Electric Force Practice

Physics 104
Spring 2008

For the system of three charges shown , the charges are

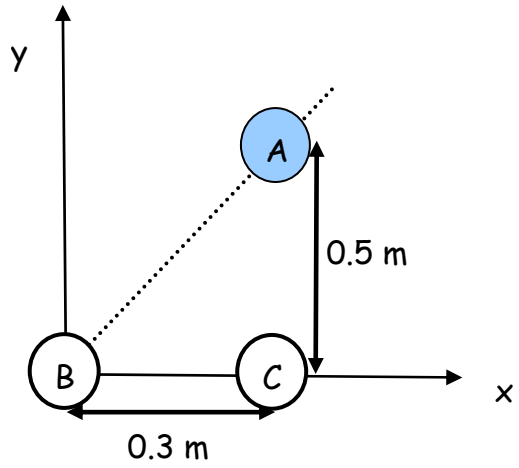
Q_A= +2.0 μC

Q_B= -4.0 μC

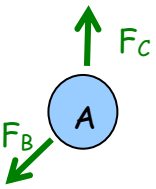
Q_C= +3.0 μC

$$F = \frac{k|q_1||q_2|}{r^2}$$

k=8.99x10^{+9}Nm^2/C^2



1. Draw a FBD for charge A



2. Find the magnitude of the force on charge A due to charge C, F_C.

$$F_C = \frac{kq_Aq_C}{r_{AC}^2} = \frac{\left(8.99\times10^{9}\right)\left(2\times10^{-6}\right)\left(3\times10^{-6}\right)}{\left(0.5\right)^2} = 0.216\ \text{N}$$

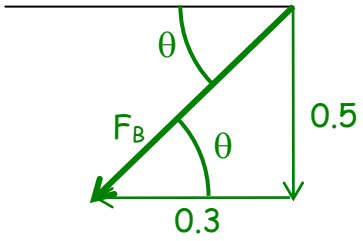
3. What is the direction of F_C?

Up or +y

4. What is the magnitude of the force on charge A due to charge B, F_B?

$$F_B = \frac{kq_Aq_B}{r_{AB}^2} = \frac{\left(8.99\times10^{9}\right)\left(2\times10^{-6}\right)\left(4\times10^{-6}\right)}{\left(\sqrt{0.5^2+0.3^2}\right)^2} = 0.212\ \text{N}$$

5. What is the direction of F_B?



$$\tan\theta = \frac{\text{opp}}{\text{adj}} = \frac{0.5}{0.3} = 1.67 \qquad \theta = \tan^{-1}\left(1.67\right) = 59^\circ$$

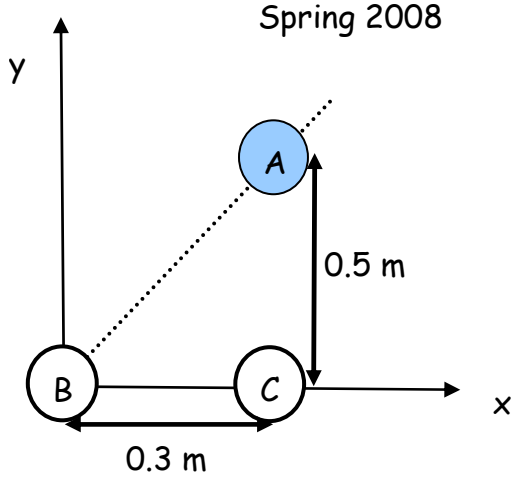
So F_B is down and to the left, 59° below the horizontal.

6. Find the x-components of F_B and F_C and find the total force in the x-direction, F_x.

Since F_C is vertical, the x component of the total force is the x-component of F_B.

$$F_x = F_{B,x} = F_B\cos\theta = \left(0.212\right)\cos\left(59\right) = 0.109\ \text{N}$$

7. Find the y-components of F_B and F_C and find the total force in the y-direction, F_y.



Add y-components of F_C and F_B.

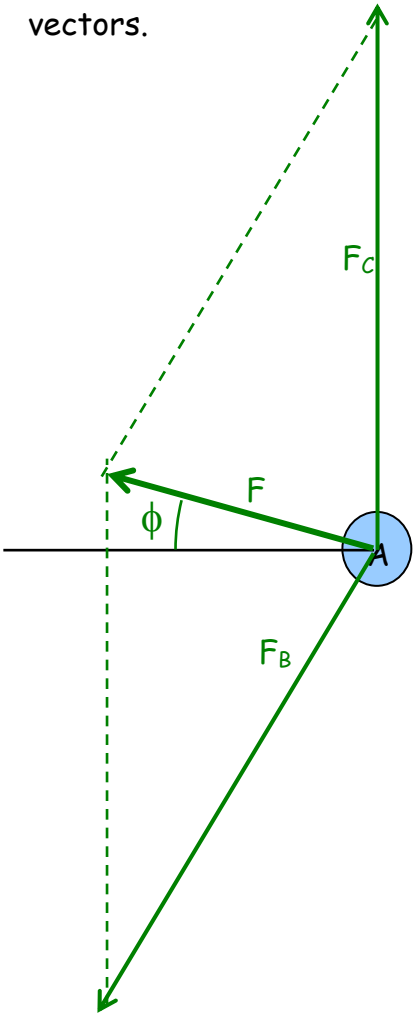
$$F_y = F_{C,y} - F_{B,y} = F_C - F_B \sin\theta$$

$$F_y = 0.216 - (0.212)\sin(59) = 0.034 \text{ N}$$

8. Use the Pythagorean theorem to find the magnitude of the Force acting on A.

$$|F| = \sqrt{F_x^2 + F_y^2} = \sqrt{(0.109)^2 + (0.034)^2} = 0.013 \text{ N}$$

9. Find the direction of the total force acting on A. Include a sketch of the vectors.



$$\phi = \tan^{-1}\frac{F_y}{F_x} = \tan^{-1}\frac{0.034}{0.109} = 17.3^\circ$$

So F = 0.013 N, up and to the left, 17.3° above the horizontal.