

ELECTRICITY DAY 6: LAB L10.2 - COULOMB'S LAW LINEARIZATION

CED 10.1 · Skills 3.A/2.D · FRQ: ED · bounded investigation record

RETRIEVAL - NO DEMO

If $F \propto 1/r^2$, which graph should be linear? Circle one: F vs r / F vs $1/r$ / F vs $1/r^2$. State what its slope should represent.

QUESTION AND MODEL

Question: Does the measured electric force between two charged spheres follow $F \propto 1/r^2$?

$$F = k|q_1q_2| \left(\frac{1}{r^2} \right)$$

Linear form: $y = mx$, with $y = F$, $x = 1/r^2$, and slope $m = k|q_1q_2|$.

SUPPLIES AND MEASUREMENT

Foil-covered pith balls, thread, charged rods, ruler, and camera; or a force-sensor/simulation reading. Measure center-to-center separation. If using deflection as a force proxy, record the calibration used to convert deflection to force.

Prediction: Sketch the expected F -vs- r curve and the expected F -vs- $1/r^2$ line.



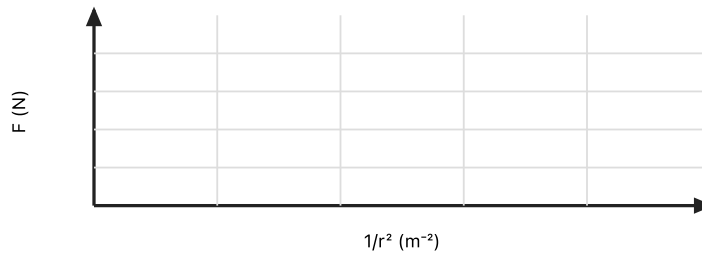
PROCEDURE

- 1. Charge both spheres using the same method. Record signs and the charge-measurement method or assumption.
- 2. Set the first center-to-center separation. Allow motion to settle.
- 3. Measure force or the calibrated force proxy. Repeat the reading.
- 4. Collect at least five separations spanning the safe apparatus range.
- 5. Recheck charge condition between trials; recharge consistently if needed.
- 6. Calculate $1/r^2$ for each trial in m^{-2} .

RAW AND LINEARIZED DATA

Trial	$r\ m$	$F_1\ N$	$F_2\ N$	mean $F\ N$	$1/r^2\ (m^{-2})$
1					
2					
3					
4					
5					
6					

Control: changing separation must not intentionally change either sphere's charge. Record visible discharge or drift as a limitation.

LINEARIZED GRAPH**PLOT MEASURED F VERTICALLY AND $1/r^2$ HORIZONTALLY**

Best-fit slope: choose two well-separated points on the best-fit line, not necessarily two raw data points. Show units.

Charge product: use $m = k|q_1q_2|$ to find $|q_1q_2|$. If q_1 is known, find $|q_2|$.

Evidence statement: state whether the intercept is consistent with zero within experimental resolution and what that means for the model.

ANALYSIS AND CER

1. Explain why graphing F against r does not by itself distinguish $1/r$ from $1/r^2$.

2. A best-fit F -vs- $1/r^2$ slope is $3.37 \times 10^{-2} \text{N} \cdot \text{m}^2$. If $q_1 = 1.50 \mu\text{C}$, find $|q_2|$.

Claim: State whether the inverse-square model is supported.

Evidence and reasoning: cite graph shape, slope/intercept, and one uncertainty tied to the apparatus.

Required lab record: raw readings, transformed data, graph, slope calculation, charge calculation, and CER.