Name_____ **Date**_____ **Pd**____

UNIT II: Exploring Electric Potential

Run the PhET simulation *Charge and Fields*.[1]

Add a background grid by selecting the box next to "grid" on the right. On the screen you will see a potential sensor. It can be dragged to any location you wish.

Exploring potential around a point charge

Place a positive 1 nC charge in the middle of your screen.

1. Move your potential sensor to several positions around the point charge.
   a) What do you notice about the value of potential as you move away from the charge?

   b) Why is only a value given for potential? Why isn't a directional arrow given as well?

2. Move your sensor to a location 5 gridmarks from the charge and record the value. Now place the sensor 10 gridmarks from the charge and record the value.

   a) What relationship might exist between potential and distance from the point charge?

   b) If you place a sensor 15 gridmarks from the point charge, how will the potential there compare to the first location? Test your prediction.

   c) Now move your sensor to different locations and leave some equipotential lines. This is done by clicking on the word plot on your sensor.
      i - Why are all the lines circular?

      ii - Where would you find the line representing 0.0 volts?

3. Erase the equipotential lines and place 2 nC in the middle of the screen. This in done by placing a 1 nC charge on top of another 1 nC charge.
   a) What relationship seems to exist between potential and the magnitude of the point charge? Test your prediction with a 3rd 1 nC charge.

[1] You can run the simulation directly from the PhET website https://phet.colorado.edu/en/simulations/category/physics or download the Java applet to your computer and run it locally.

4. Replace the positive charge with a negative 1 nC charge.
   a) Predict how the values of electric potential around the negative charge will be the same as those around the positive charge. In what ways would you find them different?

   b) How are lines of equal potential around the negative charge different from those around a positive charge?

   c) Where does the program assign the line representing 0.0 volts around a negative charge?

5. Erase the markings on the screens. Place a positive 1 nC and a negative nC charge on the screen about 20 gridmarks apart.
   a) Use the potential sensor to determine what the potential is at various locations around the two charges. After completing your exploration, answer the following questions:
   i - At what place or places is the largest positive value of potential found?

   ii - At what place or places is the largest negative value of potential found?

   iii - At what place or places is the potential zero?

   iv - Describe as best you can the general pattern of potential values.

   b) Draw lines below representing places of equal potential: you should draw four or five such lines, including the line representing places where the potential is 0 volts. If you like, use the "plot" option in the program to help you complete your diagram.

   i - Looking at the diagram you have just created, would there be an energy transfer if a positive charge were moved from point B to point A? Into or out of the field?

   ii - On your diagram above, make a heavy line representing the path along which a negative charge could be move without losing or gaining potential energy; mark this line **"Energy Free Path**."

6. Erase all markings. Leaving the positive 1 nC charge in place, replace the negative charge with a second positive 1 nC charge.
   a. Use the "Potential" values option to determine values of the potential around the two charges. After completing your exploration, answer the following questions:
      i - Where is the value of potential 0 volts?

      ii - Describe as best you can the general pattern of potential values.

      iii - If you placed a small positive charge halfway between the two positive 1 nC charges, how would it move?

      iv - Would a transfer of energy be required to move a small positive charge towards the positive charges from a point far away from the two charges? Explain.

      v - Would a transfer of energy be required to move a small negative charge towards the positive charges? Explain

      vi. In the space below, draw a number of equipotential lines. If you like, use the "plot" option in the program to help you complete your diagram.


      vii. Predict the appearance of the electric field. Check your prediction using “Field lines”. Add these to your diagram.

      viii. Try to explain the value of the potential midway between the two charges. Describe a method of proving whether your explanation is correct. Then use it with the program and record your results.