

Lab 03 - Electric Field and Electric

Potential NAME: _____

Time spent on Lab 03 = approximately 2 hours, does not need to be done at one sitting

Materials needed = Access to computer and high speed internet

Learning Objectives:

- Visualize periodic motion
- Use definitions from periodic motion and classical mechanics to experiment with forces on springs
- Generalize periodic motion to wave motion

To conduct the experiments utilized in this week's lab, you must begin by ensuring the webpage for Phet lab entitled "Charges and Fields" is able to function in your web browser. First go to:

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

Likely Chrome will be the best browser for this, but most any should work.

Next, click on the +1nC dot and drag it into the black space. You should see something like this:

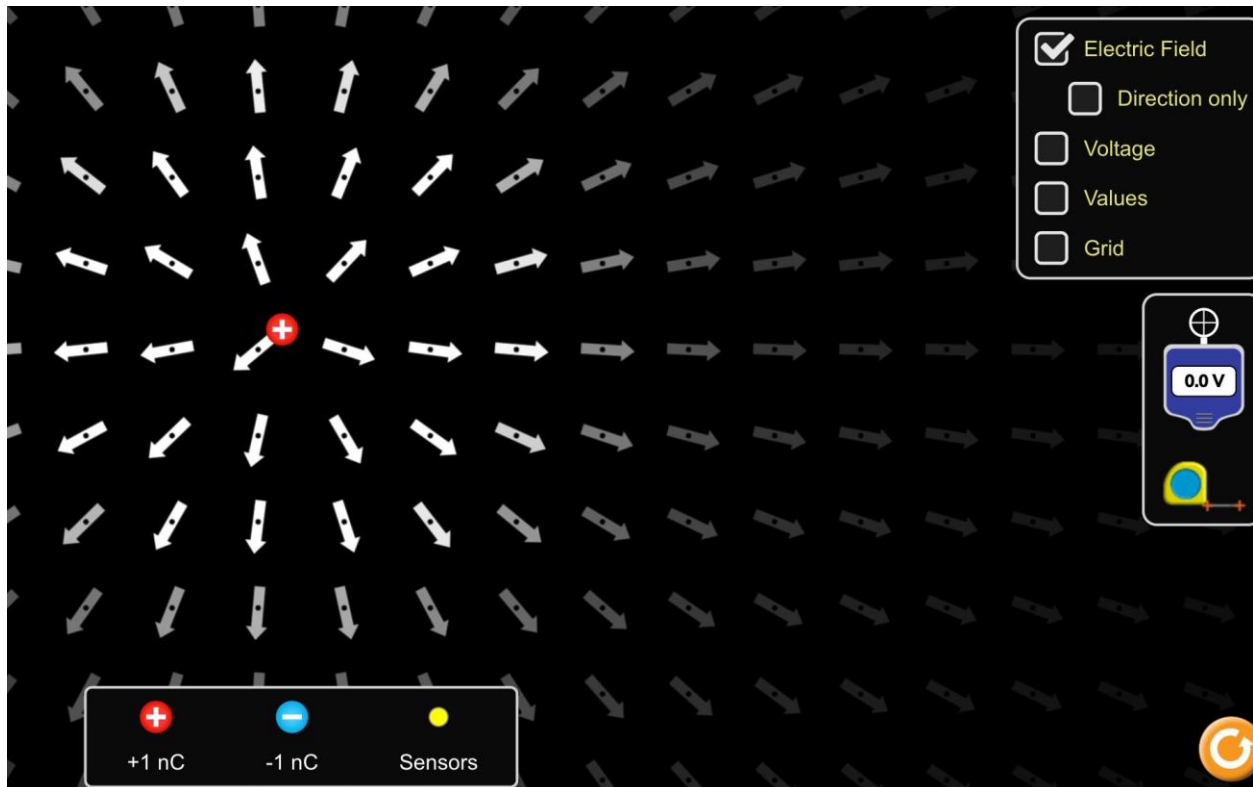


Figure #1

If you do see a similar screen, then likely the software will work. If not, please try another browser until you do see something similar.

Once you are certain your web-browser is capable of using this app, then refresh it until you have a blank/black screen and begin the activities below.

Virtual Lab:

1. What can you change about the simulation?

Make electric field lines to be continuous.

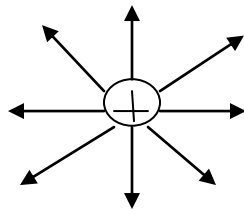
2. Click on the “sensor” dot on the bottom and put it somewhat far from a $+1\text{nC}$ charge. Then click “show values” on the upper right box. What is the physical significance of this value?

Decreasing strength of electric field with increasing in distance

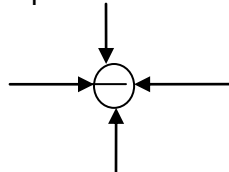
3. How can you make a charge of $+2\text{nC}$? -3nC ?

By overlapping two 1nC charges and overlapping three -1nC charges

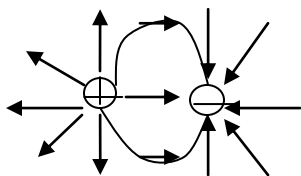
4. Draw the field lines for a $+4\text{nC}$ charge. Make sure you are sketching continuous field lines. You can use [Google Drawing](#) to complete this.



