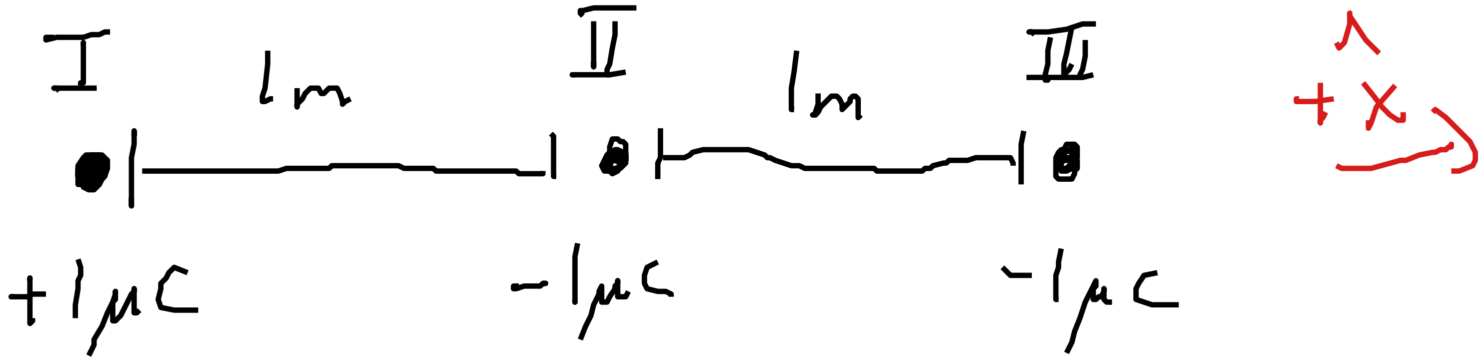
Multiple Sources

- Use Coulomb's Law to find force from each source separately
- Add forces together <u>as</u> <u>vectors</u>



What is the force on II?

$\vec{F}_{I}$: $\leftarrow$ $\qquad$ $\vec{F}_{III}$ $\leftarrow$

$\vec{F}_{net} = \leftarrow$

What is the force on III?

$\vec{F}_{I}$ $\leftarrow$ small (far) $\qquad$ $\vec{F}_{II}$ $\rightarrow$ big (close)

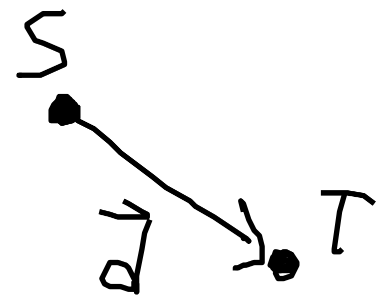
$$\vec{F} = k\,\frac{q_s q_t}{d^2}\,\hat{d}$$

← direction from source to target

(if charges are along horiz or vert line)

$$= k\,\frac{q_s q_t}{d^3}\,\vec{d}$$

(otherwise)



$$\vec{F}_{\text{II on III}} = (9\times10^{9})\,\frac{(-10^{-6})(-10^{-6})}{(1)^2}\,\overset{\hat{d}}{\hat{x}}$$

$$= 9\times10^{-3}\ \text{N}\ (+\hat{x})$$

$$= 9\ \text{mN}\ (+\hat{x})$$

$$\vec{F}_{\text{I on III}} = (9\times10^{9})\,\frac{(+10^{-6})(-10^{-6})}{(2)^2}\,\hat{x}$$

$$= 2.25\ \text{mN}\ (-\hat{x})$$

$$\vec{F}_{net} = 9\ \text{mN}\ \hat{x} + 2.25\ \text{mN}\ (-\hat{x})$$

$$= (9\ \text{mN} - 2.25\ \text{mN})\ \hat{x} = 6.75\ \text{mN}\ \hat{x}$$

using 2nd equation

$$\vec{F}_{I \text{ on } III} = (9\times10^{9})\frac{(+10^{-6})(-10^{-6})}{(2)^{\cancel{3}\,2}}\left(+\cancel{2}\,\hat{x}\right)$$

$$= 2.25\,mN\,(-\hat{x})$$

What is Q so that F on target is zero?

