There are bodies that carry "electricity"

two kinds < neg charged / pos charged.

The basic unit of charge

$e = 1.6 \times 10^{-19}$ C

impractical

Now imagine that we have 2 small bags of charges

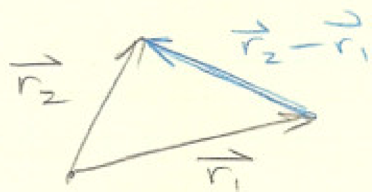
bag # 1 : Q_1
bag # 2 : Q_2

Q_1 & Q_2 can be positive or negative

$\vec{F}_{1,2}$: force on Q_2 due to the presence of Q_1

$$\vec{F}_{1,2} = k \frac{Q_1 Q_2}{|\vec{r}_1 - \vec{r}_2|^2}$$

$\vec{r}_1$: origin to bag 1
$\vec{r}_2$: origin to bag 2



$|\vec{r}_2 - \vec{r}_1|$: distance between the two bags.

k: proportionality factor

$$k = \frac{1}{4\pi\varepsilon_0}$$

ε_0: permibility of free space.

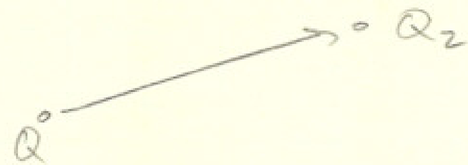
$$\varepsilon_0 = 8.854187 \times 10^{-12} \ \mathrm{F\,m^{-1}}$$
$$k \sim 9 \times 10^{9}$$

Recall:

$$\vec{r}_2 = x_2\hat{x} + y_2\hat{y} + z_2\hat{z}$$
$$\vec{r}_1 = x_1\hat{x} + y_1\hat{y} + z_1\hat{z}$$

$$\vec{r}_2 - \vec{r}_1 = (x_2 - x_1)\hat{x} + (y_2 - y_1)\hat{y} + (z_2 - z_1)\hat{z}$$
$$|\vec{r}_2 - \vec{r}_1| = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$$

Now we are interested in the direction of $\vec{F}_{1,2}$.



The force is along $\vec{r}_{12} = \dfrac{\vec{r}_2 - \vec{r}_1}{|\vec{r}_2 - \vec{r}_1|}$

$$\therefore \quad \vec{F}_{1,2} = \frac{Q_1 Q_2}{4\pi\varepsilon_0} \frac{\vec{r}_2 - \vec{r}_1}{|\vec{r}_2 - \vec{r}_1|^3}$$

And

$$\vec{F}_{1,2} = -\vec{F}_{2,1}$$

Note: to bags of like charge repell and bags of unlike charge attrack

Super Position Principle

The net force on Q_3 is the sum of the two forces.

$$\boxed{\vec{F}_3 = \vec{F}_{13} + \vec{F}_{23}}$$

$$\vec{E}(\vec{r}_3) = \frac{\vec{F}_3}{Q_3}$$