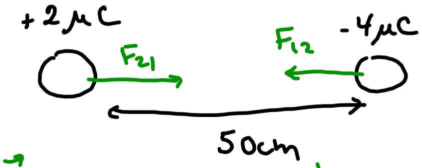
Coulomb's Law

$$F_{el} = \frac{KQq}{r^2} \qquad \left(\frac{Kq_1q_2}{r^2}\right)$$

K = coulomb's constant

$= 8.99 \times 10^9 \frac{Nm^2}{C^2}$ in a vacuum.

Q, q reprents charge in Coulombs (C)



$\vec{F}_{21} = 0.288\ N$ right

$\vec{F}_{12} = 0.288\ N$ left

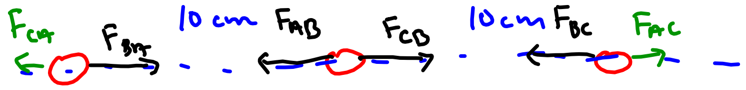
$$F_{12} = \frac{Kq_1q_2}{r^2}$$

ignoring signs.

$$= \frac{\left(9.0\times10^9 \frac{Nm^2}{C^2}\right)\left(2\times10^{-6}C\right)\left(4\times10^{-6}\right)}{(0.50m)^2}$$

$$= 0.288\ N$$

Multiple Charges



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

$q_A = +20\ \mu C$ $q_B = -20\ \mu C$ $q_C = +20\ \mu C$

$\Sigma \vec{F}_A$: $F_{BA} - F_{CA} = \frac{3}{4}F$ right

$= 270\ N$ right

$\Sigma \vec{F}_B$: ☺

$\Sigma \vec{F}_C = F_{BC} - F_{AC} = \frac{3}{4}F$ left.

$= 270\ N$ left.

$F_{CA} = \frac{1}{4} F_{BA}$

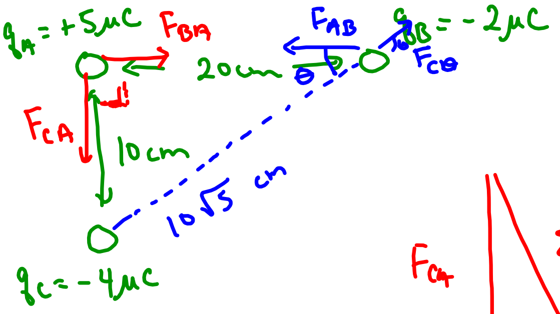
$F_{BA} = F_{AB} = F_{CB} = F_{BC} = F$

$F_{CA} = F_{AC} = \frac{1}{4}F$

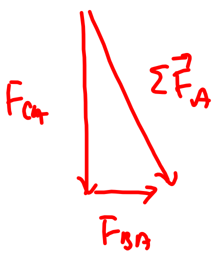
$$F = \frac{kq^2}{r^2} = \frac{(9.0\times10^9)(20\times10^{-6})^2}{(0.10\,m)^2}$$

$= 360\ N$

2-D



Find $\Sigma \vec{F}_A$. Easy



$\Sigma \vec{F}_B$ same physics - math is a bit more painful ::

$$C^2 = a^2 + b^2 - 2ab\cos C$$

$$(\Sigma F_B)^2 = F_{AB}^2 + F_{CB}^2 - 2 F_{AB} F_{CB} \cos\theta.$$

Electric Fields

We define the electric field, $\vec{E}$ as the electrical force, $\vec{F}_{el}$, per unit charge acting on a charge, q.

$$\vec{E} = \frac{\vec{F}_{el}}{q}$$

We say this is the electric field experienced by the charge, q.

The presence of a charge, Q, changes the space around it (similar to gravitational fields). This changed space is called the electric field. The electric field is independent of the charge, q, experiencing it.

The force experienced by the charge, q. is $\vec{F}_{el} = q\vec{E}$.

We define the direction of the electric field to be the same as the direction of the force on a positive charge, q.

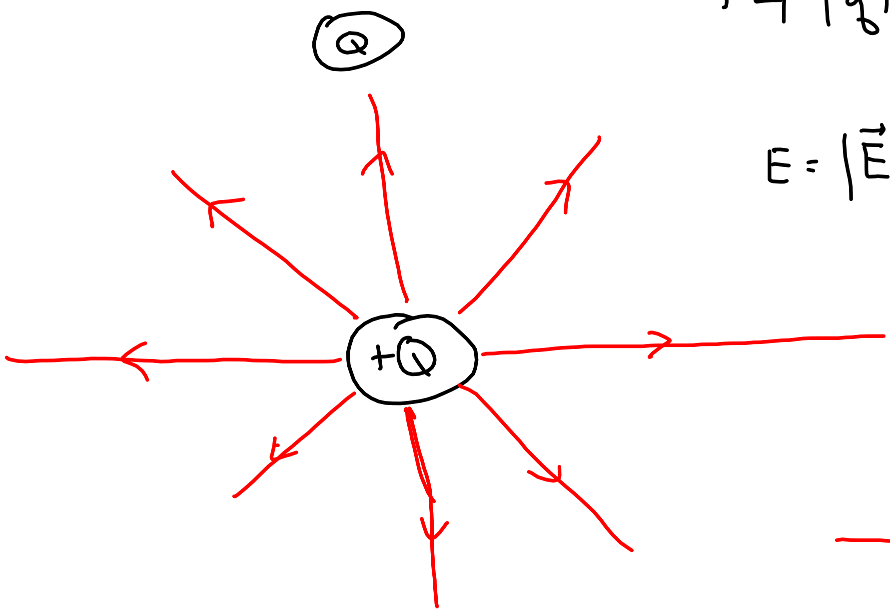
If we put a + charge, q, at point A, $\vec{F}_{el} = q\vec{E}$ is to the right, but a negative charge, −q gives $\vec{F}_{el} = -q\vec{E}$ ⇒ to the left.

(These are vector equations, the sign of charge is important)

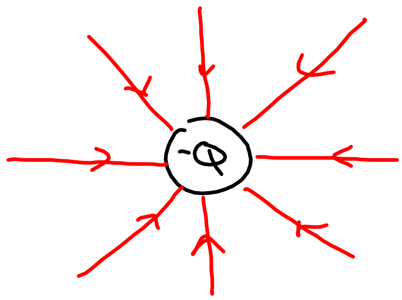
$\vec{E}$ from a point charge

$$|\vec{E}| = \left|\frac{\vec{F}}{q}\right| = \frac{\frac{KQq}{r^2}}{q}$$

$$E = |\vec{E}| = \frac{KQ}{r^2}$$ signs don't matter



Electric field lines



We can investigate an electric field with a small, positive test charge (SPTC)