1. A 6.0 V battery with internal resistance 2.5 Ω is used to charge a 2200 μF capacitor. (a) Determine the amount of charge and energy that can be "stored". (b) Determine the current when the capacitor is "90% charged". (c) Find the maximum current that occurs.

2. (a) Using the same *battery* as above what different *capacitor* would be needed to store twice the charge? twice the energy? (b) Using the same *capacitor* what different *battery* would double the charge? the energy?

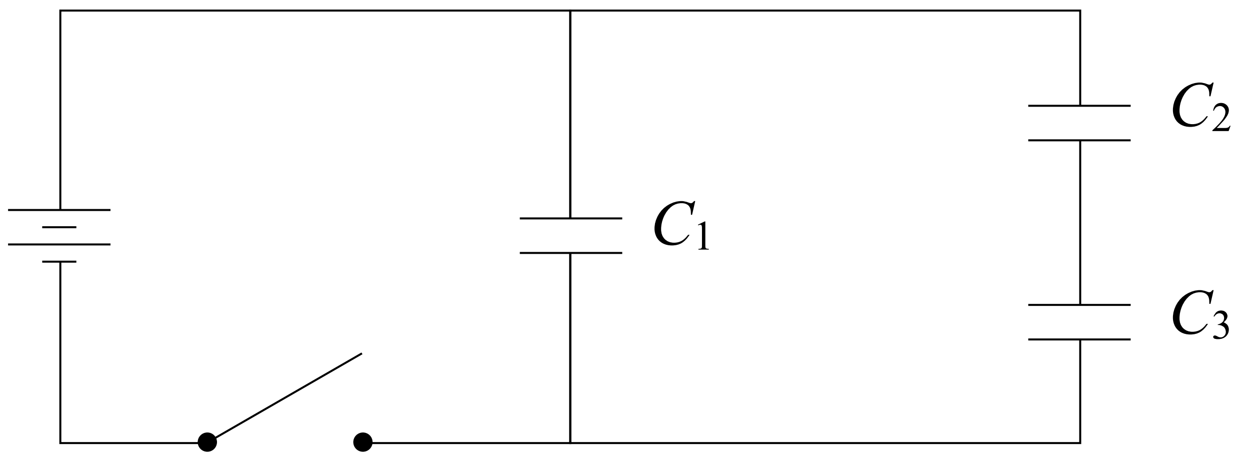
3. A capacitor of 25 μF is connected to a 1.50 V battery. The battery is then disconnected and in its place is connected a resistor of 33 Ω. (a) Find the initial charge on the capacitor. (b) What is the initial power output of the capacitor? (c) Find the amount of charge left in the capacitor when the current is 25 mA. (d) Determine the total energy dissipated by the resistor.

4. A 1$\underline{0}$0 μF capacitor is initially charged to 3.0 V. It is then connected to a battery with emf 9.0 V and internal resistance 3.5 Ω. (a) Find the initial current. (b) Find the amount of charge transferred. (c) Repeat if connections had been opposite polarity.

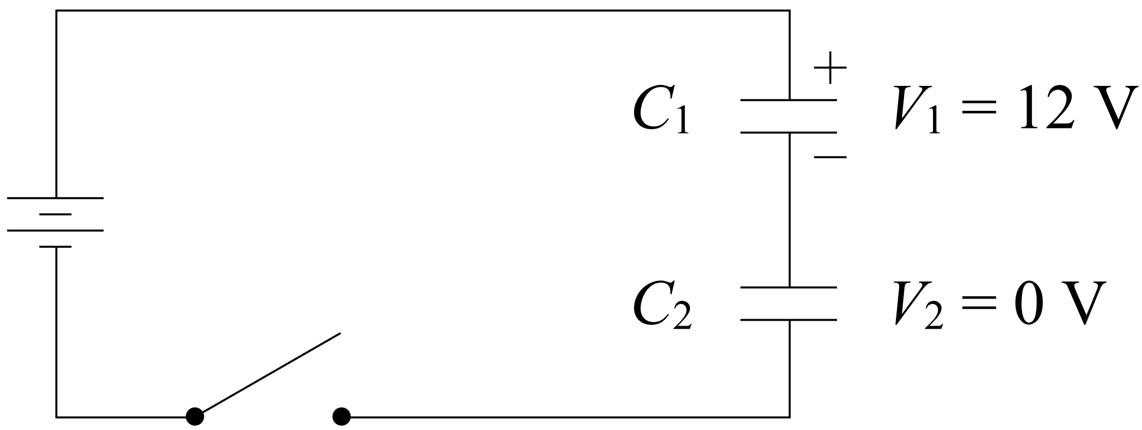
5. A 470 μF capacitor is given a charge of 3.0 mC. It is then connected to an uncharged 220 μF capacitor. (a) How much charge will be transferred between the capacitors? (b) What will be the final voltage? (c) How much heat is generated in the transfer process?

