

9. Particles of charge $+86 \mu\text{C}$, $+48 \mu\text{C}$, and $-90 \mu\text{C}$ are placed in a line. The center one (the $+48 \mu\text{C}$ charge) is 1.5 m from each of the others. Calculate the net force on each due to the other two.

Diagram showing three charges in a line:

- Charge 1: $+86 \mu\text{C}$
- Charge 2: $+48 \mu\text{C}$
- Charge 3: $-90 \mu\text{C}$

Distances: 1.5 m between each charge.

Handwritten force calculations and vectors:

- Force on Charge 1 due to Charge 2: $F_{1 \rightarrow 2} = 16.5 \text{ N}$ (repulsive, to the left)
- Force on Charge 1 due to Charge 3: $F_{1 \rightarrow 3} = 7.74 \text{ N}$ (attractive, to the right)
- Force on Charge 2 due to Charge 1: $F_{2 \rightarrow 1} = 16.5 \text{ N}$ (attractive, to the right)
- Force on Charge 2 due to Charge 3: $F_{2 \rightarrow 3} = 17.28 \text{ N}$ (attractive, to the left)
- Force on Charge 3 due to Charge 1: $F_{3 \rightarrow 1} = 7.74 \text{ N}$ (attractive, to the left)
- Force on Charge 3 due to Charge 2: $F_{3 \rightarrow 2} = 25.02 \text{ N}$ (attractive, to the right)
- Net force on Charge 2: 33.78 N (to the right)

Formula used: $F = k \frac{Q_1 Q_2}{r^2}$

Calculation for $F_{1 \rightarrow 2}$:

$$F_{1 \rightarrow 2} = k \frac{Q_1 Q_2}{r^2} = 9 \times 10^9 \frac{(86 \times 10^{-6})(48 \times 10^{-6})}{(1.5)^2} = 16.5 \text{ N}$$

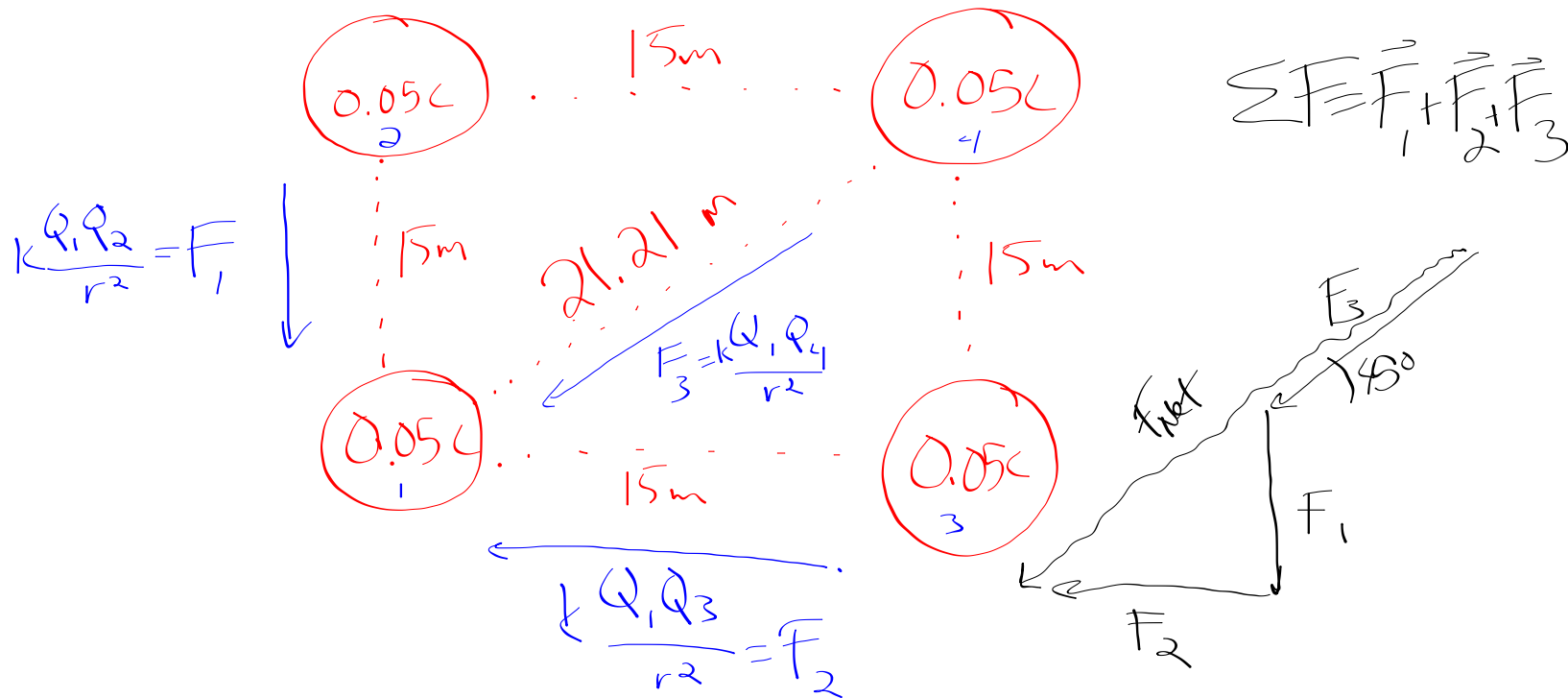
Calculation for $F_{2 \rightarrow 3}$:

