





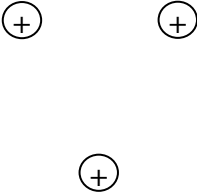
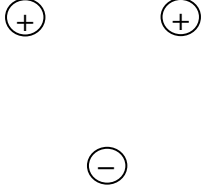

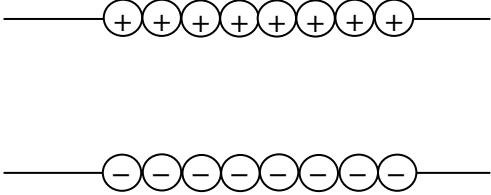

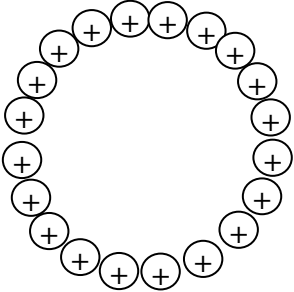
Part 2 — What are the characteristics of the electric field lines?

Turn on the “Show E-Field.” By using this feature and by placing and moving a number of E-Field sensors around each of the charge distributions (A-J), you should be able to “visualize” the magnitude and direction of the electric field force that acts on a positive “test charge” when it is positioned in different regions of space around the charges. Given this information, you should be able to produce a picture of the *field lines* (using colored pencils) produced by various charge distributions. Represent field lines with **red** arrows. Your instructor may choose to walk you through an example or two before letting you work through the remaining examples.

After having drawn representative *field lines*, use the equipotential sensor to “plot” several representative equipots (lines of equal potential). Draw these equipots as dotted **blue** lines. We’ll cover more about equipots in Parts 3 + 4.

Charge distributions

A		B	
C		D	

E		F	
G	<p>Line of charge</p> 	H	<p>2 Lines of opposite charge</p>  <p>What do you notice about the field lines between the two lines of charge? What does this tell you?</p>
I		J	 <p>Ring of charge</p>

1. How are field lines oriented relative to positive charges? Relative to negative charges?
2. How do field lines represent the strength of the electric field?
3. What do you notice about the how equipots are aligned relative to field lines?

Go to <http://www.falstad.com/emstatic/> once you have completed the other sections of this lab. This applet is excellent for showing electric field lines (and equipots) around a variety of different charge arrangements. You can use this site to verify your results for Part 2 of this lab.

Part 3 — What is an equipotential line (equipot) and how is this simulation related to work and energy?

1. Return to the applet simulation. Hit “Clear All” and turn on “Show Numbers.”
2. Place a positive 1 nano-coulomb charge near the center of the screen.
3. In the lower left of the screen is a meter for indicating electric potential, in volts, created by the charge that you introduced. Record the voltage and turn on “Plot”.
4. This line (equipot; line of equal potential) is much like a line on a topographical map that shows a particular elevation (see the image at right). Explain the similarity.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

5. You are on the side of a hill with a topographical map of the region. If you walked so that your trip follows a “topo” line, would you undergo a change in gravitational potential energy? Explain.
6. If a second charge were placed on this line (don’t do it), how much work would be done in moving the charge along this line? Explain.
7. Move the meter closer to the charge at the center of the screen. What is the new electric potential? Turn on plot again.
8. Electric potential is energy per charge ($1 \text{ volt} = 1 \text{ Joule/Coulomb}$). Is electric potential a vector or a scalar?
9. If a second positive charge were introduced and moved from the first equipotential line created to the second line (closer to the charge), would this involve positive or negative work? Explain.
10. If the second positive charge were moved away from the first positive charge, would this involve positive or negative work? Explain.
11. When we studied energy earlier in the year, a connection was found between kinetic energy, potential energy, positive work, and negative work. What is the connection?

12. Place a negative one nano-coulomb charge about a 1.5 meters away from the positive charge. Use the equipotential sensor to produce several equipots in the vicinity of the positive and negative charges. What do you note about the values for the equipots in the vicinity of the positive charge? In the vicinity of the negative charge? What would you expect the value of the equipot half way between the two charges? Include this equipot. Complete a sketch of the equipots around the two charges.