6. Two capacitors C_1 = 330 μF and C_2 = 220 μF are connected in series with a battery with emf 6.00 V and internal resistance 2.3 Ω and a SPST switch, initially open. (a) Determine the initial current when the switch is closed (assuming both capacitors are initially uncharged). (b) Find the eventual charge, voltage, and energy for each capacitor. (c) Repeat for a parallel connection of the capacitors.

7. Capacitors $C_1 = 1.5$ mF, $C_2 = 4.7$ mF, and $C_3 = 6.8$ mF are connected to a 1.50 V battery as shown. The switch is closed; this charges the capacitors. Find the eventual charge, voltage, and energy for each capacitor.



8. Capacitors $C_1 = 4.7$ mF and $C_2 = 1.2$ mF are connected to a 9.0 V battery as shown. Capacitor C_1 is charged to 12 V as shown *before* the switch is closed. Find the eventual charge and voltage on each capacitor.



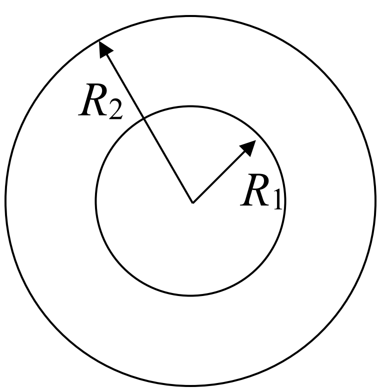
9. (a) Find the capacitance of two parallel square plates of sides 10.0 cm separated by 1.0 mm of air. (b) At the same separation how big would squares have to be to create a 1.0 F capacitor? (c) Using the same 10.0 cm squares as above what separation would result in 1.0 F of capacitance?

10. A parallel plate capacitor has circular metal plates of diameter 25.0 cm separated by 2.50 mm. (a) Determine the capacitance. (b) Find the eventual charge on each plate if it is connected to a 6.00 V battery. (c) If the battery remains connected determine the work necessary to double the separation of the plates.

11. A capacitor has parallel plates, each with area 30.0 cm^2, separated by 0.500 cm. Sandwiched between the plates is a layer of paraffin, which has dielectric constant 2.3 and dielectric strength of 11 MV/m. (a) Find the capacitance. (b) What maximum charge could be held? (b) Find the charge and electric field strength when connected to a 12.0 V battery. (c) If the battery is then disconnected, find the work necessary to remove the paraffin layer.