$$F_{2 \rightarrow 3} = 17.28 \text{ N}$$

Calculation for $F_{1 \rightarrow 3}$:

$$F_{1 \rightarrow 3} = 7.74 \text{ N}$$

10. A charge of 0.0500 C is placed at each corner of a square 15.0 m on a side. Determine the magnitude and direction of the force on each charge. (If this problem seems familiar, it should. We recently did one almost identical to it. For the stamp, nothing short of a complete solution with all supporting work will qualify as an acceptable "attempt" on this problem. Just a word of warning: simple pictures and half-hearted tries with random equations written down aren't going to cut it, at least to earn the stamp.)



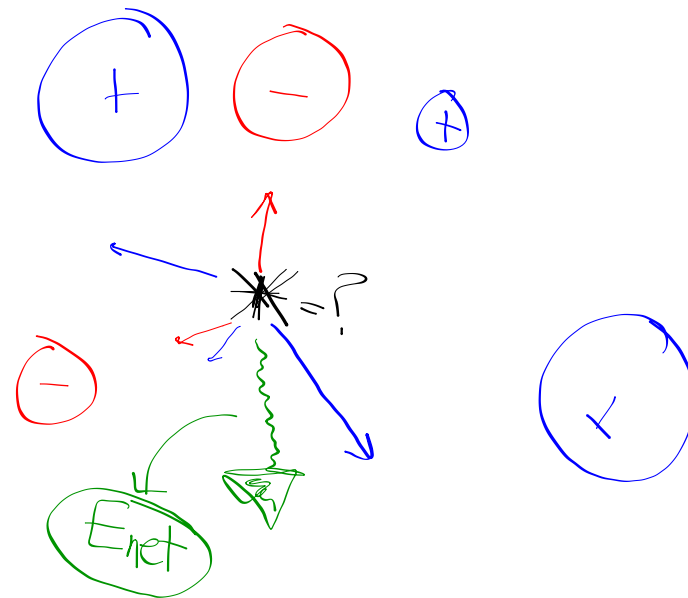
Electric Field:

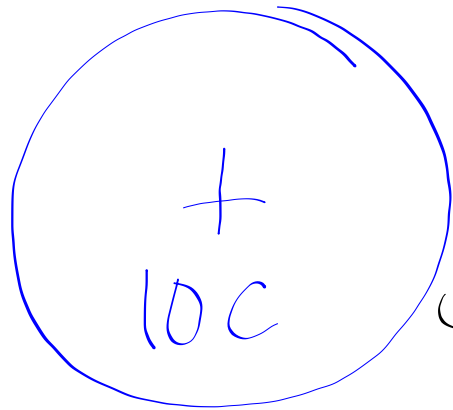
size & direction

- Tells us the force that a $+1\text{ C}$ charge would feel due to the presence of other charges.
- Tells us the force per coulomb of positive charge:

