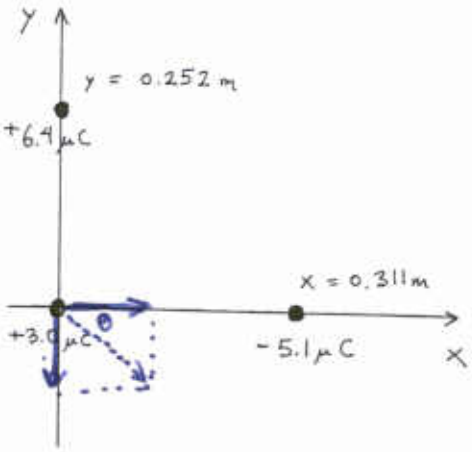
Units?
Units?

Name_____

Phys 122 — Section 4
Quiz #1

1. In the $x-y$ coordinate system shown here, a $+3.0\,\mu$C charge sits at the origin; a $-5.1\,\mu$C charge sits on the $x-$axis at $x = 0.311$ m and a $+6.4\,\mu$C charge sits on the $y-$axis at $y = 0.252$ m.

Find the net force (magnitude and direction!) on the $+3.0\,\mu$C charge arising from the other charges.



Force of the 6.4 μC charge has magnitude

$$F = k\frac{|q_1 q_2|}{r^2} = (8.99\times10^{+9})\frac{(3.0\times10^{-6})(6.4\times10^{-6})}{(0.252\text{ m})^2}\text{ N}$$

$= 2.72$ N, in the $-y$ direction.

Force of the $-5.1\,\mu$C charge has magnitude

$$F = (8.99\times10^{9})\frac{(3.0\times10^{-6})(5.1\times10^{-6})}{(0.311)^2} = 1.42\text{ N}$$

in the $+x$ direction.

Net force has mag

$$F = \sqrt{(2.72)^2+(1.42)^2}\text{ N} = 3.07\text{ N}$$

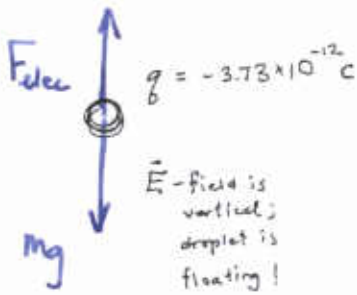
with

$$\theta = \tan^{-1}\left(\frac{2.72}{1.42}\right) = 62.4^\circ$$ below the x-axis

2. A small droplet having a charge -3.73×10^{-12} C is made to float in mid-air by the presence of a vertical electrical field of magnitude $8.20\times10^{3}\,\frac{\text{N}}{\text{C}}$.

a) Does the electric field point up or down? (Justify your answer!)

$\vec{F}_{elec}$ points up but since $\vec{F}_{elec} = q\vec{E}$ and q is negative, $\vec{E}$ must point down.



b) What is the mass of the droplet?

Forces balance, so $F_{elec} = mg$

This gives

$$|qE| = mg \qquad m = \frac{|qE|}{g} = \frac{(3.73\times10^{-12}\text{ C})(8.20\times10^{3}\,\frac{\text{N}}{\text{C}})}{9.80\,\frac{\text{m}}{\text{s}^2}}$$

$$= 3.12\times10^{-9}\text{ kg}$$

3. A $-4.0\,\mu$C charge is located on the $x-$axis at $x = 0.25$ m, and a $+8.8\,\mu$C charge is located on the $x-$axis at $x = -0.35$ m.

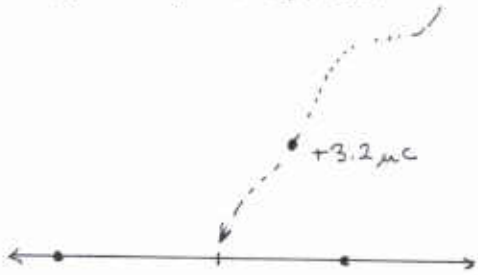
a) Find the electric potential at the origin ($x = 0.0$ m).

Add the potentials from all the charges

$$V = \Sigma \frac{kq}{r} = (8.99\times10^{9})\frac{(8.8\times10^{-6})}{(.35\text{m})}\text{V} + (8.99\times10^{9})\frac{(-4.0\times10^{-6}\text{C})}{(0.25\text{m})}\text{V}$$

$$= 8.2\times10^{4}\text{ V}$$

b) Find the amount of work required to bring up a $+3.2\,\mu$C charge from *far* away) and place it at the origin.



When the charge comes in from ∞,

$\Delta V = +8.2\times10^{9}$ V.

Work req'd is

$$\Delta EPE = q\,\Delta V = (3.2\times10^{-6}\text{C})(8.2\times10^{4}\text{V})$$

$$= 0.26\text{ J}$$

You must show all your work!

$e = 1.60\times10^{-19}$ C $\quad k = 8.99\times10^{9}\ \frac{\text{N}\cdot\text{m}^2}{\text{C}^2}$ $\quad \epsilon_0 = 8.85\times10^{-12}\ \frac{\text{C}^2}{\text{N}\cdot\text{m}^2}$ $\quad m_e = 9.11\times10^{-31}$ kg

$g = 9.80\frac{\text{m}}{\text{s}^2}$ $\quad \mathbf{F} = m\mathbf{a}$ Like charges repel... $\quad \mathbf{E} = \dfrac{\mathbf{F}}{q_0}$ $\quad$ **E** points away from a positive charge...

$$V = \frac{\text{EPE}}{q_0} \qquad 1\,\frac{\text{J}}{\text{C}} = 1\text{ V} \qquad E_x = -\frac{\Delta V}{\Delta x}\ \text{(For const. E)}$$

Point charge: $\quad E = k\frac{q}{r^2} \quad V = k\frac{q}{r}$

Cap: $\quad E\,(\text{No diel.}) = \dfrac{q}{\epsilon_0 A} = \dfrac{\sigma}{\epsilon_0} \qquad q = CV \qquad \dfrac{E}{E_0} = \kappa \qquad C = \dfrac{\kappa\epsilon_0 A}{d}$