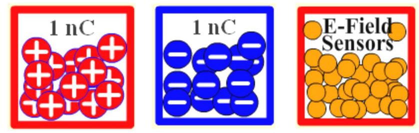
Name: ______________________________

Period: _______ Date: ______________

Charges & E-Fields PhET Lab, rvsd 2011

Introduction: It can by rationalized that the most important concept in physical science is like things _____________ while opposite things _____________. When working with static electric charges, like charges _____________ while opposite charges _____________. These charges can be as large as clouds of ionized gas in a nebula one million times the size of the earth, or as small as protons and electrons. The rule remains the same. In this lab, you will investigate how a charge creates a field around itself and how test charges behave when placed in that field.

Important Formulas: $F = Eq$ $F = k\frac{q_1 q_2}{d^2}$ $E = V/d$



$k = 9.00 \times 10^9\ Nm^2/C^2$

Procedure Part I: *Electricity, Magnets, and Circuits* → *Charges and Fields* 

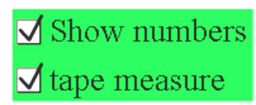
- Place a 1 nC (nanoCoulomb) positive charge and E-Field sensor in the test area. Click 

to observe the field lines in the E-field. Observe the sensor's arrow as you drag it around the in the field.
- The sensor's arrow illustrates the **force** of attraction or repulsion at a point in an electric field.
- Replace the positive charge with a negative point charge. To remove charges, drag them back into their box.

By convention, field arrows point ______________ a positive charge and ______________ a negative charge.

As the sensor gets closer to a point charge, the field strength created by that field ________________

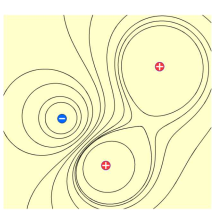
- Click on *show numbers* and *tape measure* to measure the distances from a field-creating charge to a test charge. The tape measure can be dragged to a specific distance and placed anywhere on the field.



- When measuring field strength, click 

to show **lines of equipotential**.
- Complete the table below using a single positive or negative charge:

Test charge distance, m	Field strength, V/m	Potential at location, V
1.0 m		
2.5 m		
	1.1 V/m	
4.0 m		

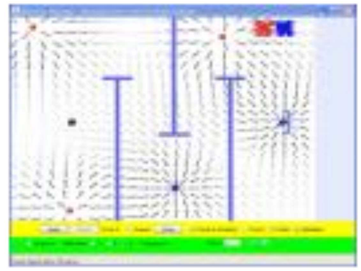


- Add at least three charges, using both positive and negative charges. Move the voltage meter around and *plot* the lines of equipotential. Plot at least ten lines.
- Sketch the multi-charge system here:
- Show the value of the potential on each line of equipotential.

Procedure Part II: *Electricity, Magnets, and Circuits* →

Electric Field Hockey Run Now!

- So, using that wonderful principle that opposite charges __________ while like charges _________ play a little *Electric Field Hockey*.
- Setup your charges and go for the goal.
- Turning on the *Field* and *Trace* may make things a little easier.
- *Reset* the simulation to try again, with your charges in place.
- Challenge the other members of your lab group to duels.
- Challenge other lab groups. (no hockey fights please.)
- Try to use less than 12 charges total. (how few can you use?)



Electric Field Hockey

<u>Conclusion Questions and Calculations:</u>

1. Closer to a point charge, the electrostatic field created is *stronger / weaker*.
2. Placed exactly between two **oppositely** charged point charges, a test charge (the sensor) will show *zero / minimum / maximum* force (N) or field strength (N/C).
3. Placed exactly on a point charge, the sensor will show *zero / minimum / maximum* field strength.
4. The point charges used in the simulation are $\pm 1.0 \times 10^{-9}$ C (**n**ano**C**oulomb). If two such positive charges are placed 2.0 m away from each other, the force between them would be... (use formula) __________________

   SHOW WORK HERE:

Thanks to Chris Bires for this worksheet