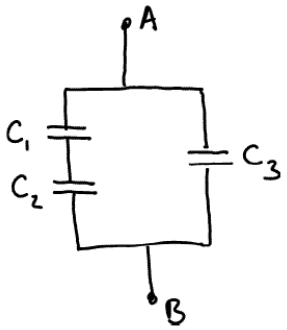
Workshop module 5 - Physics 114, Spring 2015

1. A parallel plate capacitor is charged by being connected to a battery and is then disconnected from the battery. The separation between the plates is then doubled. How does the electric field change? The potential difference? The total energy? Explain your reasoning.

2. Three capacitors are connected as shown in the sketch to the right. Their capacitances are C_1=4.0 μF, C_2=6.0 μF, and C_3=3.0 μF. If the voltage across the combination, V_{AB}, is 400V, what is the charge on each capacitor?



3. A parallel-plate capacitor has plates of area 600 cm^2 and a separation of 4 mm. The capacitor is charged to 100 V and is then disconnected from the battery. (a) Find the electric field E_o and the electrostatic energy U. A dielectric of constant κ=4 is then inserted, completely filing the space between the plates. Find (b) the new electric field E, (C) the potential difference V and (d) the new electrostatic energy. Do you think that you would have to shove the dielectric between the plates of the capacitor or do you think it might go in easily? (*Hint: think about work and energy*.)

4. Batteries are always labeled with their emf; for instance, a AA flashlight battery is labeled "1.5 volts." Would it also be appropriate to put a label on batteries stating how much current they provide? Why or why not?

5. Sharks can detect electric fields as weak as 1 microvolt/meter, which is in the range of the electric fields found along the skins of animals (in particular … fish the shark wants to eat!). The organs that can detect such weak fields are called the ampullae of Lorenzini. These are jelly-filled tubes that are many centimeters long but only a millimeter or two in diameter. One end of the tube opens at the surface of the shark's head. The walls of the tubes have high resistivity, but the resistivity of the jelly is quite low. How do you suppose the ampullae of Lorenzini function?

6. The current in a wire varies with time according to the relation I= 3.0 A + (0.73 A/s^2))t^2. a) How many coulombs of charge pass a cross section of the wire in the time interval between t=0 and t=10 s? b) What constant current would transport the same charge in the same time interval?