Lab 2: Electric Field and Potential

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1 Purpose

To study the relationship between electric field and the electric potential difference associated with it.

2 Theory

The relationship between the electric field and electric potential difference will follow the equation $\Delta V = -\int_a^b \vec{E} \cdot ds$, which simplified is $\Delta V = \frac{k_e q}{r}$. This means electric potential will have a opposite yet linear relationship with the electric field, while having an inverse relationship with distance.

3 Experiment Analysis

4 Procedure

5 Data and Graphs

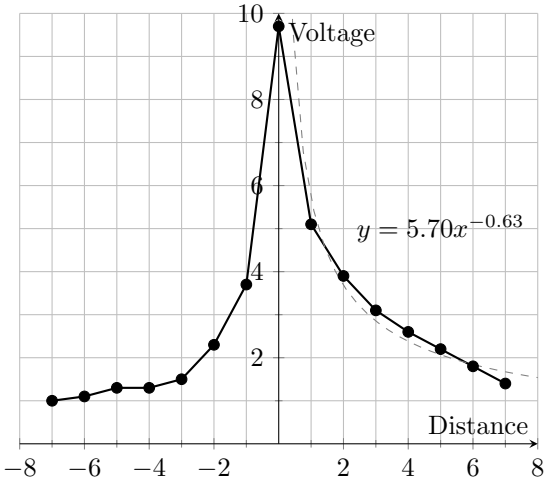
5.1 Part 1

[**Table 5.1**] Part 1: Single Point Charge in a 0V Ring

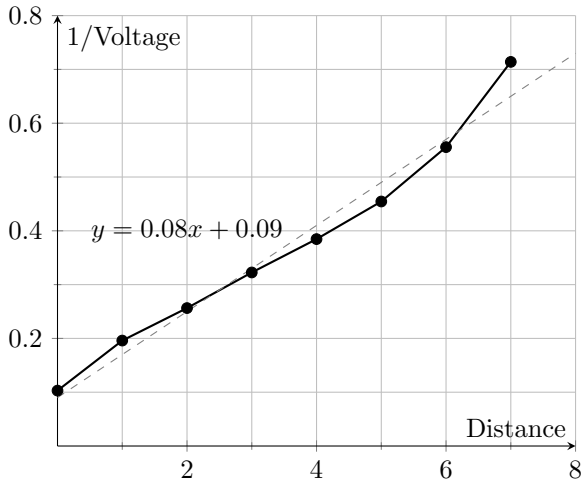
Distance (cm)	Voltage (V)
-7	1
-6	1.1
-5	1.3
-4	1.3
-3	1.5
-2	2.3
-1	3.7
0	9.7
1	5.1
2	3.9
3	3.1
4	2.6
5	2.2
6	1.8
7	1.4

[**Table 5.1.2**] Table 5.1 With Inversed Voltage

Distance (cm)	1/Voltage (1/V)
0	0.103
1	0.196
2	0.256
3	0.323
4	0.385
5	0.455
6	0.556
7	0.714



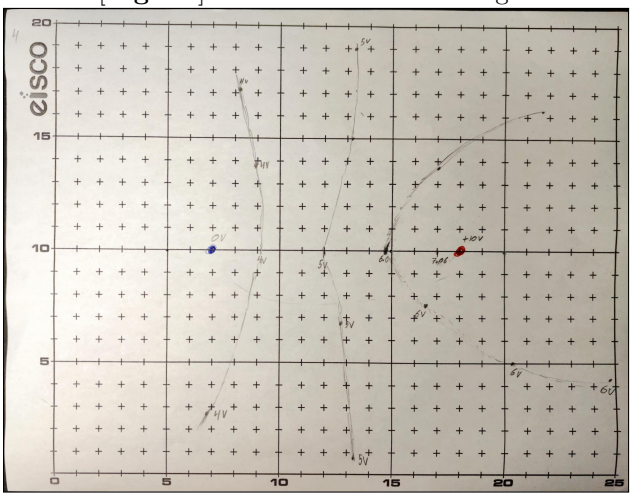
[**Fig 5.1**] Table 5.1 visualized in a graph.



[**Fig 5.1.2**] The linearization of Fig 5.1.

