Name: _____ **Date:** _____ **Period:** _____

AP Physics C
Capacitance HO34

1.) A parallel-plate air capacitor has a capacitance of 500 pF and a charge of magnitude 0.346 μC on each plate. The plates are 0.453 mm apart. (UP 25-1)

a.) What is the potential difference between the plates?

b.) What is the area of each plate?

c.) What is the electric-field magnitude between the plates?

d.) What is the surface charge density on each plate?

2.) A spherical capacitor is formed from two concentric spherical conducting shells separated by vacuum. The inner sphere has a radius 20.0 cm, and the capacitance is 150 pF. (UP 25-4)

a.) What is the distance between the surfaces of the two spheres?

b.) If the potential difference between the two spheres is 220 V, what is the magnitude of charge on each sphere?

c.) What is the surface charge density on each sphere?

3.) A spherical capacitor is formed from two concentric spherical conducting shells separated by a vacuum. The inner sphere has a radius 12.0 cm, and the outer sphere has radius 15.0 cm. A potential difference of 140 V is applied to the capacitor. (UP 25-5)

a.) What is the capacitance of the capacitor?

b.) What is the magnitude of **E** at r = 12.1 cm, just outside the inner sphere?

c.) What is the magnitude of **E** at r = 14.9 cm, just inside the outer sphere?

4.) A cylindrical capacitor has an inner conductor of radius 2.5 mm and an outer conductor of radius 4.0 mm. The entire capacitor is 3.5 m long. (UP 25-7)

a.) The potential of the outer conductor is 350 mV higher than that of the inner conductor. Find the charges (magnitude and sign) on the inner conductor and on the outer conductor.

b.) What is the capacitance per unit length?

5.) A parallel-plate air capacitor is made by using two plates 0.18 m square, spaced 0.58 cm apart. It is connected to a 50 V battery. (UP 25-40)

a.) What is the capacitance?

b.) What is the charge on each plate?

c.) What is the electric field between the plates?

d.) What is the energy stored in the capacitor?

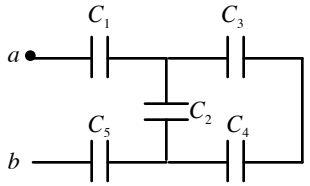
e.) If the battery is disconnected and then the plates are pulled apart to a separation of 1.16 cm, what are the answers to parts (a), (b), (c), and (d)?

6.) Suppose the battery in Problem 5 remains connected while the plates are pulled apart. What are the answers to parts (a), (b), (c), and (d) after the plates have been pulled apart? (UP 25-41)

7.) In the figure below, $C_1 = C_5 = 4.6\ \mu$F, and $C_2 = C_3 = C_4 = 2.3\ \mu$F. The applied potential is $V_{ab} = 540$ V. (UP 25-43)

a.) What is the equivalent capacitance of the network between points a and b?

b.) Find the charge on each capacitor and the potential difference across each capacitor.



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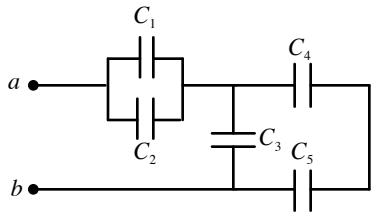
AP Physics C
Capacitance HO35

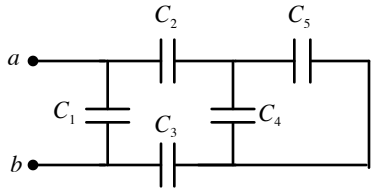
1.) 

In the figure to the left $C_1 = C_2 = 5.0\ \mu$F and $C_3 = C_4 = C_5 = 10.0\ \mu$F. The potential difference between a and b is 120 V.

a.) Find the equivalent capacitance of the network.

b.) Find the charge and voltage across each capacitor.

c.) Find the total energy stored in the network.

2.) 

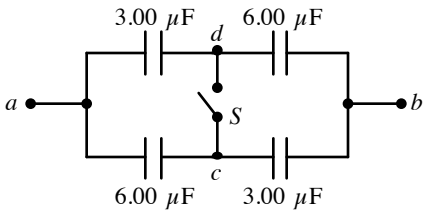
In the figure to the left $C_1 = C_2 = C_3 = C_4 = C_5 = 5.0\ \mu$F. The potential difference between a and b is 100 V.

a.) Find the equivalent capacitance of the network.

b.) Find the charge and voltage across each capacitor.

c.) Find the total energy stored in the network.

3.) Repeat Problem 1 if $C_1 = C_5 = 6.0\ \mu$F, $C_3 = 3.6\ \mu$F and $C_2 = C_4 = 4.0\ \mu$F. The potential difference between a and b is 120 V.

4.) 

The capacitors in the figure to the left are initially uncharged and are connected as in the diagram with the switch S open. The applied potential difference is $V_{ab} = 360$ V. (UP 25-48)

a.) What is the potential difference V_{cd}?

b.) What is the potential difference across each capacitor after switch S is closed?

c.) How much charge flowed through the switch when it was closed?

5.) A cylindrical air capacitor of length 25.0 m stores 5.40 x 10^{-9} J of energy when the potential difference between the two conductors is 3.00 V. (UP 25-21)

a.) Calculate the magnitude of the charge on each conductor.

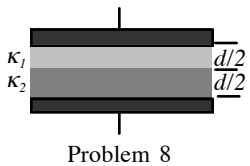
b.) Calculate the ratio of the radii of the inner and outer conductors.

6.) The dielectric to be used in a parallel-plate capacitor has a dielectric constant of 3.40 and a dielectric strength of 2.00 x 10^7 V/m. The capacitor is to have a capacitance of 1.37 nF and must be able to withstand a maximum potential difference of 6000 V. What minimum area may the capacitor plates have? (UP 25-27)

7.) Two identical, oppositely charged conducting plates are separated by a dielectric 1.60 mm thick, with a dielectric constant of 4.50. The resultant electric field in the dielectric is 1.40 x 10^6 V/m. (UP 25-30)

a.) Find the charge per unit area on each conducting plate.

b.) Find the charge per unit area on the surfaces of the dielectric.



Problem 8

8.) A parallel-plate capacitor has the space between the plates filled with slabs of dielectric, one with constant κ_1 and one with constant κ_2. Each slab has thickness $d/2$, where d is the plate separation. Show that the capacitance is (UP 25-57)

$$C = \frac{2\varepsilon_0 A}{d}\left(\frac{\kappa_1\kappa_2}{\kappa_1 + \kappa_2}\right)$$