



Berkeley Physics Tournament 2026

Lab Section

Society of Physics Students, Berkeley

*"Edison told his wife Mina that he hope[d] there will be no battery in heaven."
—Neil Baldwin reading a letter from Thomas Edison to his wife about the struggles of capacitance.*

Thomas Edison was an inventor widely known for the incandescent light bulb, but his work on telegraphs allowed for multiple signals to be transmitted and received on a line. He struggled with the issue of “static charge,” which today we describe as the *capacitance* between telegraph wires and the ground. Charge stored up on these lines, turning them into energy storage mechanisms.

In order to remediate this issue, he experimented with different *dielectrics*, which are insulating materials between wires, to control buildup of static charge.

Your goal is to design, carry out, and reflect on an experiment that, as accurately as possible, determines the permittivity (ϵ) of standard copy paper.

NOTE: Be sure to include a detailed account of your procedure, explanations for why you chose to perform various actions, and discuss sources of potential error during your experiment. These items, along with your data and analysis, will determine your score for this section.

Provided Materials


1. Digital Multimeters
2. Aluminum Foil
3. Copy Paper (your dielectric)
4. Masking Tape
5. Rulers and calipers

Use the multimeter by first plugging the black banana plug into COM and the red banana into the one labeled voltage, then set the dial to K before touching the probes to the circuit or object. During measurement, keep the probes steady, maintain firm contact, and wait a moment for the reading to settle before recording it.

Objective

The objective of this experiment is to explore the relationship between the total capacitance C of two conducting plates and their overlapping area A . We will also estimate the permittivity of paper (ϵ) using the relationship between these variables. You need to minimize the distance between your two plates due to the theory mentioned in part 2 in order for the multimeters to read anything.

To test out various variables, you will be making DIY capacitors. While your exact design and procedure will vary, the idea is to have two conductive plates (foil), with a non-conductive dielectric in between them (paper). It is essential that your two plates to the multimeter do not conduct electricity with each other. Again make sure that your design allows for measurement using the multimeter provided.

Remember, to measure capacitance, set your multimeter to the capacitance symbol: 

Part 1

Part 1 of this experiment will consist of finding the relationship between C and A . Using the materials provided to you, find how capacitance changes with changes in area.

Tips. Ensure the plates are as flat as possible to avoid the air becoming an unintentional extra dielectric. Consider using a heavy object or uniform manual pressure to avoid this issue. Your multimeter reading will be low, so

Part 2

Part 2 of this experiment consists of finding a value for the permittivity of standard copy paper. Capacitance is inversely proportional to distance such that,

$$C \propto \frac{1}{d}$$

Using this fact, and the relationship you found in Part 1 with area, determine the proportionality constant ϵ , in units F/m . Note that the standard thickness of copy paper is $0.1\text{mm} \pm 0.01\text{mm}$.

Tips. Reminder to pay special attention to units. The SI units for capacitance are Farads (F) and distance is meters (m).

Submission

Please write your lab on blank sheets of paper. Put your team ID of the top left of every page, and the page number on the right side of every page. Please also organize your submission by section, and this will help improve your organization score! Put every page your team wants graded into the provided envelope. Then, put your team ID and name on the top of both sides of the envelope.

Points	3	2	1	0
Procedure	Plan has a clear objective. Steps are easy to understand and experiment is sound.	Plan has a mostly clear objective. Steps are mostly understandable. Experiment is a reasonable approach to solving the problem.	Plan is somewhat vague, and steps are difficult to follow. Proposed experiment will not effectively solve the problem at hand.	Plan is very vague or not given. Experiment is not related to the task at hand.
Data	Repeated, relevant data for the experiment is collected in a range, with types of variables identified (independent, dependent, control). Data is clearly realized in a table or graph.	Relevant data is collected but may not include multiple trials. Data is graphed or charted in some way.	Data is collected for the experiment, but with limited range or no repeat trials. Data is not visualized.	Uncorrelated or no data is collected.
Discussion	Discussion shows clear understanding of the problem and comes to a reasonable final solution. Connects their experiment to physical laws.	Discussion shows good understanding of the problem and comes to a fair final solution. Some connection is drawn to the laws of physics.	Discussion does not show good understanding of the problem, and no meaningful connections are drawn between the result and the laws of physics.	No answer is presented, and no connection is attempted to physics.
Errors	Sources of error are identified during the experiment, and some level of quantifiable error is estimated and added. Recommendations for safety/effectiveness for a further experiment are given.	Sources of error are identified during the experiment. Reflection is made on issues and possible future adjustments are noted.	A source of error is identified. Vague references to improvements are made.	There is no effort to reflect on the experiment.
Organization	(Not possible) This section is out of 2 points.	Report is written in an organized manner and presents the experiment well.	Report is written in a somewhat organized manner but is mostly understandable.	Report is scattered and requires some level of effort to follow.