

Name: _____ Partner: _____

Phy121 Laboratory 3: Equipotentials

An equipotential line (or surface in 3D) is a connected set of points which all have the same electrical potential. In practice, we cannot measure the potential at a point but we measure its potential difference with respect to a reference point; in this lab, we will use “ground” as the $V=0$ reference point.

Activity 1. Shape of equipotential lines of parallel conductors

1. Take the piece conductive paper (Pasco Sci. PK-9025) which has parallel copper electrodes and place it on the board.
2. Using a pencil, draw to **SCALE** the size and shape of the electrodes in Figure 1.

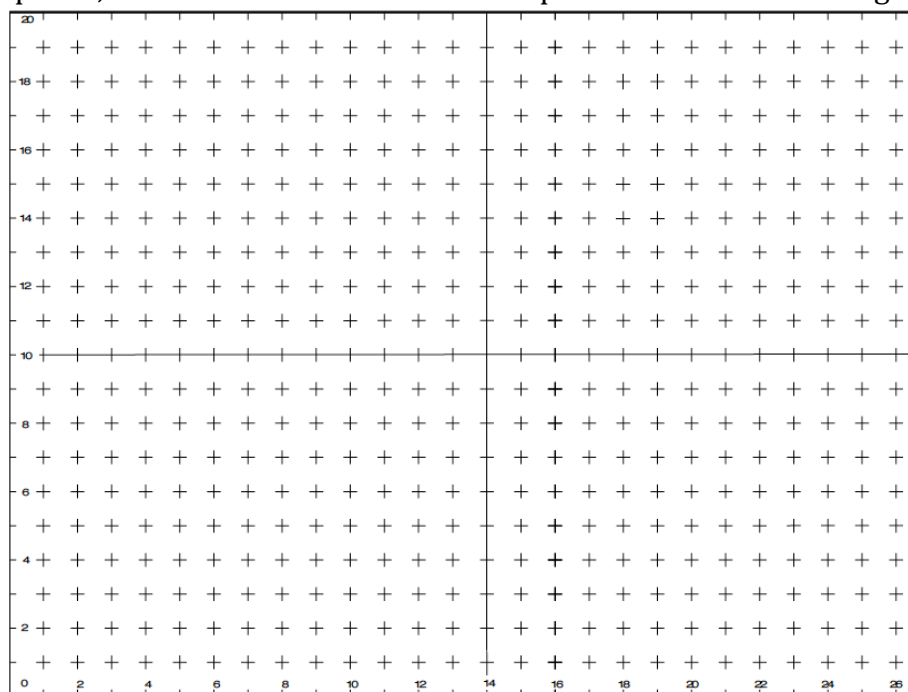


Figure 1. Equipotential lines due to parallel electrodes.

3. Apply 10V of potential difference between the electrodes. You can do this using the following steps.
 - a. You have been provided with special wires that have circular, metal ends. Use a thumbtack to attach a wire to one of the electrodes. Connect to the other end of the wire to the positive terminal (red in color) of the power supply.
 - b. Take another wire and connect it to the other electrode on the conducting paper. Connect the other end of this wire to the negative terminal (black in color) of the power supply.
 - c. Turn the power supply ON and adjust the voltage to 10V. Make sure that the “CC” red light remains OFF.
4. Measure the potential difference between a reference point and the points of interest.
 - a. You have been provided with a digital multi-meter (DMM) to help you measure the potential difference. Turn the knob on the DMM so that the arrow points to V (or V with bar above it).

- b. Connect the common (ground) to the negative terminal of the electrodes on the conducting paper or power supply. Does it matter where you connect it? and why? You can easily test this but to give the right reason, you may want to revisit this after you are done with Activity 3.

- c. Connect the terminal with V on the DMM to a wire and use the other end of this wire as a probe.
- d. Find a point on the conducting paper where the DMM reads 7V and mark it on Figure 1. If you read a negative value, it means you have reversed the wires and your reference point is at higher potential than your point of interest. Have your instructor help you sort this out.
- e. Repeat the above step several times (at least 5 times) so that you can have a picture of the equipotential lines. Describe the shape of the equipotential.

- f. Repeat the above two steps for 6V, 5V, 4V and 3V. Describe the shape of the equipotential curves and their position with respect to the electrodes.

- g. Make a table and then plot the voltage (on the vertical) with respect to the position of the equipotential. Measure the position of the equipotentials from the reference electrode.