$$F = k\frac{qq}{d^2}$$

Q must be positive

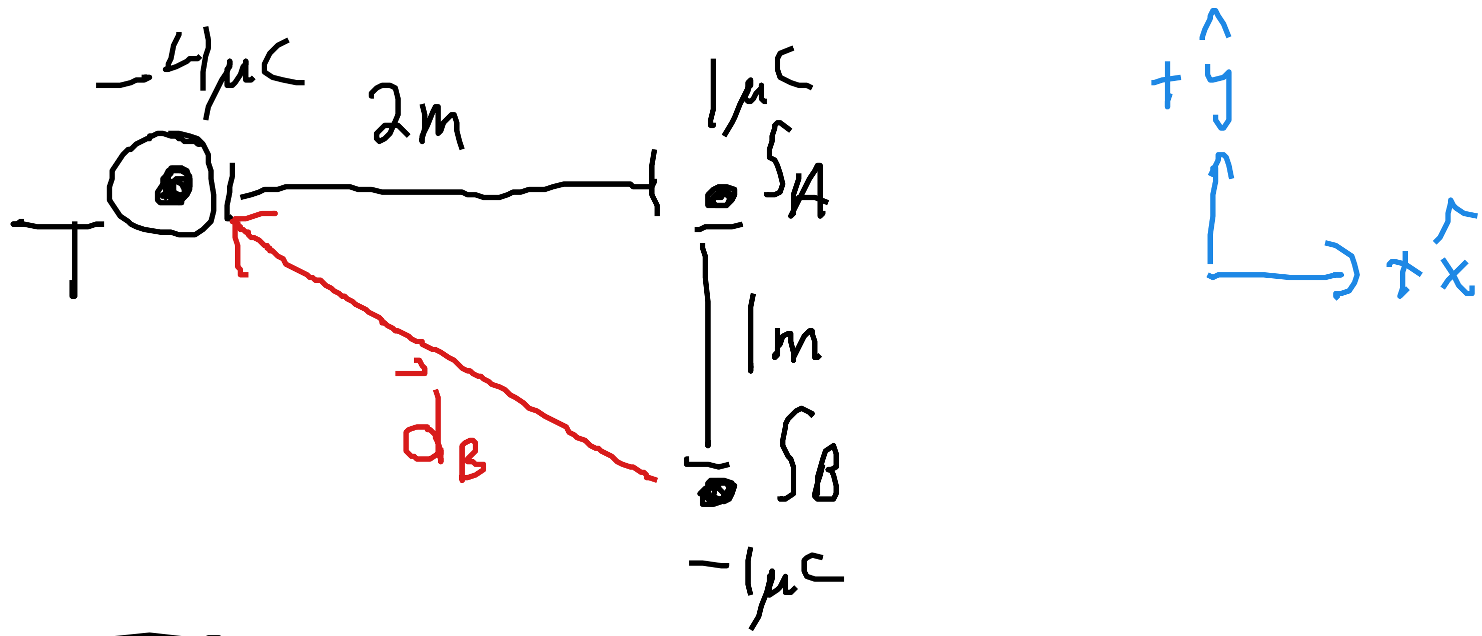
$+4\mu C$ to cancel

the fact that it is twice as far away.

$$\vec{F}_{\underline{III}} = k\frac{Q(-1\mu C)}{2^2}\hat{x} + k\frac{(-1\mu C)(-1\mu C)}{1^2}\hat{x}$$

$$= \cancel{k(-1\mu C)}\hat{x}\left[\frac{Q}{2^2} + \frac{-1\mu C}{1^2}\right] = 0$$

$$\frac{Q}{4} = \frac{1\mu C}{1} \rightarrow Q = 4\mu C$$



A) ↗   B) ↘   C) ↖   D) ↙

S_A: → attracted to A

S_B: ↖ repelled by B

F_{net}: up... and to the right (A is closer than B)

$$\vec{d}_B = -2m\,\hat{x} + 1m\,\hat{y} \qquad d_B = \sqrt{2^2+1^2} = \sqrt{5}$$

$$\vec{F}_B = (9\times10^9)\frac{(-1\mu C)(-4\mu C)}{(\sqrt{5})^3}(-2\hat{x}+\hat{y})$$

$$= 3.2\,mN\,(-2\hat{x}+\hat{y})$$

$$= -6.4\,mN\,\hat{x} + 3.2\,mN\,\hat{y}$$

$$\vec{F}_A = (9\times10^9)\frac{(1\mu C)(-4\mu C)}{(2)^2}(-\hat{x}) \qquad \hat{d}$$

$$= 9\,mN\,(+\hat{x})$$

$$F_{net} = (-6.4\,mN + 9\,mN)\,\hat{x} + 3.2\,mN\,\hat{y}$$

$$= 2.6\,mN\,\hat{x} + 3.2\,mN\,\hat{y}$$