experiment 1

Electric Field Mapping

University of Wollongong in Dubai

SUBMITTED BY:

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PHYS143
Physics for Engineers

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Purpose

To study the potentials, equipotential curves and electric fields produced by various two-dimensional electrostatic charge distributions.

Hypothesis Statement

The experiment is expected to generate potentials, equipotential curves, and electric fields that are identical to electrostatic charge configurations.

- The equipotential curves are expected to align parallel with the two plates in the parallel plate configuration, with electric field lines flowing horizontally from one plate to the other (positive to negative).
- The equipotential curves are expected to curve around the two charges in the case of the electric dipole setup, with electric field lines mapping from the positive to the negative charge.

Materials

- Pasco® field mapping board
- Digital voltage meter with point probes
- D.C. power supply
- Sheets of conducting paper
- Silver Conductive Ink Pen
- Push pins
- Cork board

Procedures

- Mount the conductive paper by placing two push pins in opposite corners to keep the conductive paper stationary.
- Connect the electrodes to the DC power supply using the power supply wires by placing a push pin through the hole in the wire terminal, into the electrode and into the cork board beneath.
- Connect the other ends of the power supply wires to the power supply.
- Check the electrodes for proper conductivity. To do this, connect one voltmeter lead near a push pin on an electrode. Touch the voltmeter's second lead to other points on the same electrode. The maximum potential between any two points on the same electrode should not exceed 1% of the potential applied between the two electrodes.

A. Parallel Plates

- Draw a thin line from one plate to the other, connecting the midpoints of the two plates.
- Place one of the voltmeter leads on one of the parallel plate electrodes at one end of the line. This is the reference probe.
- Measure the potential difference between the reference probe and the other voltmeter probe every 0.5 cm along the line, starting at a distance of 0.5cm from the start of the line. Tabulate the measurements.

B. Electric Dipole – opposite charges

- Place the reference voltage probe between the two electrodes, along an imaginary line that connects the two electrodes.
- With the other voltage probe, find points that are at the same potential as the reference probe, i.e., map out the equipotential line on which the reference probe is located.
- Map out a few equipotential curves near each of the point charges.

Data

Voltage supplied by the DC Power Supply: **10.0 V** Current: **0 A**

Distance (cm)	Potential Difference (V)
0.5	9.9
1.0	9.74
1.5	8.55
2.0	7.36
2.5	7.39
3.0	7.41
3.5	7.41
4.0	7.38
4.5	7.38
5.0	7.38
5.5	7.38
6.0	7.38
6.5	7.38
7.0	7.39
7.5	7.39
8.0	7.39
8.5	7.39
9.0	7.37
9.5	7.36
10.0	7.36
10.5	7.36
11.0	7.36

Table 1: Potential difference for various distances along the positive electrode

Distance (cm)	Potential Difference (mV)
0.5	10.9
1.0	11.8
1.5	12.6
2.0	13.6
2.5	13.9
3.0	14.6
3.5	14.7
4.0	14.8
4.5	14.9
5.0	15.1
5.5	15.3
6.0	15.6
6.5	15.7
7.0	16.0
7.5	16.3
8.0	16.6
8.5	16.8
9.0	16.7
9.5	16.9
10.0	17.0
10.5	17.2
11.0	17.3

Table 2: Potential difference for various distances along the negative electrode

Observations

Observations from the tabulated data noted while performing the experiment:

- Pinpointing electrode potential values closer to the electrodes can be tricky as the points end up being extremely close to the push pins.
- The values obtained are not always the exact value, and often have fluctuations. However, most values obtained are close to the 'perfect' values themselves.
- The electric field lines point from the positive plate to the negative plate.
- Field lines are uniformly spaced parallel to each other, and perpendicular to the plates.
- The equipotential lines are perpendicular to the electric field lines and parallel to the plates.
- When sketching the electric field lines, the lines end up crossing the equipotential lines mapped out by the experiment.
- This is consistent with the previously known knowledge of equipotential curves and electric field lines.

