**29** *–* **Point Charges in****Electrostatic Fields** *– PhET E-fields II*

***Purpose:*** Investigate the fields created by point charges when all other forces are ignored.



***Apparatus:*** PhET Simulation *Charges and Fields*

***Discussion:*** A point charge in space creates an electrostatic field, similar to a massive object creating a gravitational field. In fact, this similarity extends to the mathematical relationship between electrostatic force  and universal gravitational force . In this lab, familiarize yourself with how point charges create fields and how muliple fields, from multiple charges, interact.

*It is worth noting that the field strength,* ***E*** *can be expressed in units of N/C and V/m.*

***Important Formulas:***

*Field Strength:*  and  *Electrostatic Force:  k =9 .00x109 Nm2/C2*

***Procedure and Analysis, part 1:***

1. Open your PhET Simulations: ***Electricity, Magnets, and Circuits 🡪 Charges and Fields* **

2. Place a single point charge in the work area and observe the field it creates with a test charge.

3. Draw the field lines (using convention, arrows) around a positive and (separately) a negative charge.

 

4. Draw the field lines around two nearby charges for each of the three pairs below.

     

5. Where, around a point charge, is the magnitude of the electrostatic force the greatest?

the least?

6. Where, around a point charge, is the magnitude of the electrostatic potential the greatest?

7. Using a single positive point charge +1.0 nC, complete the table below. Check your work in the simulation when possible.

|  |  |  |
| --- | --- | --- |
| Distance from charge, m | Field strength, V/m | Potential at location, V |
| 2.1 m |  |  |
| 0.90 m |  |  |
|  |  | 9.0 V |
|  |  | 26.4 V |
|  | 1.1 V/m |  |
|  | 27.0 V/m |  |

8. Show, mathematically or with the formulas from your chart, that V/m = N/C.

**Conclusion Questions and Calculations:**

1. Closer to a point charge, the electrostatic field strength is *stronger / weaker*.
2. Placed exactly between **two** **oppositely-**charged point charges, a test charge (the sensor) will show *zero /* *minimum / maximum* force.
3. Placed exactly between **two** **similar**-charged point charges, a test charge (the sensor) will show *zero /* *minimum / maximum* force.
4. Placed exactly on a point charge, the sensor will show *zero / minimum / maximum* field strength.
5. A balloon is electrostatically charged with 1.4 μC (microcoulombs) of charge. A second balloon 23 cm away is charged with -2.1 μC of charge. The force of *attraction / repulsion* between the two charges will be:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. If one of the balloons has a mass of 0.064 kg, with what acceleration does it move toward or away from the other balloon? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Imagine two 10. g objects hanging **in** **standard earth gravity** from 1.0m ultra-light strings, separated by 0.50m. Complete the chart below with free-body (force) diagrams to describe the effect on the objects under these circumstances:

|  |  |  |
| --- | --- | --- |
| Left object has a neutral charge, right object has a negative -1.0C charge | Left object has a positive +1.0C charge, right object has a -1.0C negative charge | Left object has a positive +1.0C charge, right object has a positive +1.0C charge |
|  |  |  |

1. For each of the above diagrams, calculate the initial force (before any movement from 0.5m away) of attraction/repulsion on each object.

9. Does attraction due to universal gravity need to be included in your calculations above? Why/Why not?