***Experimental Analysis of Coulomb’s Law***

***Problem 1***

Students conducted a lab to experimentally determine the value of Coulomb’s constant. They measured the force between two charged spheres as they varied the separation of the charges. Each sphere was given a charge of 5.0 x 10-6 C. The data is shown below:

|  |  |
| --- | --- |
| Separation (m) | Force (N) |
| 0.2 | 5.4 |
| 0.3 | 2.4 |
| 0.4 | 1.4 |
| 0.5 | 0.87 |
| 0.6 | 0.60 |
| 0.7 | 0.40 |
| 0.8 | 0.32 |

1. Identify the manipulated and responding variables. What is one variable that must be controlled during this experiment?
2. Create a graph of *F* vs  *r*.

X: [ , , ]

Y: [ , , ]

|  |  |  |
| --- | --- | --- |
| Separation (m) |  | Force (N) |
| 0.2 |  | 5.4 |
| 0.3 |  | 2.4 |
| 0.4 |  | 1.4 |
| 0.5 |  | 0.87 |
| 0.6 |  | 0.60 |
| 0.7 |  | 0.40 |
| 0.8 |  | 0.32 |

1. Create a second column using the manipulated data that will give a linear relationship.
2. Graph the new data and determine the equation of the Line of Best Fit. What are the units for the slope?

X: [ , , ]

Y: [ , , ]

1. Using the data and Coulomb’s Law, determine the experimental value of Coulomb’s constant?

***Problem 2***

A second experiment is done (using the value of Coulomb’s constant from the previous experiment) with two equal but unknown charges. The separation is varied and the Force on the charges is measured. The data is shown below:

|  |  |
| --- | --- |
| Separation (m) | Force (N) |
| 0.2 | 2.8 |
| 0.3 | 1.2 |
| 0.4 | 0.70 |
| 0.5 | 0.45 |
| 0.6 | 0.31 |
| 0.7 | 0.23 |
| 0.8 | 0.19 |

1. Identify the manipulated and responding variables. What is one variable that must be controlled during this experiment?
2. Create a graph of *F* vs  *r*.

X: [ , , ]

Y: [ , , ]

1. Create a second column using the manipulated data that will give a linear relationship.

|  |  |  |
| --- | --- | --- |
| Separation (m) |  | Force (N) |
| 0.2 |  | 2.8 |
| 0.3 |  | 1.2 |
| 0.4 |  | 0.70 |
| 0.5 |  | 0.45 |
| 0.6 |  | 0.31 |
| 0.7 |  | 0.23 |
| 0.8 |  | 0.19 |

1. Graph the new data and determine the equation of the Line of Best Fit. What are the units for the slope?

X: [ , , ]

Y: [ , , ]

1. Using the data and Coulomb’s Law, determine the experimental value for the magnitude of EACH charge.

***Problem 3***

A third experiment is done (using the value of Coulomb’s constant from the first experiment) with two charged spheres, the first having a charge of +2.5μC. The charge on the second sphere is varied while the separation is kept constant. The force is then recorded. The data is shown below:

|  |  |
| --- | --- |
| Charge (μC) | Force (N) |
| +1.0 | 0.20 |
| +2.0 | 0.40 |
| +3.0 | 0.60 |
| +4.0 | 0.80 |
| +5.0 | 0.99 |
| +6.0 | 1.2 |
| +7.0 | 1.4 |

1. Identify the manipulated and responding variables. What is one variable that must be controlled during this experiment?
2. Create a graph of *F* vs  *q*.

X: [ , , ]

Y: [ , , ]

1. Using the data and Coulomb’s Law, determine the experimental value for the separation between the charges.