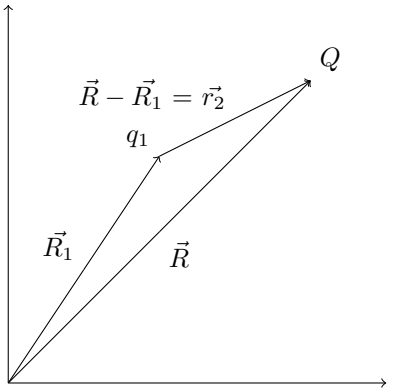
Introduction to Electromagnetism

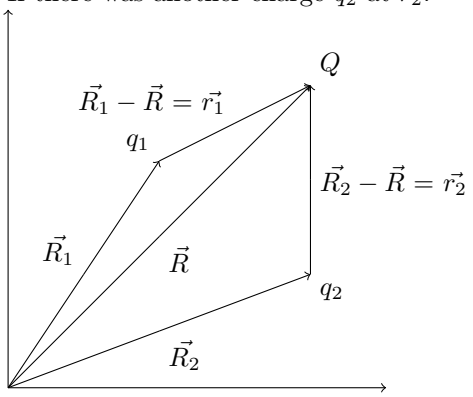
1 Coulomb's Law



the force on Q due to q_1 is given by:

$$\vec{F_1} = \frac{1}{4\pi\epsilon_0}\frac{q_1 Q}{r_1^2}\hat{r_1}$$

If there was another charge q_2 at $\vec{r_2}$:



The force on Q due to q_2 is given by:

$$\vec{F_2} = \frac{1}{4\pi\epsilon_0}\frac{q_2 Q}{r_2^2}\hat{r_2}$$

And the net charge on Q is given by:

$$\vec{F} = \vec{F_1} + \vec{F_2}$$

$$\vec{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 Q}{r_1^2}\hat{r_1} + \frac{1}{4\pi\epsilon_0}\frac{q_2 Q}{r_2^2}\hat{r_2}$$

If there were n charges, the net force on Q would be:

$$\vec{F} = \sum_{i=1}^{n} \frac{1}{4\pi\epsilon_0} \frac{q_i Q}{r_i^2} \hat{r_i}$$

$$\vec{F} = Q \sum_{i=1}^{n} \frac{1}{4\pi\epsilon_0} \frac{q_i}{r_i^2} \hat{r_i}$$

where $\sum_{i=1}^{n} \frac{1}{4\pi\epsilon_0} \frac{q_i}{r_i^2} \hat{r_i}$ is the electric field $\vec{E}$ at $\vec{R}$ due to the n charges.

Field: A value, vector or tensor, that is defined for every point in space and time.

2 Vector Calculus