PHYS 51W - Workshop - March 2 - 8

These problems are based on material from Chapter 24, capacitors and dielectrics.

1. A 2.0 μF capacitor has square parallel metal plates separated by 1.0 mm.

a. What is the area of the plates? What is the length of one of the sides of the plates?

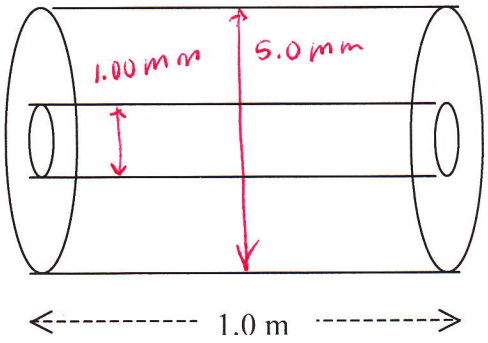
b. If you double the length of the sides, what is the new capacitance?

c. If you double the separation between the plates, what is the new capacitance?

2. A coaxial cable is 1.0 m long. It consists of concentric cylindrical conductors. The inner conductor has a diameter of 1.00 mm; the outer conductor has a diameter of 5.00 mm.

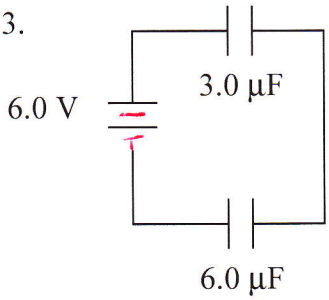
a. What is the capacitance?

b. If I put a potential of 1000 V across this capacitor, how much total charge appears on one of the cylinders?

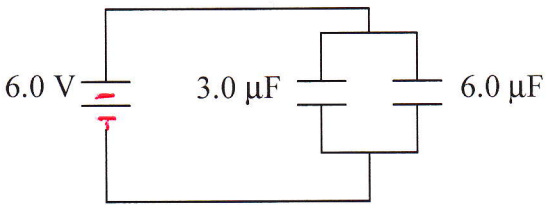


Not to scale.

3.

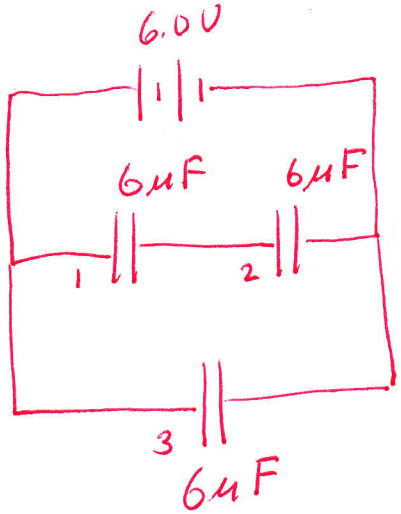


a. In the circuit above, determine the total capacitance. Find how much charge is on each capacitor, and find the potential difference across each capacitor.



b. In the circuit above, determine the total capacitance. Find how much charge is on each capacitor, and find the potential difference across each capacitor.

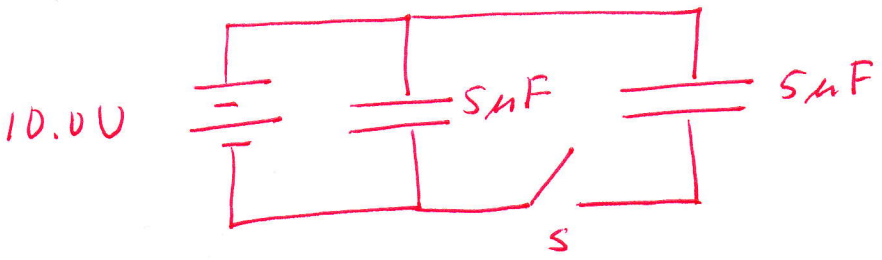
4. In the circuit shown, find the equivalent capacitance of the capacitor network. Find the charge on each capacitor, and find the potential difference across each capacitor.



5. In the circuit shown, S is a switch which is initially open. The capacitor on the right is initially uncharged.

a. Find the potential V across each capacitor, and the charge on each, before the switch is closed.

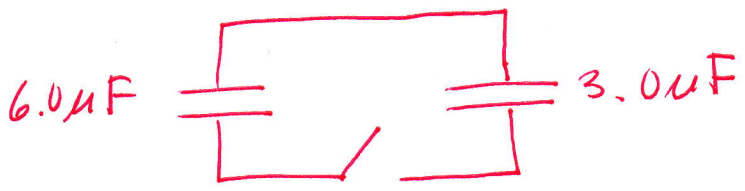
b. Find the potential V across each capacitor, and the charge on each, after the switch is closed.



left

6. In the picture below, the capacitor on the ~~right~~ has a potential of 10.0 V across it initially, while the capacitor on the right is uncharged. The switch S is initially open.

Determine the potential across each, and the charge on each, after the switch is closed. Compare the energy stored in this system before and after the switch is closed.



7. a. Two different capacitors are connected in series across a battery. Capacitor 1 has greater capacitance than Capacitor 2. Which one has more charge on it? Which one has a greater potential fall across it?

b. Answer the questions if the two are connected in parallel across the battery.

8. A metal sphere has a radius of 10.0 cm. The potential of the sphere is 100,000 V.

a. How much charge is on the sphere?

b. What is the electric field near the sphere?

c. The energy density in a region where there is an electric field is given by $u = \frac{\varepsilon_o}{2} E^2$. Find the total energy stored in the electric field of the sphere.

9. A parallel plate capacitor with air between the plates has a capacitance of 3.0 μF. The capacitor is attached to a 10.0 V battery.

a. How much energy is stored in the capacitor?

b. A thin piece of glass, with a dielectric constant K = 5.0, is slid between the plates. What is the new capacitance? Compare the potential difference across the capacitor before and after the glass is used. Compare the charge on the capacitor before and after the glass is used. What is the new energy stored on the capacitor?

10. Two identical air-filled parallel plate 5.0 μF capacitors are connected in parallel. Initially, there is a potential difference of 10.0 V across them. Find the charge on each and the energy stored on each.

A thin piece of glass with dielectric constant K = 5.0 is slid between the plates on one of the capacitors. Find the charge on each; the potential difference across each; and the energy stored on each after this happens.