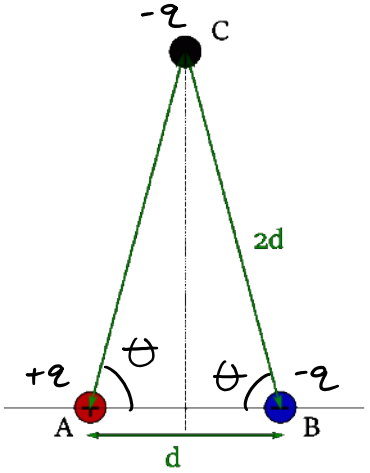
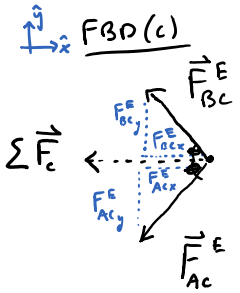
Week 5 Quiz

Friday, April 30, 2021 10:29 AM

Two point charges (**A** and **B**) of equal magnitude, **q**, and opposite sign are separated by a distance **d** form each other. A third point charge (**C**) of equal magnitude is placed a distance 2**d** from each charge A and B, and rests along a vertical line that is halfway between charges **A** and **B**. The net force acting on charge **C** is found to have only a horizontal component, pointing to the left. The only forces acting on charge **C** are electric forces (i.e. ignore gravity etc..). Note: Charge **A** is positive, charge **B** is negative and **k** = 8.99 x 10^9 N·m²/C²



(a) What is the sign of charge **C**? Explain.



C must be negative so that it is attracted to A & repelled by B. If it was positive the net force would be to the right.

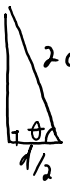
(b) Calculate the magnitude of net force acting on charge **C** if **d** = 0.500 meters, and **q** = 30.0 μC.

w/ $|q_A| = |q_B| = |q_C|$ & $|\Delta\vec{r}_{AC}| = |\Delta\vec{r}_{BC}|$, $|\vec{F}^E_{AC}| = |\vec{F}^E_{BC}|$

$$|\vec{F}^E_{AC}| = \frac{k|q_A||q_C|}{|\Delta\vec{r}_{AC}|^2} = \frac{kq^2}{(2d)^2}, \quad F^E_{AC_x} = -|\vec{F}^E_{AC}|\cos\theta = F^E_{BC_x} \Rightarrow \Sigma F_x = -2|\vec{F}^E_{AC}|\cos\theta$$

$$F^E_{AC_y} = -F^E_{BC_y} \Rightarrow \Sigma F_y = 0$$

Geometry



$$\cos\theta = \frac{d/2}{2d} = \frac{1}{4}$$

So, $\Sigma\vec{F} = \left\langle -\frac{kq^2}{8d^2}, 0 \right\rangle$

$$|\Sigma\vec{F}| = \frac{kq^2}{8d^2} = \boxed{4.05\ N}$$

Rubric

~~ Part (a) ~~	~~ Part (b) ~~
0.5 pts - correct answer	1 pt - FBD
1.5 pts - reasoning	1 pt - Coulomb force equation
	1 pt - Finding mag of one force
	1.5 pt - Finding force vector component
	1 pt - Geometry for theta
	1 pt - net force in the x-direction
	1 pt - net force in the y-direction
	0.5 pt - Correct answer and units