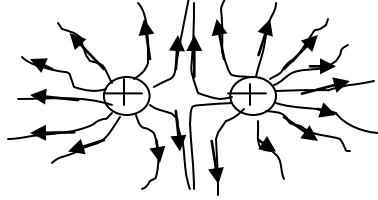
5. Refresh the screen and repeat this for a -2nC charge.



6. Refresh the browser, and place a $+2\text{nC}$ and a -2nC about 1 meter away from each other. Sketch continuous field lines between these two charges below.



7. Refresh again and place TWO $+2\text{nC}$ charges about 1 meter apart and sketch the continuous field lines below



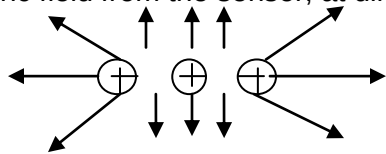
8. When you have two like charges in a line – where is the electric field the greatest?
Is there ever a point where the field will be zero?

The charge is greatest at the opposite sides. Yes

9. When you have two unlike charges in a line – where is the electric field the greatest?
Is there ever a point where the field will be zero?

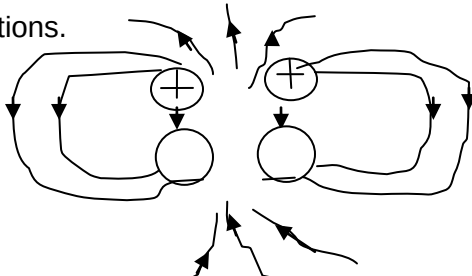
The area between the two charges. No.

10. Refresh and place THREE $+2\text{nC}$ charges at equal distances from each other. Draw continuous electric field lines below, in addition to writing at least 5 magnitudes of the electric field from the sensor, at different positions.



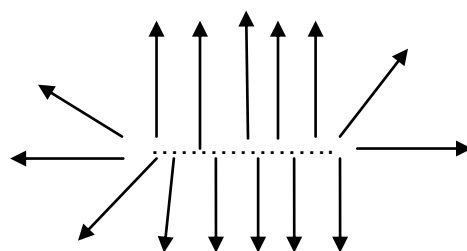
Electric field values: 70.8, 20.9, 25,401, 4.02, 127,010

11. Refresh and place FOUR charges, TWO $+2\text{nC}$ and TWO -2nC , in a square shape. Draw in continuous electric field lines and write in the electric field sensor magnitude at five different positions.



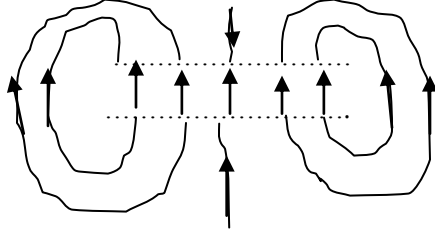
Electric field values: 105, 34, 8.56, 72, 0.95,

12. Refresh and place a row of $+2\text{nC}$ charges on the bottom of the screen. You should use at least 20 separate charges in the row. Draw the continuous electric field lines below and write in the electric field strength at 1.5 meters above the center of the line of charges.



Electric field: 88.4v/m

13. DO NOT refresh, and now place a long line of -2nC , the same number as you did for positive charges, on the top of the screen about 3 meters from the positive charges. Sketch the continuous electric field lines below and make note of the electric field value at the same position, 1.5 meters above the center of the positive row.



Electric field : 88.4v/m

You have just created a parallel plate capacitor! We will study these in more detail in the next week, but it's worth having this image of the E-field between oppositely charged plates in mind, as we get into capacitance

Now refresh and click the options for “values” and “grid” on the upper right part of the screen. Place ONE +2nC charge on the left center of the screen. Place ONE -2nC charge on the same grid line only the right side of the screen about 3 meters away. Then move the electric field sensor along the grid line that connects the two charges and write down the electric field value at equal distances, say every 20 cm.

14. Make a table of the electric field values in the leftmost column. Next write down the distance between each measurement, in the second column. Now write down a calculated voltage in the third column. Lastly, measure the voltage at each of the positions with the volt-meter provided in the toolbox on the right side of the screen, and write those values down in the fourth column.

E-field		V =calculated	V _{measured}
88.1	40.0	-35.24	33.67
32.6	80.6	-22.53	14.99
18	120.2	-5.78	5.11
16	160.6	-0.16	-1.13
20.9	200.2	1.94	-8.00
46.5	240.6	10.34	-20.46
292	280.1	96.97	-65.80

15. How well do your calculated voltages match the measured voltages? Comment on any differences.

They do not match because the electric field is not uniform and the values are an estimate.

Next week will use Voltage extensively, so it’s worth having a good idea of where voltage “comes from” in terms of static charges. Voltage is approximated as the negative of the change of the electric field, times the distance covered when the E-field changes.

Once you have completed all lab questions, please download this document as a PDF only! Then upload this PDF to Blackboard under the assignment “Lab 03”, for grading.

- Portions of this lab were taken from a write-up by Elyse Zimmer, KIPP Houston Public Schools.