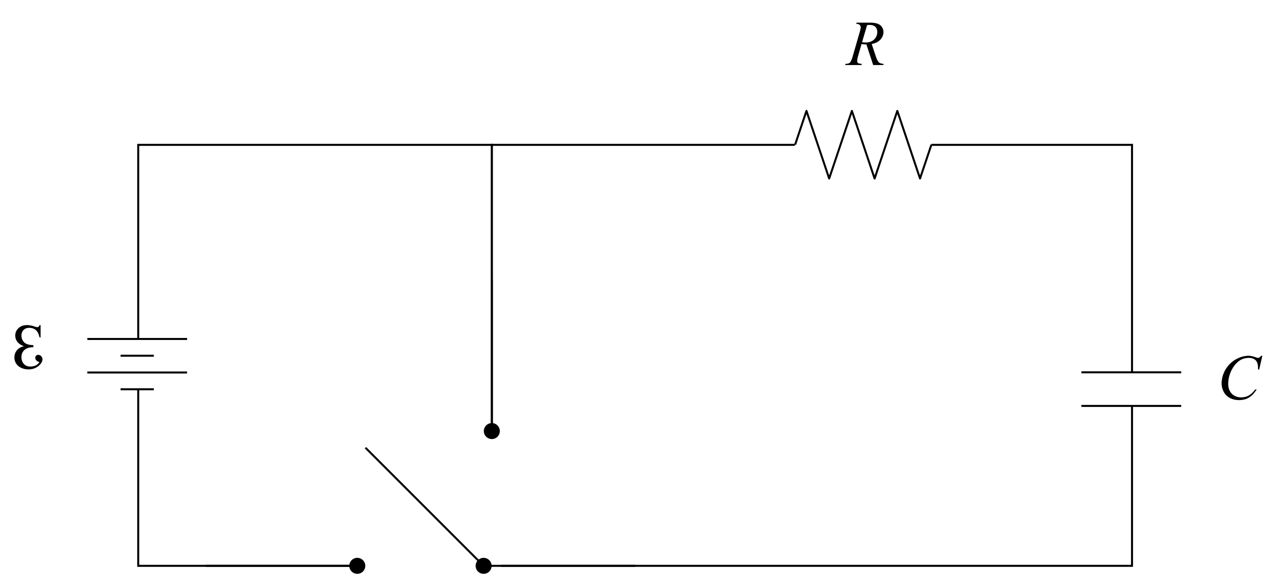
12. A capacitor has parallel plates, each with area 0.050 m^2, separated by 7.00 mm. A metal plate of the same cross section and thickness 3.00 mm is inserted between the plates. (a) Determine the change in capacitance due to the presence of the metal plate. (b) Repeat if a pyrex plate ($\kappa = 5.0$) of the same dimensions is inserted instead of the metal plate. (c) Does it matter if the inserted plate is centered?

13. Derive a formula for the capacitance of a spherical capacitor consisting of two metallic shells separated by air, as shown below.

