PhET Electric Field

The electric field is a way of quantifying the influence of electric charges on the environment around them. If a collection of charges causes an electric field, we can calculate the force on another charge placed in that field using the equation

$\mathbf{F} = q\,\mathbf{E}$,

Where **F** is the force (a vector), q is the additional charge placed in the field, and **E** is the electric field (once again, a vector).

The magnitude of the field caused by a single point charge Q a distance r from that charge is given by

$E = K\,Q / r^2$,

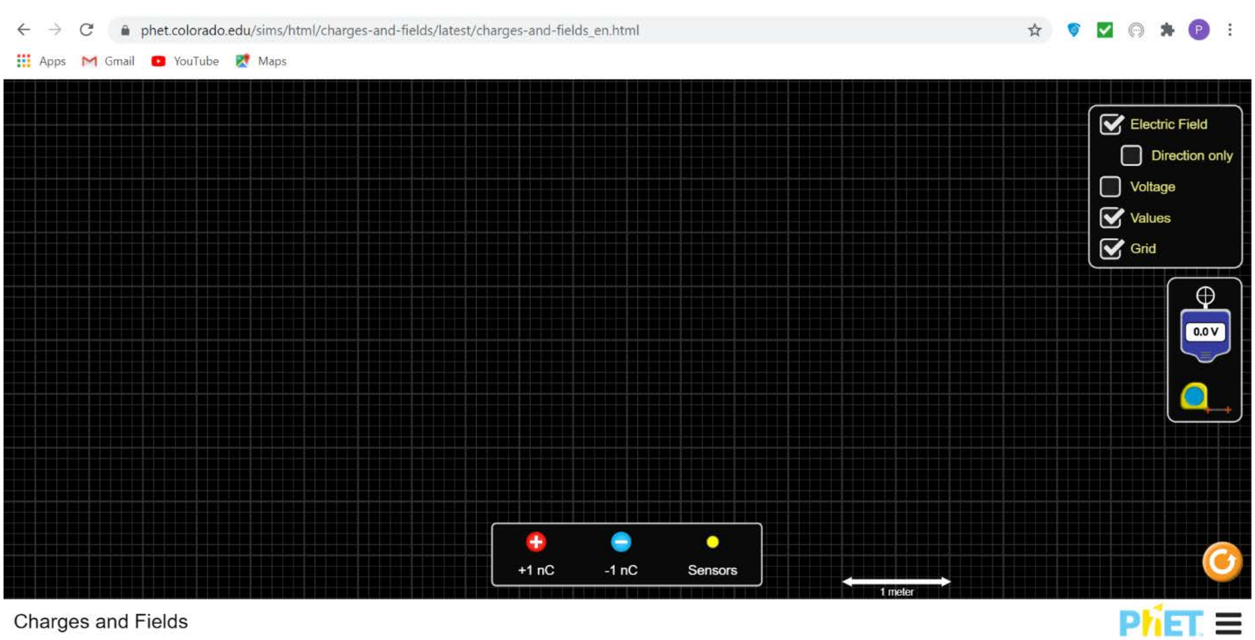
where K is a constant, 9×10^9 N m^2/C^2. The direction of the field is away from the charge Q if Q is positive, and toward the charge Q if Q is negative.

A field caused by more than one charge is the vector sum of the fields caused by each individual charge. There is a complex-sounding name for this – “superposition” – which sounds like it belongs in a Marvel Comic. Here we will work on superposition.

Start here:

https://phet.colorado.edu/sims/html/charges-and-fields/latest/charges-and-fields_en.html

Then click on “Values” and “Grid” in the upper right part of the screen. You’ll see this:



Drag a +1 nC charge and a -1 nC charge to locations near the middle of the screen so that they are at the same vertical level but 2.0 meters apart (according to the length scale at the bottom of the screen), with the positive charge on the left and the negative charge on the right. Now put the negative charge back in the box at the bottom of the screen so that only the positive charge remains.

Drag a sensor onto the screen and measure the electric field at three locations. The first location is 1.0 meter to the right of the positive charge. The second location is 1.0 meter above that point and the third location is one meter below the first location. Record the magnitudes and directions of the electric fields at those three locations. In addition, take the horizontal direction to be the x-direction (with the positive x-direction to the right) and the vertical direction to be the y-direction (with the positive y-direction upward), and record the x and y components of those three electric field values.

Now return the -1 nC charge to its original location and move the +1 nC charge to the box. Repeat the measurements of the electric field at the same three locations, and calculate the x and y components of the electric fields at each of the three locations.

Finally, bring the positive charge back to its original location so that the electric field is caused by both the positive and negative charges. Measure the electric fields at the three locations you have measured previously, and determine the x and y components of the electric fields at those locations.

Open a Word document and record in the document your electric field measurements for +1 nC only, -1 nC only and with both charges in component form.

And then answer this question in the Word document:

Do the electric fields caused by the individual charges add to give the field caused when both charges are present?

Now remove the two charges from the screen and make a new arrangement of charges in which four +1 nC charges are at the four corners of a square that is 2.5 m on a side. Answer these questions in your Word document:

What is the electric field in the center of the square? Does your answer make sense?

Convert your Word document to pdf and submit it via Canvas.