PP|638

5.

$q_1 = +6.0\mu C$

$q_2 = -2.0\mu C$

$r = d$

$F_q = 2.0N$ (attractive)

$$F_q = \frac{kq_1q_2}{r^2}$$

$$d^2 = \frac{kq_1q_2}{F_q}$$

$$d^2 = \frac{\left(9.0\times10^9 \frac{N\cdot m^2}{C^2}\right)(6.0\times10^{-6}C)(2.0\times10^{-6}C)}{2.0N}$$

$$d = 0.23m$$

---

$r = 2d = 2(0.23m) = 0.46m$

$F = ?$

$$q_1 \text{ and } q_2 = \frac{q_1+q_2}{2} = \frac{+6.0\mu C + (-2.0\mu C)}{2} = \frac{4.0\mu C}{2} = 2.0\mu C$$

$q_1 = +2.0\mu C$

$q_2 = +2.0\mu C$

$$F_q = \frac{\left(9.0\times10^9 \frac{N\cdot m^2}{C^2}\right)(2.0\times10^{-6}C)^2}{(0.46m)^2}$$

$$F_q = 0.17N$$

---

OR by using proportionalities:

$$F_q = \frac{kq_1q_2}{r^2}$$

$$F_q' = \frac{k\left(\frac{q_1}{3}\right)q_2}{(2r)^2}$$

$$F_q' = \frac{\frac{1}{3}kq_1q_2}{4r^2}$$

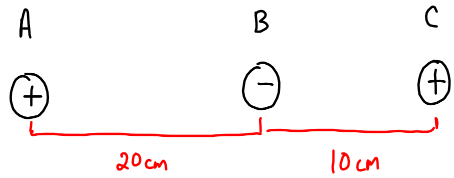
$$F_q' = \frac{1}{12}\frac{kq_1q_2}{r^2} \leftarrow F_q$$

$$F_q' = \frac{1}{12}(2.0N)$$

$$F_q' = 0.17N$$

# The Vector Nature of Coulomb's Law

**Example (FOP | 584)**



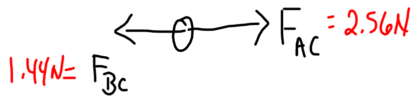

$q_A = +4.0 \times 10^{-6}\,C$

$q_B = -2.5 \times 10^{-7}\,C$

$q_C = +6.4 \times 10^{-6}\,C$

What is the net force on C?

Draw a FBD for C:




$$F_{AC} = \frac{k q_A q_C}{r_{AC}^2}$$

$$F_{AC} = \frac{\left(9.0\times10^{9}\,\frac{N\cdot m^2}{C^2}\right)\left(4.0\times10^{-6}\,C\right)\left(6.4\times10^{-6}\,C\right)}{(0.30\,m)^2}$$

$$F_{AC} = 2.56\,N$$

$$F_{BC} = \frac{k q_B q_C}{r_{BC}^2}$$

$$F_{BC} = \frac{\left(9.0\times10^{9}\,\frac{N\cdot m^2}{C^2}\right)\left(2.5\times10^{-7}\,C\right)\left(6.4\times10^{-6}\,C\right)}{(0.10\,m)^2}$$

$$F_{BC} = 1.44\,N$$

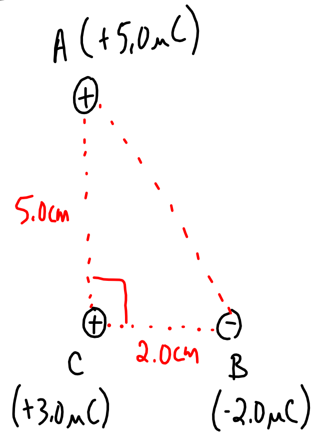
$$F_{C\,net} = F_{AC} - F_{BC}$$

$$F_{C\,net} = 2.56N - 1.44N$$

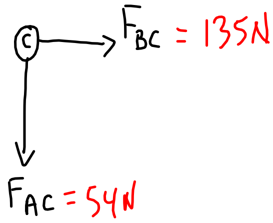
$$F_{C\,net} = 1.12\,N$$

$$\vec{F}_{C\,net} \doteq 1.1\,N\ [R]$$

PP|639




What is the net force on charge C?



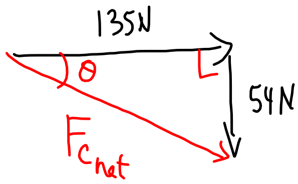

$$F_{AC} = \frac{\left(9.0\times10^{9}\,\frac{N\cdot m^2}{C^2}\right)\left(5.0\times10^{-6}\,C\right)\left(3.0\times10^{-6}\,C\right)}{\left(0.050\,m\right)^2}$$

$F_{AC} = 54\,N$

$$F_{BC} = \frac{\left(9.0\times10^{9}\,\frac{N\cdot m^2}{C^2}\right)\left(2.0\times10^{-6}\,C\right)\left(3.0\times10^{-6}\,C\right)}{\left(0.020\,m\right)^2}$$

$F_{BC} = 135\,N$

Vector addition diagram




$c^2 = a^2 + b^2$

$c^2 = 135^2 + 54^2$

$c = 145\,N$

$\tan\theta = \frac{54}{135}$

$\theta = 22°$

$\vec{F}_{C_{net}} = 1.5\times10^{2}\,N$ [22° CW from line connecting B and C]

TO DO: PP|640