$$\frac{\text{N}}{\text{C}}$$

$$E = \frac{F}{q}$$





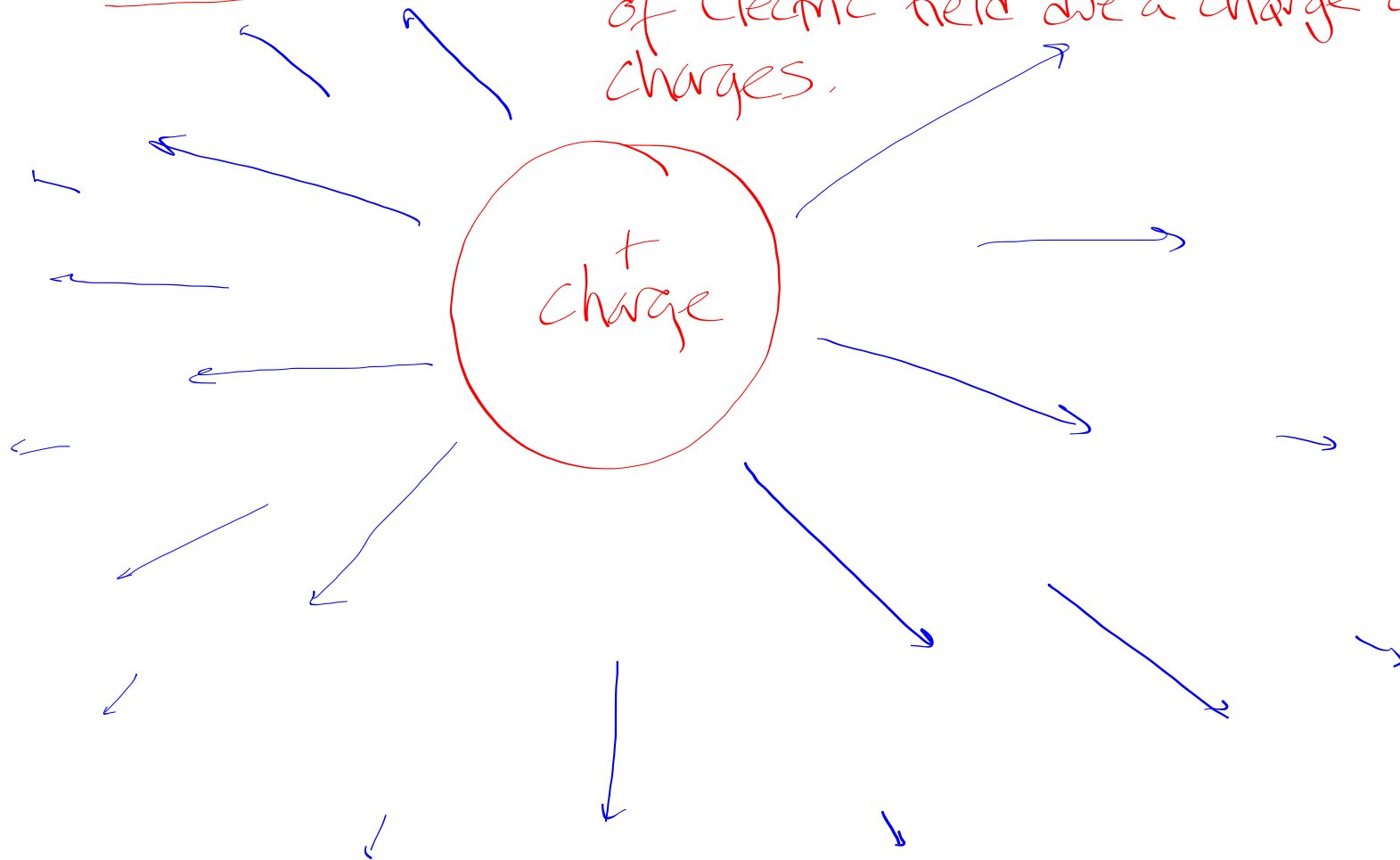
$$E = \frac{F}{q} = \frac{\frac{kQq}{r^2}}{q} = \frac{kQ}{r^2}$$

