ELECTRIC FIELD

Al alternative method of describing the interaction between charges is to introduce the concept of the electric field E. Recall in our brief overview of Maxwell's equations that we mentioned that the E-field is a fundamental quantity in Maxwell's equations that is very important in understanding E&M.

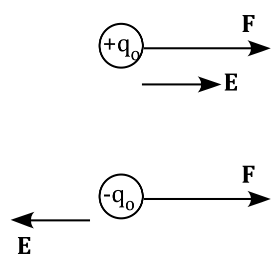
***Def*: The Electric Field E at a point in space is equal to the electric force F that a test charge q_o experiences, divided by the test charge q_o.**

$$\boxed{\vec{E} = \frac{\vec{F}}{q_o}}$$ **Electric Field**

Units
[E] = N/C

The test charge q_o can be positive or negative:

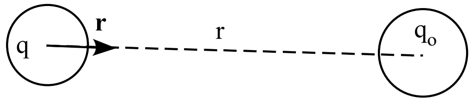
a) If q_o is positive, **F** and **E** are in same direction.
b) If q_o is negative, **F** and **E** are in opposite direction.



A. One of the reasons the ***E****-field concept is very important is because it allows us to calculate the force* ***F*** *that a charge q will experience if we know the E-field.*

B. If a charge q is placed at a point where the E-field is ***E****, then it will experience an electric force* ***F*** *= q****E****.*

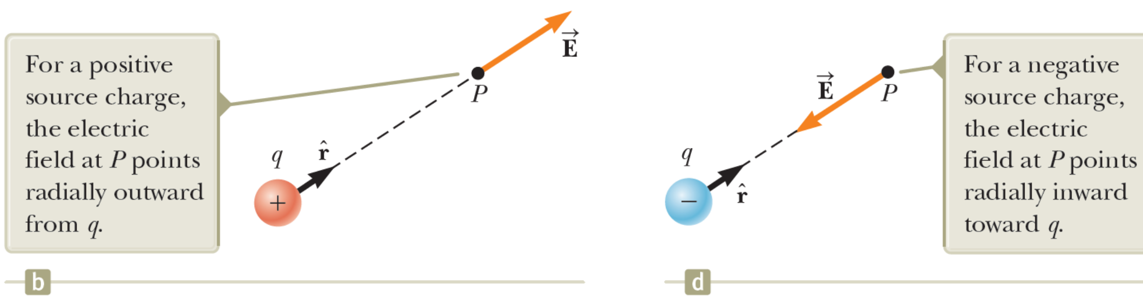
Ex. Calculate the E-field at a distance r from a point charge q.



$$\vec{F} = \frac{kqq_o}{r^2}\hat{r}$$

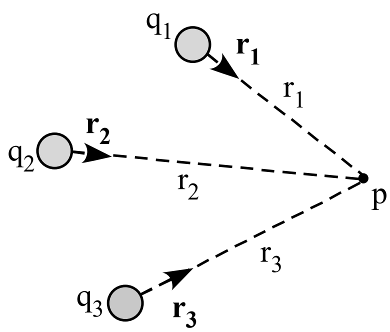
$$\boxed{\vec{E} = \frac{\vec{F}}{q_o} = \frac{kq}{r^2}\hat{r}}$$ Electric Field due to a point charge.

a) If q is positive, then the E-field is symmetrically radially outward.
b) If q is negative, then the E-field is symmetrically radially inward.
c) The electric field is a property of the charge q and is independent of the test charge q_o



One of the reasons the **E**-field concept is very important is because it allows us to calculate the force **F** that a charge *q* will experience if we know the E-field. The force is given by **F** = q**E**.

Superposition Principle for **E**-Fields
The Electric Field at some point in space is equal to the sum of the Electric Fields due to the surrounding charges.



$$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{E}_3$$

$$\vec{E} = \frac{kq_1}{r_1^2}\hat{r}_1 + \frac{kq_2}{r_2^2}\hat{r}_2 + \frac{kq_3}{r_3^2}\hat{r}_3$$

In general, for n – point charges:

$$\boxed{\vec{E} = k\sum \frac{q_n}{r_n^2}\hat{r}_n}$$ E-field due to n-point charges.

If you know the E-field at any point in space, you can determine the force on a charge *q* placed at that point by ***F*** = *q**E***. Using the E-field concept we say that it's the E-field that exerts the force F on q.