

PHYS 102 Experiment 4. Capacitor Lab

Preliminary work:

Study Example 24.2 Properties of a Parallel-Plate capacitor, and Section 26.4 R-C Circuits (Charging a Capacitor) of the textbook.

Online Experiment Link:

<https://ophysics.com/>

Procedure:

1. Open the website given under the “Online Experiment Link”. From the top menu choose the menu item “E&M”, and from the appearing drop-down menu choose the experiment “Capacitor Lab”.
2. Read the description given at the bottom of the page.

PART A

3. Set the “Plate Area” parameter as $A=2m^2$. By varying the “Distance Between Plates” parameter and noting the value of the capacitance, complete the table below.

$d(10^{-4} m)$	5	6	7	8	9	10
$C(10^{-9} F)$						

5. Plot C (on the vertical axis) versus $1/d$ (on the horizontal axis) on a graph paper. You should have a straight line.
6. Measure the slope of the straight line from the plot.
7. Calculate the numerical value of the constant ϵ_0 from the slope and compare it with the value given in the book.

PART B

8. Set the “Distance Between Plates” parameter to $d=1 mm=10^{-3} m$. By varying the “Plate Area” parameter and noting the value of the capacitance, complete the table below.

$A(m^2)$	1.0	1.5	2.0	2.5	3.0	3.5
$C(10^{-9} F)$						

9. Plot C (on the vertical axis) versus A (on the horizontal axis) on a graph paper. You should have a straight line.

10. Measure the slope of the straight line from the plot.

11. Calculate the numerical value of the constant ϵ_0 from the slope and compare it with the value found in part A.

PART C

12. Set the “Distance Between Plates” parameter as 1 mm , and the “Plate Area” parameter as 1 m^2 . Set the “Voltage” parameter to 5 V , and “Resistance” parameter to $5\ \Omega$. Discharge the capacitor, and uncheck the “Animate On” box. The two new buttons which appear are backward and forward time buttons. With each click of these time is translated by an amount Δt . Check the “Close Switch” box and note that at time $t=0$ the current in the circuit is $I=1\text{ A}$, and voltage on the capacitor is $V_{cap}=0\text{ V}$, meaning that an uncharged capacitor at initial time $t=0$ behaves like a short circuit. Increment time by an amount $10\Delta t$ by counting 10 clicks on the forward time button, and noting the current in the circuit, complete the following table.

$t(\Delta t)$	10	20	30	40	50	60
$i(t)(A)$						
$\ln(i(t))$						

13. Plot $\ln(i)$ (on the vertical axis) versus t (on the horizontal axis) on a graph paper. You should have a straight line whose equation is $\ln(i) = \frac{-t}{RC}$.

14. Using the values of $R=5\ \Omega$ and C given by the simulation, calculate the numerical value of Δt from the slope of the curve.

15. Write a properly formatted report of your results, convert it into a PDF file and upload it to MOODLE. Deadline for submission is Monday, 10 August 2020 at 07:59 (am). Late submissions will result in deduction of 10 points for each day late.