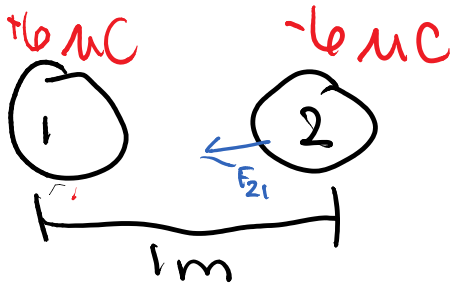


Coulomb's Law Examples

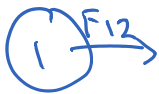
Monday, March 17, 2014 11:47 AM

Find the forces F_{12} and F_{21}



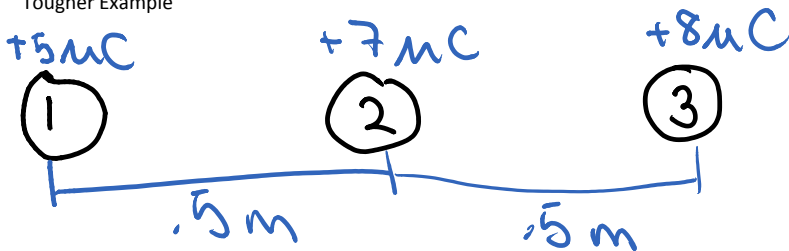
$$F_{12} = \frac{k q_1 q_2}{r^2} = \frac{8.99 \times 10^9 \cdot 6 \times 10^{-6} \cdot 6 \times 10^{-6}}{1^2}$$

~~$= 3.24 \times 10^{-19} \text{ N to the right}$~~
 $0.32 \text{ N to the right}$



~~$F_{21} = 3.24 \times 10^{-19} \text{ to the left}$~~
 $0.32 \text{ N to the left}$

Tougher Example



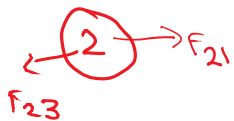
~~$F_{32} = 2.01 \times 10^{-18} \text{ N}$~~ 2.01 N

$$F_{31} = \frac{8.99 \times 10^9 \cdot 8 \times 10^{-6} \cdot 5 \times 10^{-6}}{1^2}$$

~~$= 3.6 \times 10^{-19} \text{ N}$~~ 0.36 N

~~$F_3 = F_{32} + F_{31} = 2.37 \times 10^{-18} \text{ N}$~~ $2.37 \text{ N to the right}$

Find the force on charge 2.
 Find the force on charge 3.



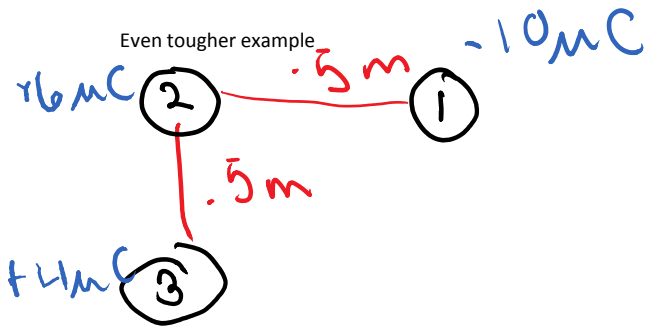
$F_2 = F_{21} - F_{23}$
 (opposite directions)

$$F_{21} = \frac{k q_1 q_2}{r^2} = \frac{8.99 \times 10^9 \cdot 5 \times 10^{-6} \cdot 7 \times 10^{-6}}{.5^2} = \frac{1.26 \times 10^{-18} \text{ N}}{.5^2}$$

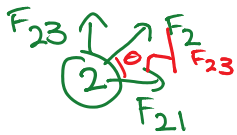
$$F_{23} = \frac{8.99 \times 10^9 \cdot 7 \times 10^{-6} \cdot 8 \times 10^{-6}}{.5^2} = \frac{2.01 \times 10^{-18} \text{ N}}{.5^2}$$

~~$F_2 = 0.75 \times 10^{-18} \text{ to the left}$~~

0.75 N to the left



Find the force on charge 2



$$F_{21} = \frac{k q_1 q_2}{r^2} = \frac{8.99 \times 10^9 \cdot 6 \times 10^{-6} \cdot 10 \times 10^{-6}}{.5^2}$$
$$= \cancel{2.16 \times 10^{-18} \text{ N}} \quad 2.16 \text{ N}$$

$$F_{23} = \frac{8.99 \times 10^9 \cdot 6 \times 10^{-6} \cdot 4 \times 10^{-6}}{.5^2} = \cancel{8.63 \times 10^{-19} \text{ N}}$$
$$0.863 \text{ N}$$

$$F_2^2 = F_{21}^2 + F_{23}^2$$

$$F_2 = \sqrt{F_{21}^2 + F_{23}^2} = \sqrt{(2.16 \times 10^{-18})^2 + (8.63 \times 10^{-19})^2}$$
$$= \cancel{2.33 \times 10^{-18} \text{ N}} \quad 2.33 \text{ N}$$

$$\tan \theta = \frac{\text{opp}}{\text{adj}} = \frac{F_{23}}{F_{21}} =$$

$$\theta = \tan^{-1} \left(\frac{F_{23}}{F_{21}} \right) = \tan^{-1} \left(\frac{8.63 \times 10^{-19}}{2.16 \times 10^{-18}} \right) = 21.8^\circ$$

~~$2.33 \times 10^{-18} \text{ N}$~~ at 21.8° above horizontal

2.33 N at 21.8° above horizontal