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 $F = k\frac{q_1 q_2}{d^2}$ and universal gravitational force $F = G\frac{m_1 m_2}{d^2}$. 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: $E = F/q$ and $E = V/d$ *Electrostatic Force:* $F = k\frac{q_1 q_2}{d^2}$ *k =9 .00x10⁹ Nm²/C²*

Procedure and Analysis, part 1:

1. Open your PhET Simulations: ***Electricity, Magnets, and Circuits → Charges and Fields*** Run Now!
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	

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:

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