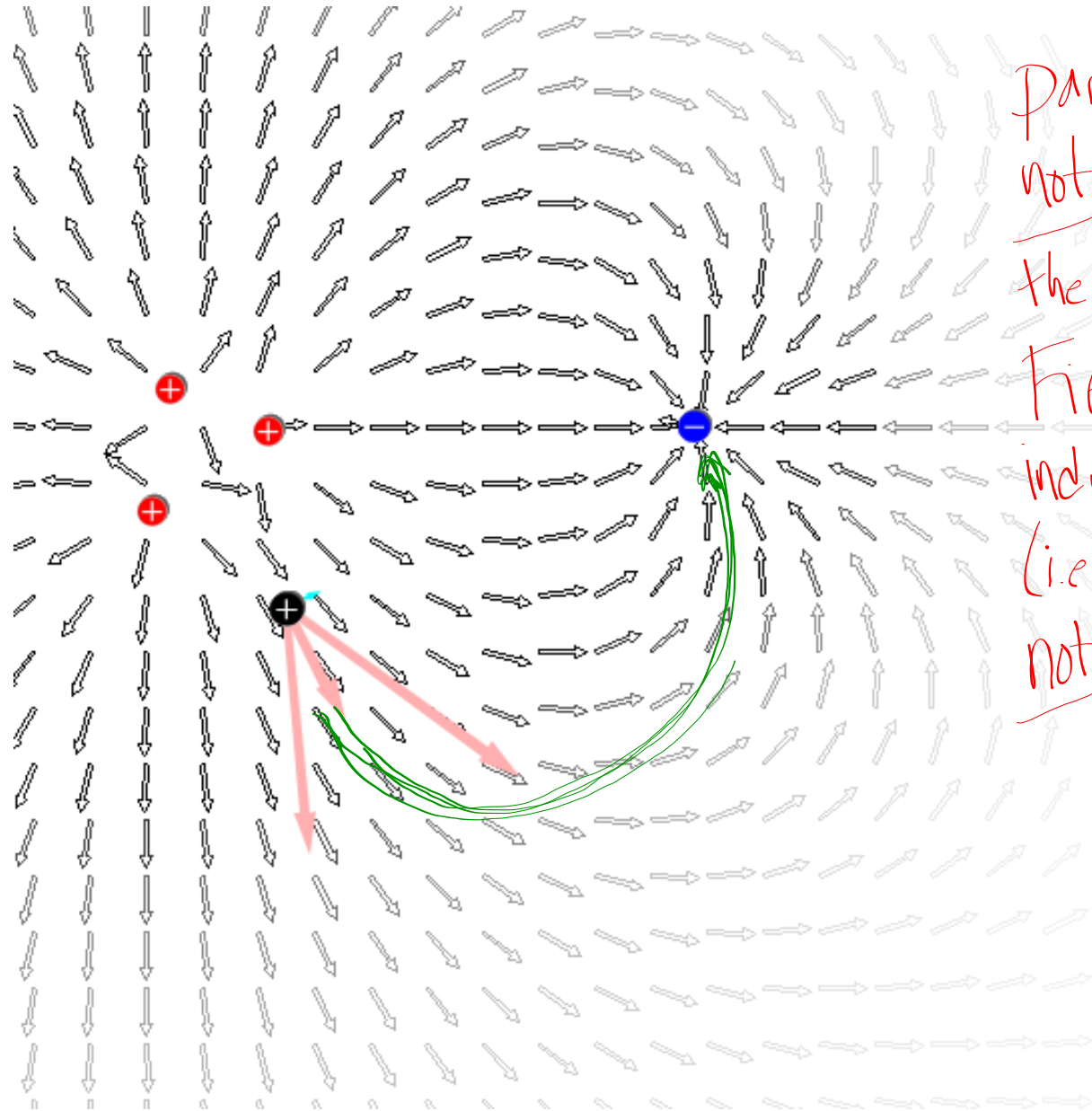
3m * = ?

$$\vec{E} = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(10)}{9} = 1 \times 10^9 \text{ N/C}$$

(sorta down & to the right)

Field Lines : Show direction & relative size of electric field due a charge or charges.





particles do
not follow
the field lines!
Field lines
indicate force
(i.e. acceleration),
not velocity