.731) = 69.9°$$

$$\overrightarrow{E_{Net}} = 8.75\ x\ 10^{10}\ {}^{N}/_{C}\ @\ 69.9°\ Above\ \widehat{(-\imath)}$$

**So, the correct answer is C !**

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The electric force acting on a charged object ($Q = -1.98 \text{ x } 10^{-4}$ C) is measured to be 2.21 N $(\widehat{\text{West}})$. What is the magnitude of the electric field acting on the charged object creating this force?

**A.** $4.38 \text{ x } 10^{-4}\ {}^{N}/_{C}\ (\widehat{\text{East}})$

**B.** $1.12 \text{ x } 10^{4}\ {}^{N}/_{C}\ (\widehat{\text{West}})$

**C.** $\mathbf{1.12 \text{ x } 10^{4}\ {}^{N}/_{C}\ (\widehat{\text{East}})}$

**D.** $4.38 \text{ x } 10^{-4}\ {}^{N}/_{C}\ (\widehat{\text{West}})$

$$\overrightarrow{F_E} = Q\vec{E}$$

**Solve for electric field**

$$\vec{E} = \frac{\overrightarrow{F_E}}{Q} = \frac{2.21\ N\ (\widehat{West})}{-1.98\ x\ 10^{-4}\ C} = -1.12\ x\ 10^{4}\ {}^{N}/_{C}\ (\widehat{West}) = 1.12\ x\ 10^{4}\ {}^{N}/_{C}\ (\widehat{East})$$

**So, the correct answer is C !**

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A magician/illusionist wants to set up a floating person. They apply the same positive charge to top of a flat circular base and to the bottom of an identical circular platform they will stand on. If they are to "float" 10.0 m above the base, and the platform and their mass has a combined total of 120. kg, how much positive charge must be on each the base and the platform in order for the floating to occur?

**A.** $1.06 \text{ x } 10^{11}$ C

**B.** $2.76 \text{ x } 10^{2}$ C

**C.** $1.31 \text{ x } 10^{-5}$ C

**D.** $\mathbf{3.62 \text{ x } 10^{-3}}$ **C**

$$F_E = \frac{QQ}{4\pi\varepsilon_0 d^2} = mg$$

**Solve for $Q$**

$$Q = 2d\sqrt{\pi\varepsilon_0 mg} = 2(10.0\ m)\sqrt{\pi\left(8.85\ x\ 10^{-12}\ {}^{C^2}/_{Nm^2}\right)(120.\ kg)\left(9.80\ {}^{m}/_{s^2}\right)}$$

$$Q = 20.0\ m\sqrt{3.270\ x\ 10^{-8}\ {}^{C^2}/_{m^2}} = (20.0\ m)\left(1.81\ x\ 10^{4}\ {}^{C}/_{m}\right) = 3.62\ x\ 10^{-3}\ C$$

**So, the correct answer is D !**

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

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