Name: Date: Class:

Exploring Capacitors PhET Worksheet Answer Key

Instructions

- Open the following PhET simulation: Capacitor Lab: Basics.
- Check all of the boxes so you can see all available data.
- Supply voltage to the capacitor by sliding the battery control.
- Answer the following questions.

Part 1: Charging the Capacitor

1. In which direction do the electrons flow?

Electrons flow from the negative terminal of the battery toward one plate of the capacitor and away from the other plate, through the circuit.

2. Do the electrons flow forever? Explain.

No. Electrons flow only until the capacitor becomes fully charged, at which point the flow stops.

As charge builds up on the plates, the electric field between them increases. Eventually, this field balances the battery voltage, stopping further electron flow.

3. What happens to each plate as the capacitor charges?

One plate becomes negatively charged (gains electrons), and the other becomes positively charged (loses electrons).

Part 2: Changing Plate Distance and Area

Instructions: Now change the separation distance and plate area. Answer the following questions.

4. What effect does changing the separation distance have?

Increasing the distance → decreases capacitance
Decreasing the distance → increases capacitance
Closer plates experience stronger electric attraction, allowing more charge to be stored.

5. What effect does changing the plate area have?

Increasing area → increases capacitance
Decreasing area → decreases capacitance
More area means more surface for charge to collect, allowing more charge storage.

6. Why do you think changing the plate area affects capacitance?

Larger plate area provides more space for electrons to accumulate, increasing the total stored charge. Key idea: More area = more charge storage = higher capacitance.

7. Why do you think changing the separation distance affects capacitance? (Hint: If like charges get closer, will they experience more or less repulsion?)

When the plates are closer, the electric attraction between opposite charges is stronger, allowing more charge to build up.

If plates are farther apart, the attraction weakens, reducing charge storage.

Hint explanation: Like charges repel—if charges get closer, repulsion increases, limiting how much charge can accumulate.

Part 3: Light Bulb Investigation

Instructions: At the bottom of the page, click the panel labeled "Light Bulb."

- Increase the voltage on the battery.
- Disconnect the capacitor from the battery and place it in the center hole.
- Answer the following question.

8. Do the plates hold onto their charge? Explain your reasoning.

Yes. When disconnected from the battery, the plates retain stored charge.
The capacitor stores electrical energy in the electric field between its plates.

Part 4: Discharging Through a Light Bulb

Instructions: Now connect the capacitor to the light bulb. Answer the following questions.

9. What happens to:

Light bulb: Briefly lights up, then goes out.
Capacitor plates: Gradually lose charge as electrons flow through the bulb.

Explanation: The stored energy in the capacitor discharges through the bulb, producing light briefly until the capacitor is empty.

10. Change the parameters of the capacitor, recharge it, and reconnect it to the light bulb. What effect do these changes have?

Larger plate area → brighter bulb and/or longer glow
Smaller separation → brighter bulb and/or longer glow
Higher voltage → brighter bulb and longer glow
Explanation: These changes increase capacitance or stored energy, allowing the bulb to stay lit longer.

Part 5: Real-World Applications

11. Based on your observations, what are some potential uses of capacitors? Where might you see them in everyday life?

Expected examples include:

- Camera flashes
- Phone and computer power supplies
- Defibrillators
- Flashlights
- Speakers
- Power backup systems
- Motor starters

Capacitors are used to store and release electrical energy quickly, smooth voltage, and protect electronic circuits.