

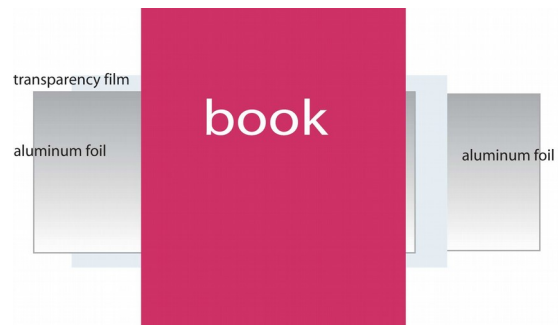
Worksheet: Capacitors

Name: _____ Group name: _____

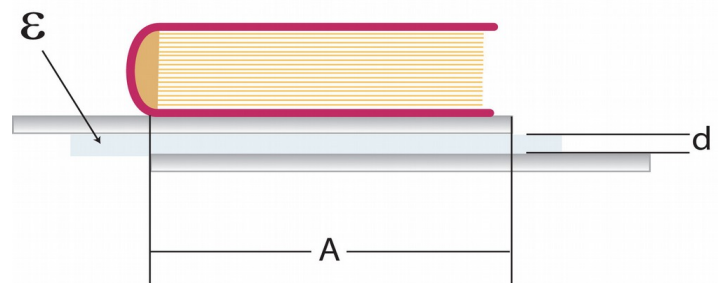
Each multimeter includes a capacitance setting (—|—). Be sure to notice the **prefix**: the measurement may be in nF (nano-Farad) or μ F (micro-Farad). Switch on the multimeter on the capacitance setting. Make sure the feelers are **tightly plugged** in to the multimeter. You should observe a small “bias” of a 1 nF or so. Press the “REL” key to get rid of that bias (it should show close to 0 nF afterwards).

1. Most capacitors consist of two large conducting sheets or plates separated by a thin piece of insulating material, called a dielectric. Build a capacitor by using aluminium foil as sheets and plastic/paper sheets as dielectric.

Cut the aluminum foil into two rectangles of about 10 inches by 8.5 inches (narrower than the transparency film). Smooth the aluminum on the table with your hands. Create a sandwich, making a bottom layer of aluminum, middle layer of transparency film, and a top layer of aluminum. It is important that the top and bottom layers **not** touch (if they touched, it would short out the capacitor).



Put a book or heavy item on top of the capacitor to compress the plates. Leave some aluminum showing to make electrical contact for both plates. Your capacitor should look like the diagram on the right. Notice that the overlapping surface area of aluminum is really only part of either sheet of aluminum.



- Vary the **distance** d between the plates using different number of sheets of plastic

| Number of sheets | Capacitance |
|------------------|-------------|
| | |
| | |
| | |

- Vary the **overlapping surface** A by moving the top sheet of aluminum foil:

| Overlapping surface (%) | Capacitance |
|-------------------------|-------------|
| | |
| | |
| | |

- Change the type of **dielectric** from mylar (large ϵ) to WHITE paper (small ϵ).

| Material | Capacitance |
|----------------------------------|-------------|
| Mylar (large ϵ) | |
| White paper (small ϵ). | |

- Which capacitance equation is supported by your data? (circle one)

$$C = eAd \quad C = e\frac{A}{d} \quad C = e\frac{d}{A} \quad C = e\frac{1}{Ad}$$

2. Analyze the circuit shown on the right and answer the following questions (your instructor will provide the value of C)

- With the switch is closed what is the voltage across the capacitor?

$$V = \text{_____}$$

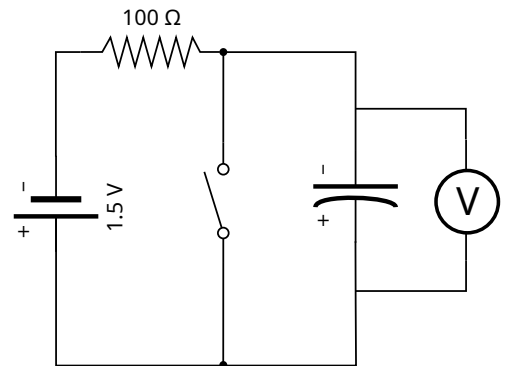
- Use Ohm's law to calculate the current through the resistor with the switch closed:

$$I = \text{_____}$$

- When the switch is opened, the capacitor will begin to charge, and V will increase. After a very long time, how much voltage do you expect to find on the capacitor? How much current?

$$V = \text{_____}$$

$$I = \text{_____}$$

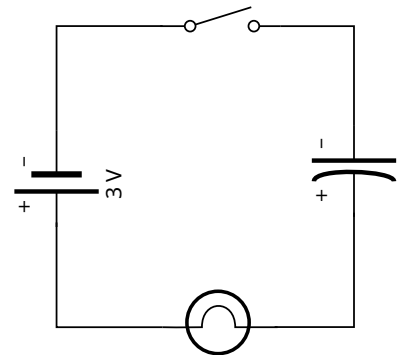


- Build the circuit with switch closed. Mind the **polarity** of the capacitor (red = +). Get a stopwatch ready. Open the switch and measure the voltage every few seconds. Sketch the curve on the right.

| Seconds | Voltage |
|---------|---------|
| 1 | |
| 2 | |
| 5 | |
| 10 | |

3. Build the circuit shown using a light bulb.

- Close the switch and describe what happens to the brightness as time goes on.



- Explain this in terms of the current through the bulb:
- After a few minutes, remove the battery and connect the bulb directly to the capacitor (move one test lead to “bypass” the battery). Describe and explain what you observe.
- Replace the bulb with the LED board (LED in series with 300 Ω resistor) and mind the **polarity**; charge the capacitor and then bypass the battery.

How long does the LED stay lit? _____

What does it mean for the current through light bulb and LED?