

Physics 121 Lab 3: Equipotential Surface Mapping

Equipotential lines (or surfaces in 3D) are set of points that have the same electrical potential. These define simple curves (lines in 2D or surfaces in 3D) that never cross each other. In practice, we cannot measure the potential at a point but we measure its potential difference with respect to a reference point. This way we can still talk about equipotential points (lines or surfaces) since all the points will have the same potential difference with respect to the reference point.

Activity 1. Shape of equipotential lines of parallel conductors – The capacitor

1. Take a conductive paper (Pasco Sci. PK-9025) with parallel copper electrodes and place it on the cardboard. Secure it using thumbtack. By the way, the actual shape of the electrodes looks like a capital “T” or an inverted “T”.
2. Using a pencil, draw to **SCALE** the size and shape of the electrodes in Figure 1.

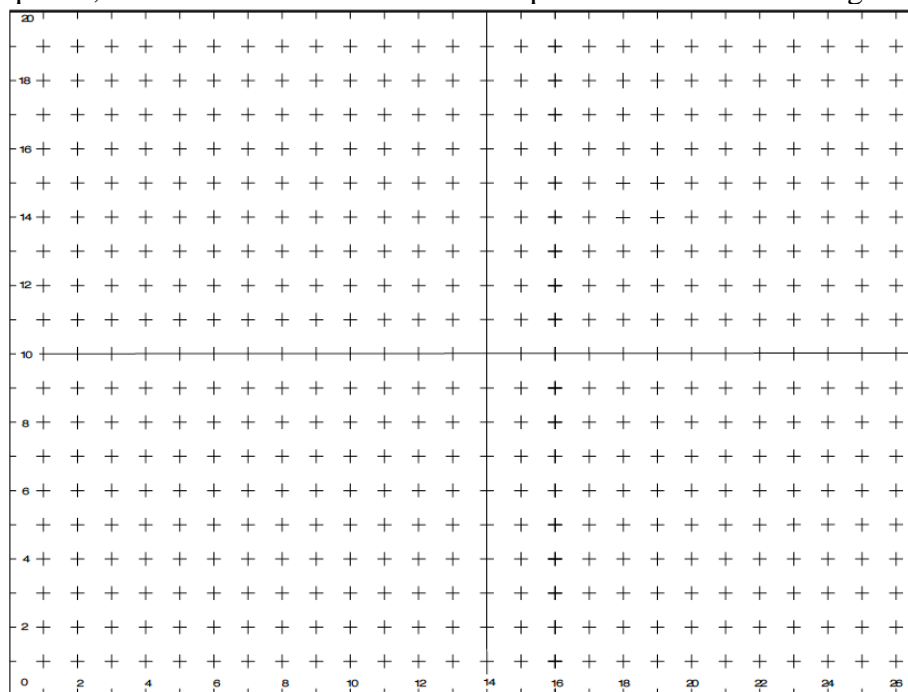


Figure 1. Equipotential lines due to parallel electrodes.

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 a flat head and a hole. Use these features and a thumbtack to attach the 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.

- 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).
- 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?
- Connect the terminal with V on the DMM to a wire and use the other end of this wire as a probe.
- 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. To correct this, turn your leads around.
- Repeat the above step several times (at least 5 times) so that you can have a picture of the equipotential lines.
- Repeat the above two steps for 6V, 5V, 4V and 3V.
- Make a table and then plot the voltage (on the vertical) with respect to the position of each equipotential. Measure the position of the equipotentials from the reference electrode.

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

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

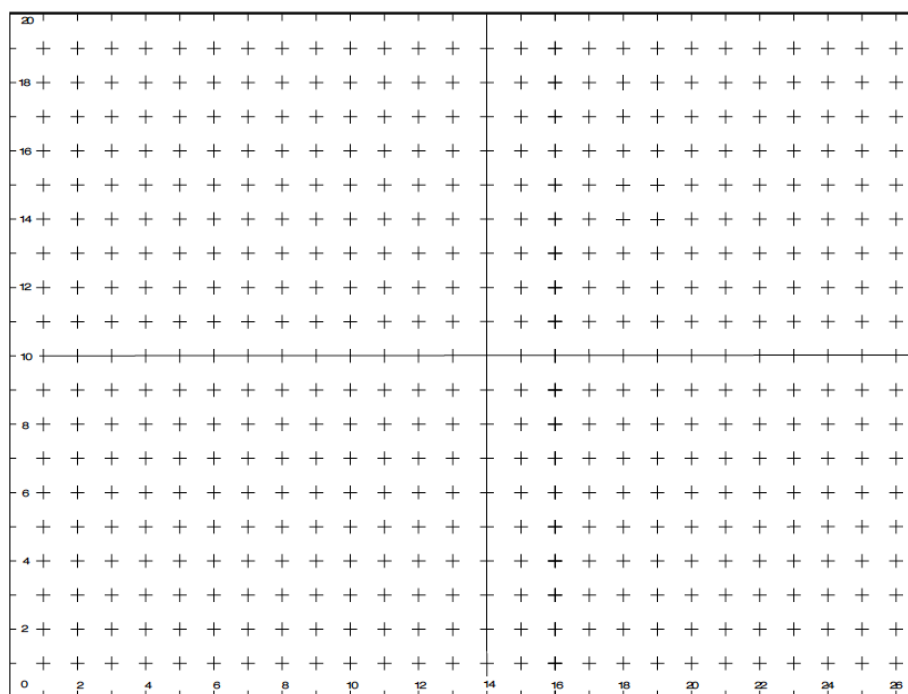


Figure 2. Equipotential lines due to point electrodes.