5.2 Part 2

[**Fig 5.2**] Part 2: Two Point Charges

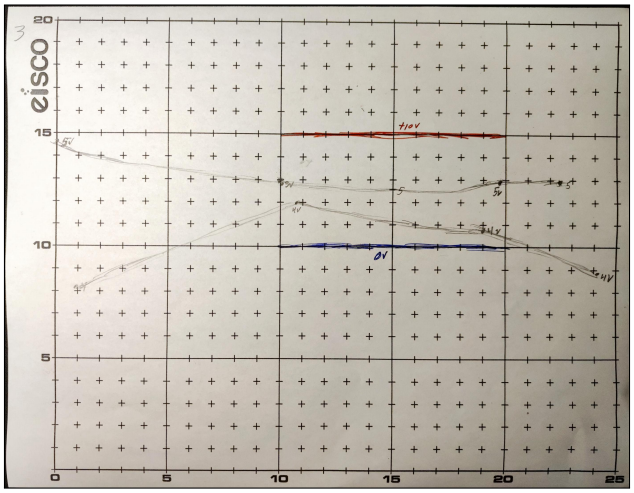


[**Table 5.2**] Fig 5.2 Analyzed

Distance between Equipotentials	**Voltage Difference (V)**	**Electric Field Magnitude (V/m)**
2.8 cm	1	35.7
2.8 cm	1	35.7

5.3 Part 3

[**Fig 5.3**] Part 3: Two Line Charges



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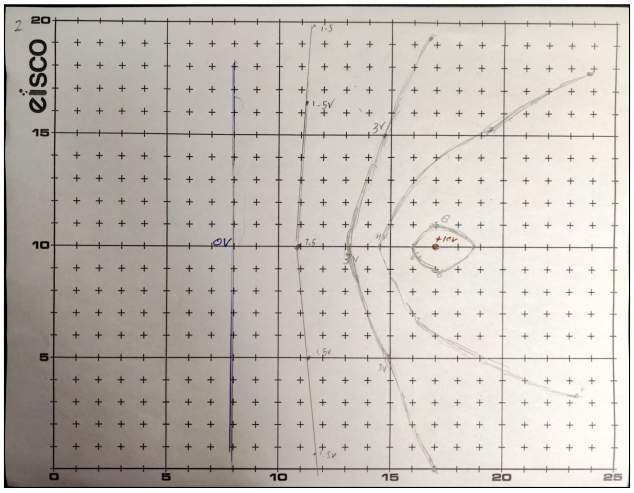
5.4 Part 4

[**Fig 5.4**] Part 4: One Line Charge and One Point Charge



6 Results

7 Questions

7.1 Part 1

1. Which function will describe the behavior?
   An inverse function.

2. Fit it with the best fit line. What does the coefficient in the equation given by excel mean?
   The coefficient of the equation represents the electric field.

3. Paste your graph with fitting line here.
   See Fig 5.1.

7.2 Part 2

1. **Choose two equipotential points and calculate the electric field**
   See Table 5.2

2. Include a picture of your equipotential lines for this configuration here. With a pen or marker of different color draw the electric field lines.
   See Fig 5.2

3. Do equipotential lines cross? Why or why not?
   They do not cross because they are lines of constant potential. There cannot be a point of 2 different potentials in an equipotential line.

4. Which direction does the electric field point with respect to equipotential? Does E point to high or low electric potential?
   It goes from high to low electric potential.

5. In this final step we will combine the direction information given by the equipotentials with the magnitude information from the measured potential differences discussed above. First estimate the magnitude and record your results in this chart.
   See Table 5.2.

7.3 Part 3

1. Given the voltage difference between the two plates and the separation distance what is the magnitude of the electric field inside the plates? Do this calculation using at last three combinations of equipotential lines.

Distance between Equipotentials	**Voltage Difference (V)**	**Electric Field Magnitude (V/m)**
1.6 cm	1	62.5

2. Include a photo of the equipotential lines and the electric field that you found for this configuration.
   See Fig 5.3.

Distance between Equipotentials	Voltage Difference (V)	Electric Field Magnitude (V/m)
1.5 cm	2	133
1.4 cm	1	71.4
2.0 cm	1.5	75

7.4 Part 4

1. What is the magnitude of the electric field inside the "plates"?

2. Include a photo of the equipotential lines and the electric field that you found for this configuration. See Fig 5.4.

8 Conclusion