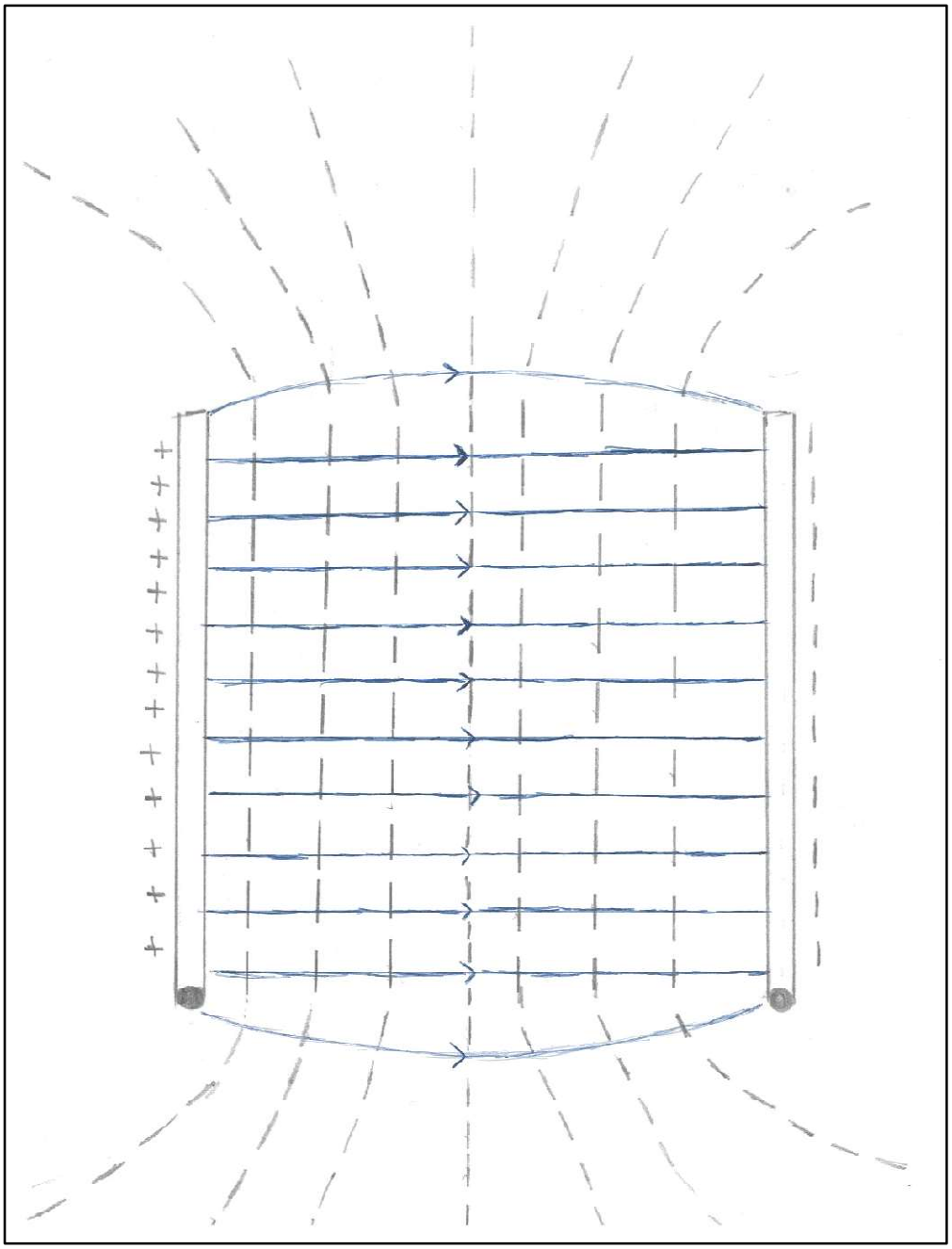

Figure 1: Electric Field Lines & Equipotential Curves for Parallel Plates

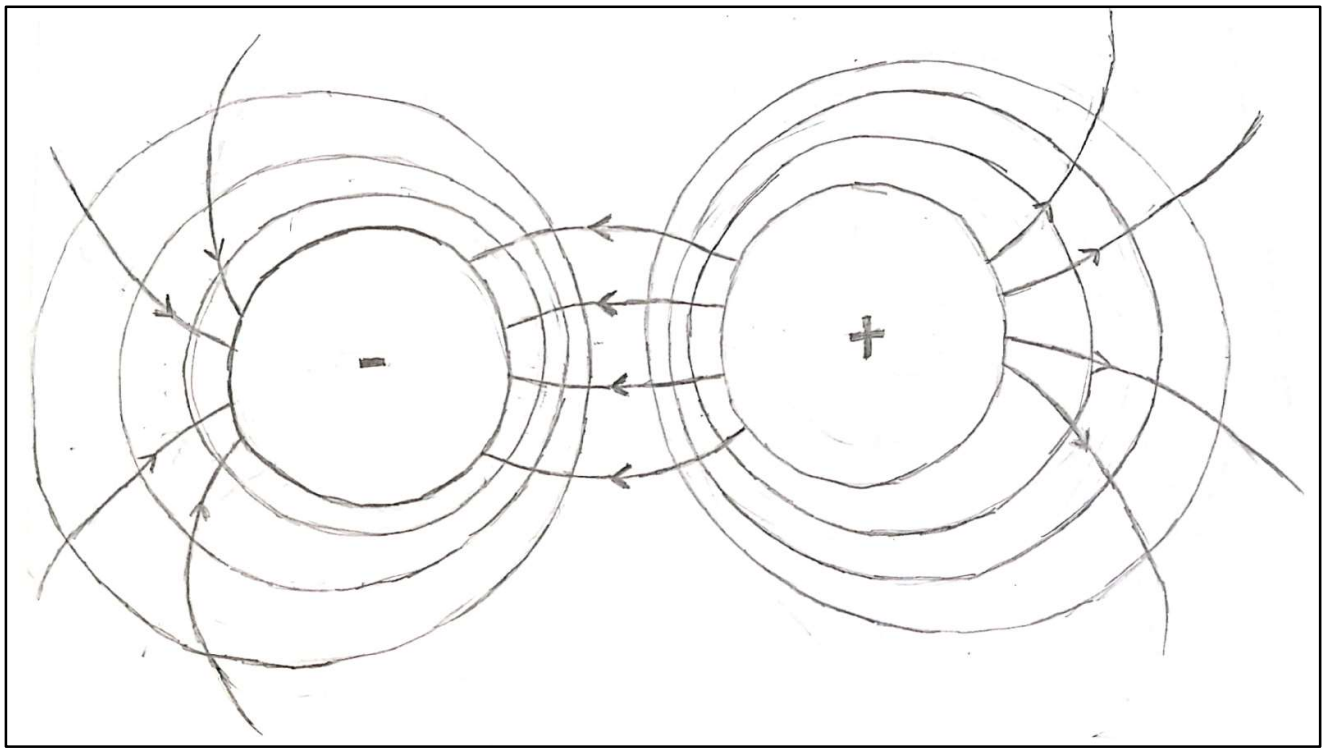

Figure 2: Electric Field Lines & Equipotential Curves for Electric Dipole

Conclusion

1. What was the purpose of the lab?

The lab's purpose was to study the electric fields produced by various two-dimensional electrostatic charge distributions.

2. How does the lab we performed relate to what we are studying in class?

The experiment is a direct link to the concepts taught in the lecture related to electric potential and fields.

3. Give a brief recap of the procedure used.

The conductive paper was mounted using pins. The electrodes were connected to the DC power supply. A thin line was drawn from one plate to another. One of the voltmeter leads was placed on one of the electrodes at one end of the line. The potential difference was then measured for every 0.5 cm along the line.

4. What problems did you have during the lab? Did you have to modify your procedure?

The problems encountered in this experiment are that of inaccuracy with the voltmeter which provided fluctuating and inaccurate readings. Yes, we modified our procedure slightly by taking a range of the readings rather than one of the fluctuated readings.

5. Do your results make sense? What are the sources of error?

The equipotential lines are perpendicular to the electric field lines and parallel to the plates. When sketching the electric field lines, the lines end up crossing the equipotential lines mapped out by the experiment. This is consistent with the previously known knowledge of equipotential curves. Possible sources of error include power supply error, tip of the probe not being fine, measurement errors, etc.

6. What did you learn from this lab?

We learnt that the potentials, equipotential curves and electric fields generated are the same as the electrostatic charge configurations. The equipotential curves also align parallel with the two plates and the electric field lines are mapped from positive to negative charge.

7. If you were to repeat this lab in the future, how would you modify or improve the procedure?

To improve the procedure of this experiment, our team suggests making sure that the tip of the probe used is finer, which would help to provide more accuracy to the voltmeter readings. Also, the quality of the connecting wires could be improved considering poor quality of connecting wires can introduce resistance.