Practice Problems Section 6 Solutions

1. A parallel plate capacitor consists of two flat sheets separated by vacuum (with permittivity , dielectric constant ). Each sheet has an area of 0.500 m2 and the sheets are separated by a distance of 2.50 mm. The capacitor has a charge of 5.00 μC.
2. Solve for the capacitance of the capacitor and the voltage across the capacitor. **Show your work.**

For a parallel plate,

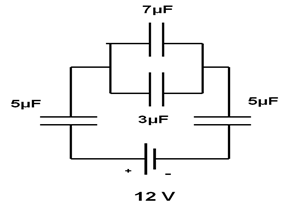
The capacitance of a capacitor is the charge to voltage ratio, .

Thus,

1. You now place a dielectric in between the plates. The charge on the plates is still 5.00 μC. Qualitatively, will the voltage go up, down or stay the same? **Explain your answer in terms of polarization of charges and induced charges in the dielectric**.

Due to the electric field created by the charges on the plates, the atoms in the dielectric will become polarized, producing an electric field in the opposite direction. Thus, the net electric field between the plates will decrease. With a decrease in electric field, the **voltage between the plates will also go down**.

(Note: This is why the capacitance goes up! The charge to voltage ratio goes up due to the voltage going down.)

1. Consider the diagram to the right.
   1. Calculate the equivalent capacitance of the system. **Show your work**.

The 7 μF and 3 μF capacitors are in parallel. Thus, they form an equivalent capacitance of 10 μF. The two 5 μF capacitors, along with the 10 μF equivalent capacitor are all in series. Thus the equivalent capacitance of the system is given by

* 1. Solve for the charge stored on the 7 μF capacitor. **Show your work**.

The charge stored on each of the 5 μF capacitors as well as the 10 μF equivalent capacitor is the same since they are in series. This charge is found by

Thus, the 7 μF and 3 μF capacitors have a total of 24 μC of charge. There are many ways to find the charge on each. Here is one approach:

Since the 7 μF and 3 μF capacitors are in parallel, they must have the same voltage.

This is one equation involving both the charge on the 7 μF capacitor and the 3 μF capacitor. In addition, we know that

Combining these two equations yields

* 1. How much energy is stored in the 7 μF capacitor? **Show your work**.

The energy stored in a capacitor is