**PHYSICS 1E03 LAB 1 WRITE-UP**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**                                                          **Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**                                                           **Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Partner:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_                                                           Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **Station Number:\_\_\_\_\_\_\_\_\_\_**

**RESULTS**

**PART 1: Measuring the Electric Potential Between Parallel Plates**

**Potential:**

Largest variation in potential difference along positive plate = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Largest variation in potential difference along negative plate = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Supply voltage: 6.00 volts

Equal distance interval Δd= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Vertical position of the central line: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Table 1 - Potential measurements between parallel plates***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Distance d from negative Plate**  (m) | **Along central line** | | **5 cm from central line** | |
| **Potential, V**  **(V)** | **ΔV**  **(V)** | **Potential, V**  **(V)** | **ΔV**  **(V)** |
| 0 |  | ------------- |  | -------------- |
| 0.01 |  |  |  |  |
| 0.02 |  |  |  |  |
| 0.03 |  |  |  |  |
| 0.04 |  |  |  |  |
| 0.05 |  |  |  |  |
| 0.06 |  |  |  |  |
| 0.07 |  |  |  |  |
| 0.08 |  |  |  |  |
| 0.09 |  |  |  |  |
| 0.1 |  |  |  |  |

Uncertainty of the potential measurements in 2 decimal figures (see below for how to calculate it)\* = \_\_\_\_\_\_\_\_\_\_\_\_\_

\* The above uncertainty is estimated using standard deviation of the 10 values below measured repeatedly at a single point along the central line:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |

**Potential vs. Distance Graphs (Inside the Plates)**

Place your graphs for potential inside the plates vs. distance here for both the central line and a line 5 cm from it. You should overlay the two plots. Make sure to use different colours for each and include a legend. Each set of data must have a line of best fit with the equation of the line and R2 value displayed.

From the graphs of potential versus distance:

Average potential/distance for central line = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average potential/distance 5 cm from central line = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**PART 2: Measuring the Electric Potential Outside Parallel Plates**

Equal distance interval (Δr) = 1 cm = 0.01 m

*Table 2 - Potential measurements outside parallel plates, along central line*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Distance d from negative Plate**  (m) | **Potential along central line** | | **Potential after swapping plate connections along central line** | |
| **Potential,**  V    (V) | ΔV    (V) | **Potential,**  V    (V) | ΔV    (V) |
| 0 |  | ------------- |  | ------------- |
| 0.01 |  |  |  |  |
| 0.02 |  |  |  |  |
| 0.03 |  |  |  |  |
| 0.04 |  |  |  |  |
| 0.05 |  |  |  |  |

Uncertainty of the potential measurements (same as Part 1) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Potential vs. Distance Graph (Outside the Plates)**

Place your graphs here for potential outside the plates vs. distance before and after swapping plate connections. You should overlay the two plots. Make sure to use different colours for each and include a legend. Each set of data must have a line of best fit with the equation of the line and R2 value displayed.

From the graphs of potential versus distance:

Average potential/distance before swapping plate connections = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Average potential/distance after swapping plate connections = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**PART 3: Determining the Magnitude and Direction of the Electric Field**

 Equal distance interval (Δr) = 1 cm = 0.01 m

*Table 3 - Electric field on central line, inside and outside the plates*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Inside the Plates** | | **Outside the Plates** | |
| **Distance Δr from negative Plate**  **(m)** | **ΔV**  **(V)**  **From Table 1** | **E**  **(V/m)** | **ΔV**  **(V)**  **From Table 2** | **E**  **(V/m)** |
| 0 | ------------ |  | ------------ |  |
| 0.01 |  |  |  |  |
| 0.02 |  |  |  |  |
| 0.03 |  |  |  |  |
| 0.04 |  |  |  |  |
| 0.05 |  |  |  |  |
| 0.06 |  |  |  |  |
| 0.07 |  |  |  |  |
| 0.08 |  |  |  |  |
| 0.09 |  |  |  |  |
| 0.1 |  |  |  |  |
|  |  |  |  |  |

**Electric Field vs. Distance Graph (Inside and Outside the Plates)**

Place your graphs for electric field inside and outside the plates vs. distance here. You should overlay the two plots. Make sure to use different colours for each and include a legend. Each set of data must have a line of best fit with the equation of the line displayed.

**PART 4: Plotting Equipotential Lines**

*Table 4 - Tracing equipotential lines*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Between Plates A and B**  **d = \_\_\_\_\_\_\_ cm** | | | **Between Plates B and C**  **d = \_\_\_\_\_\_\_ cm** | | |
|  | 5 V | 4 V | 3 V | 5 V | 4V | 3 V |
| **x (cm)** | **y (cm)** | **y (cm)** | **y (cm)** | **y (cm)** | **y (cm)** | **y (cm)** |
|  |  |  |  |  |  |  |
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**Equipotential Lines for Parallel Plates**

Place your graphs for the shapes of the 5V, 4V, 3V, 2V, and 1V equipotential lines. Make sure use different colours for each and include a legend.

Graph of Equipotential Lines formed by Plates A and B (larger separation)

Graph of Equipotential Lines formed by Plates B and C (smaller separation)

**DISCUSSION AND CONCLUSIONS**

***Question*** 1. Is there any variation in the voltage along the plates? If so, is it significant?

***Question*** 2. What contributes to the uncertainty in the measured voltage? Is it random or systematic? List 2 sources of uncertainty.

***Question*** 3. What does the slope of the V vs. R graph represent? Explain your answer. Compare the slope of your graph (for central line inside the plates) to the experimental value. Do they agree within experimental uncertainties?

***Question*** 4. How does the behaviour of the potential difference outside the plates compare to the behaviour inside the plates?

***Question*** 5. Is there any evidence that the spare plate has changed the potential distribution? Explain.

***Question*** 6. Discuss the electric field direction you observed, and how you determined it.

***Question*** 7. Is the electric field along the central line fixed or variable? Do not forget that this is a vector quantity, so fixed means fixed in magnitude *and* direction.

***Question*** 8. How does the electric field outside the plates, on the **central line**, compare to the field inside the plates?

***Question*** 9. The lines of equipotential outside the parallel plates diverge. Using the 3V and 4V lines, estimate the distance away from the edge of the plates where the electric field strength drops to half of its value between the plates.

***Question*** 10. Will an electron acted upon only by the electrostatic field follow a field line? Explain. (Hint: consider motion of an object in a gravitational field as an analogy).

***Question*** 11. Does the close proximity of the ground plate alter the field shape, and if so, how?  Has the electric field strength between the ‘new’ parallel plates changed? Elaborate.