

ELECTRICITY DAY 15: LAB L10.4 - CAPACITOR GEOMETRY

CED 10.6 · Skills 3.A/2.D · FRQ: ED · target: linearize C versus $1/d$ and attribute C to geometry

RETRIEVAL - NO DEMO

A parallel-plate capacitor stays otherwise unchanged while d doubles. Predict the C factor and justify it from the geometry equation.

QUESTION AND VARIABLES

Question: Does measured capacitance follow $C \propto 1/d$ when plate area and dielectric are fixed?

Independent variable: d . **Dependent variable:** C . **Controls:** overlap area, dielectric, lead placement, instrument range, and nearby conductors.

SUPPLIES

Parallel-plate capacitor, insulating spacers, ruler/caliper, and LCR meter. Disconnect all batteries and discharge the capacitor before connecting the meter.

Primary fallback: PhET *Capacitor Lab: Basics*. Hold area and dielectric fixed and record C while varying d .

PREDICTION

Sketch C vs d and C vs $1/d$. Identify which should be linear.

PROCEDURE

- 1. Measure and record the overlap dimensions; calculate A in m².
- 2. Set the largest planned separation and verify plate alignment.
- 3. Measure C. Repeat without changing d and record both readings.
- 4. Collect at least six separations. Do not let the plates touch.
- 5. Calculate mean C and 1/d for every row using SI units in the analysis.

RAW AND TRANSFORMED DATA

Measured plate area: A = _____ cm² = _____ m²

d (mm)	C ₁ (pF)	C ₂ (pF)	mean C (pF)	1/d (mm ⁻¹)

Control check: if plate overlap shifts, remeasure A and mark the affected row rather than silently keeping it.

LINEARIZED GRAPH**GRAPH MEAN C VS 1/D**

$$C = \epsilon_0 A \left(\frac{1}{d} \right) \quad m = \epsilon_0 A$$

Slope: Choose two well-separated points on the best-fit line, not two raw points. Show units.

Extract area: Convert the slope to F·m and calculate $A_{\text{slope}} = m/\epsilon_0$.

ANALYSIS AND CER

1. Compare slope-based area with measured area using percent difference.

2. Is the intercept consistent with zero within experimental resolution? Interpret a nonzero intercept.

3. Identify one uncertainty in d and explain why it matters most at small separations.

Claim: State whether the data support $C \propto 1/d$.

Evidence and reasoning: cite linearity, slope, intercept, and the area comparison.

Required lab record: prediction, raw/processed data, graph, slope, area extraction, uncertainty, and CER remain together.