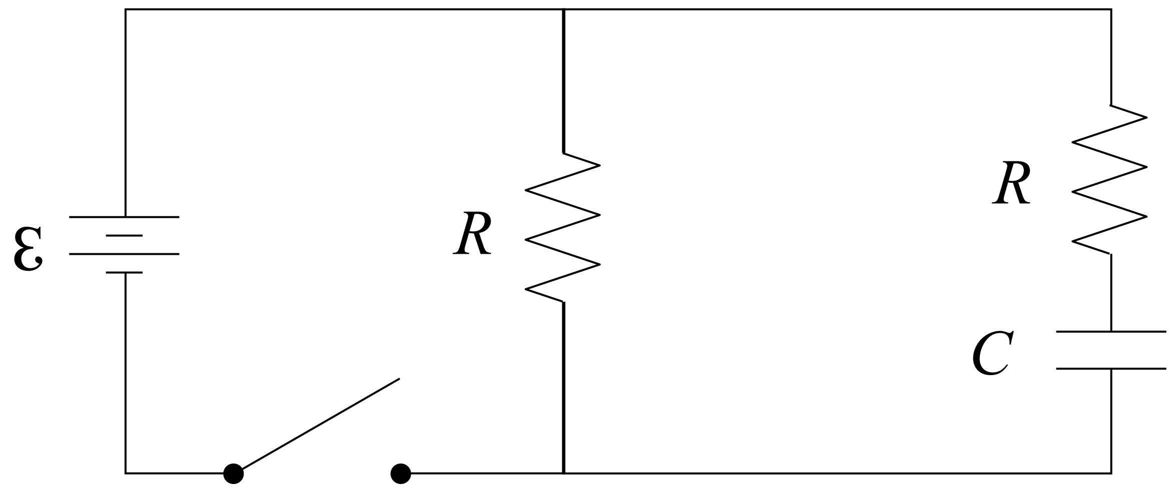


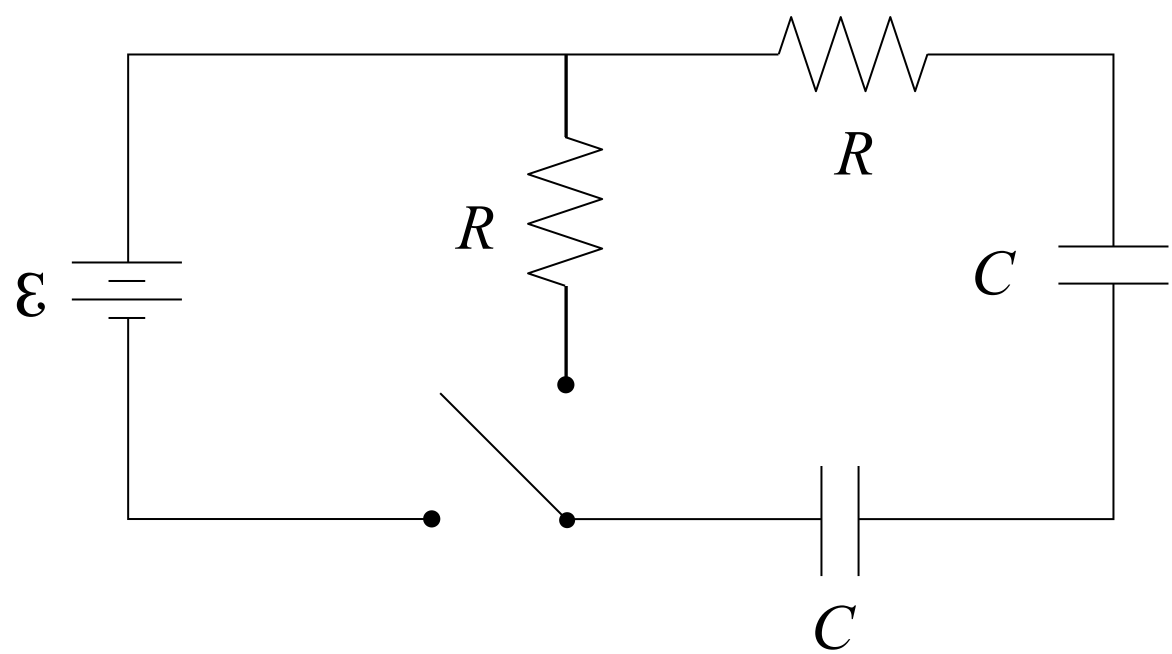
14. Derive a formula for the capacitance of the capacitor shown below in which there are alternating charged plates, equally spaced. Let A be the area of one plate and d be the separation.

15. The capacitor in the circuit below is charged and discharged using the SPDT switch. Find expressions for voltage and current as functions of time.

