8/26 In Class – Coulomb's Law, and E fields

The electric field

Physicists were long unhappy with the notion of action-at-a-distance forces. Meaning, how do the two charges in the Coulomb Force affect each other if they don't touch? The answer: each charge generates a field everywhere in space.

The definition of the electric field, $\vec{E}$ is:

$$\vec{E} \equiv \frac{\vec{F}}{Q}$$

For point charges, this means that one point charge, q, generates a field of magnitude

$$E = K\frac{q}{r^2}$$

and you find the direction of the field at any point of interest by pretending to put a very small, positive test charge at that point and using Coulomb's Law to find the direction.

1. The electric field is a vector. It has no special name for its units. What is one way to write the units of $\vec{E}$?

2. Find the electric field a distance of 3m above a point particle with a +2C charge.

3. Find the electric field a distance of 3m below a point particle with a +2C charge.

4. Find the electric field a distance of 6m to the right of a point particle with a +2C charge.

5. Find the electric field a distance of 6m to the right of a point particle with a −2C charge.

6. A point particle with a charge of $Q_1 = 1$ nC is at the origin. A second point particle with charge $Q_2 = -2$nC is at $x = 30$cm,

   (a) What is the electric field due to those two particles at $x = 60$cm? (Do this the "hard" way. Find $\vec{E}_1$ from $K\frac{q_1}{r^2}$; do the same for $\vec{E}_2$, then add the two vectors. Recall that you find the direction as if there were a positive test charge feeling the Coulomb force.)

(b) What force would a charge of 3nc feel at that same point ($x =$ 60cm)? (Do this one the "easy" way. Multiply your $\vec{E}$ by Q. Do you understand why?) How does this compare to your answer to problem 1 (on todays worksheet = number 6 on yesterdays)?

7. A point particle with a charge of $Q_1 = 1$ nC is at the origin. A second point particle with charge $Q_2 = -2$nC is at $y = 30$cm,

   (a) What is the electric field due to those two particles at $x = 30$cm? (Do this the "hard" way. Find $\vec{E}_1$ from $K\frac{q_1}{r^2}$; do the same for $\vec{E}_2$, then add the two vectors. Recall that you find the direction as if there were a positive test charge feeling the Coulomb force.)

   (b) What force would a charge of 3nc feel at that same point ($x =$ 60cm)? (Do this one the "easy" way. Multiply your $\vec{E}$ by Q. Do you understand why?) How does this compare to your answer to problem 2 (on todays worksheet = number 7 on yesterdays)?