Activity 2. Shape of equipotential lines due to point charges (conductors)

1. Select the piece of conductive paper (Pasco Sci. PK-9025) with copper electrodes that appear co-linear but discontinuous. Place it on the board and apply 10V of potential difference between the electrodes.
2. Find the equipotentials of 7V, 6V, 5V, 4V and 3V and sketch them on Figure 2. Describe the shape of the equipotentials and compare with the equipotential lines in figure 1.

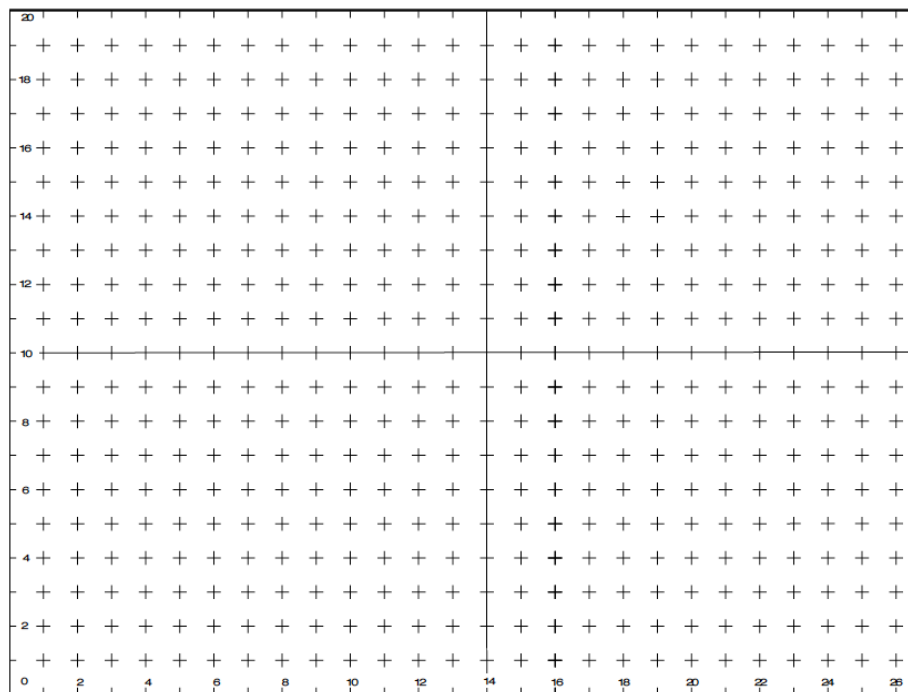


Figure 2. Equipotential lines due to point electrodes.

Activity 3. Equipotential of conductors and cavity

1. For this activity, you will use the conductive paper on which there are (conducting) shapes in between the electrodes. Although not to scale, the schematics in figure 3 shows the shapes and several virtual points. There is nothing special about these points, except they are on a conducting material.
2. Apply 10V of potential difference between the parallel electrodes just as you did in Activity one.
3. Measure the potential difference between the reference point and the points described in table 1 and shown on Figure 3.

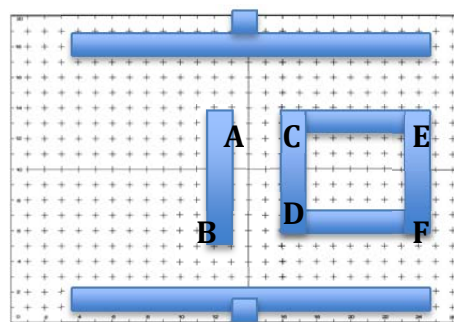


Figure 3. Configuration of conducting shapes.

Table 1. Potential difference between reference point and labeled points on Figure 3.

Point	A	B	Half way between A and B	Some random point between A and B
Pot. Diff. (V)				

What can you conclude from the measurements in Table 1. Feel free to test your hypothesis by making more measurements. Also revisit step 4b in Activity 1.

4. Measure the potential difference between the reference point and the points describe in table 2.

Table 2. Potential difference between reference point and point on Figure 3 after applying 10V between the parallel electrodes.

Point	Somewhere between C and D	Somewhere between E and F	Somewhere between C and E	Some random point on the rectangle
Pot. Diff. (V)				

What can you conclude from the measurements in Table 2. Feel free to test your hypothesis by making more measurements.

Write an Abstract that summarizes your measurements and observations. Don't forget to submit the data and plot you made in activity 1 (step "g") and discuss them as part of your results.