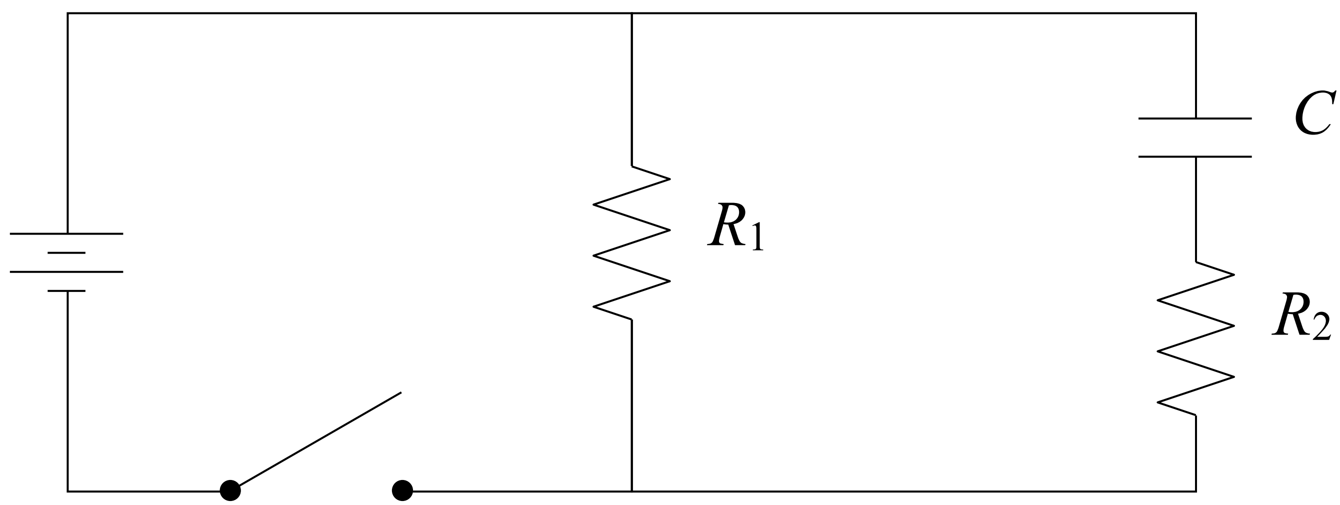


16. Make careful sketches of voltage vs. time and current vs. time for each capacitor charging and discharging. Determine the time constant for each action in terms of *R*, *C*, and relevant constants.

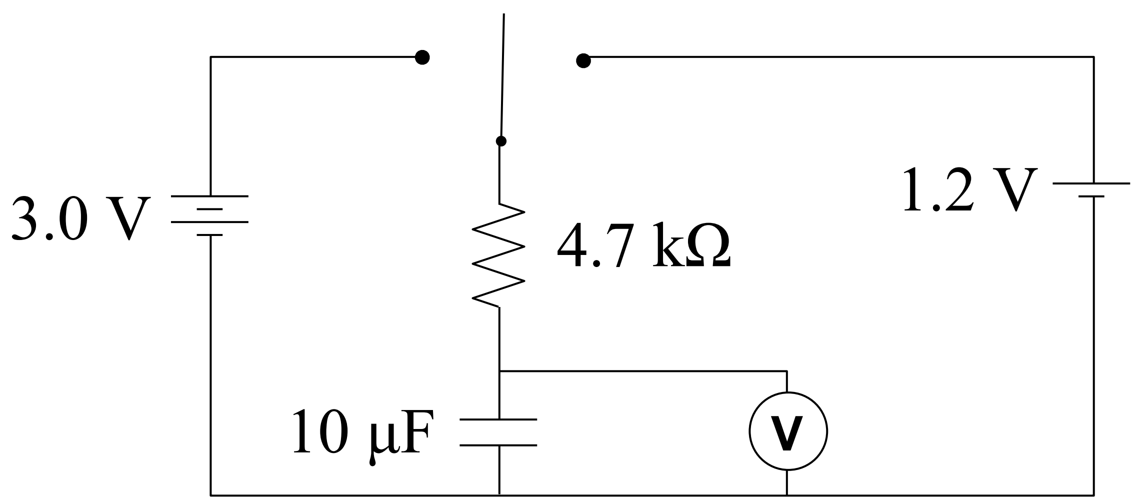




17. Resistors $R_1 = 330\ \Omega$ and $R_2 = 680\ \Omega$, a capacitor $C = 2.2$ mF, and a 9.00 V battery are connected as shown. The switch is closed at $t = 0$ and then opened at $t = 2.00$ s. (a) Find the maximum voltage across the capacitor. (b) Make a careful sketch of voltage vs. time for each resistor and the capacitor.



18. The switch is moved back and forth between positions 1 and 2. (a) Determine the time constant for each position. (b) Reverse the polarity of the cell. Predict the time for the voltage of the capacitor to drop from 3.0 V to zero.



19. The capacitor in the circuit below is charged and discharged by closing and opening the switch. (a) Sketch voltage vs. time graphs for each resistor and the capacitor. Find the time constant for (b) discharging and (c) charging.