Homework for Chapter 25

(due 10/6/22)

Questions: 4, 6, 10 Exercises & Problems: 4, 15, 19, 27, 32, 45, 48, 51, 57

Question 4

Figure 25-20 shows three circuits, each consisting of a switch and two capacitors, initially charged as indicated (top plate positive). After the switches have been closed, in which circuit (if any) will the charge on the left-hand capacitor (a) increase, (b) decrease, and (c) remain the same?



Question 6

Initially, a single capacitance C_1 is wired to a battery. Then capacitance C_2 is added in series. Are (a) the potential difference across C_1 and (b) the charge q_1 on C_1 now more than, less than, or the same as previously? (c) Is the equivalent capacitance C_{12} of C_1 and C_2 more than, less than, or equal to C_1 ? (d) Is the charge stored on C_1 and C_2 together more than, less than, or equal to the charge stored previously on C_1 ?

Question 10

When a dielectric slab is inserted between the plates of one of the two identical capacitors in Fig. 25-23, do the following properties of that capacitor increase, decrease, or remain the same: (a) capacitance, (b) charge, (c) potential difference, and (d) potential energy? (e) How about the same properties of the other capacitor?



Problem 4

The plates of a spherical capacitor have radii 38.0 mm and 40.0 mm. (a) Calculate the capacitance. (b) What must be the plate area of a parallel-plate capacitor with the same plate separation and capacitance?

Problem 15

In Fig. 25-31, a 20.0 V battery is connected across capacitors of capacitances $C_1 = C_6 = 3.00 \,\mu\text{F}$ and $C_3 = C_5 = 2.00C_2 = 2.00C_4 = 4.00 \,\mu\text{F}$. What are (a) the equivalent capacitance C_{eq} of the capacitors and (b) the charge stored by C_{eq} ? What are (c) V₁ and (d) q₁ of capacitor 1, (e) V₂ and (f) q₂ of capacitor 2, and (g) V₃ and (h) q₃ of capacitor 3?



Problem 19

In Fig. 25-34, the battery has potential difference V = 9.0 V, $C_2 = 3.0 \mu$ F, $C_4 = 4.0 \mu$ F, and all the capacitors are initially uncharged. When switch S is closed, a total charge of 12 μ C passes through point *a* and a total charge of 8.0 μ C passes through point *b*. What are (a) C_1 and (b) C_3 ?



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Problem 27

Figure 25-42 shows a 12.0 V battery and four uncharged capacitors of capacitances $C_1 = 1.00 \ \mu\text{F}$, $C_2 = 2.00 \ \mu\text{F}$, $C_3 = 3.00 \ \mu\text{F}$, and $C_4 = 4.00 \ \mu\text{F}$. If only switch S₁ is closed, what is the charge on (a) capacitor 1, (b) capacitor 2, (c) capacitor 3, and (d) capacitor 4? If both switches are closed, what is the charge on (e) capacitor 1, (f) capacitor 2, (g) capacitor 3, and (h) capacitor 4?

Problem 32

A parallel-plate air-filled capacitor having area 40 cm^2 and plate spacing 1.0 mm is charged to a potential difference of 600 V. Find (a) the capacitance, (b) the magnitude of the charge on each plate, (c) the stored energy, (d) the electric field between the plates, and (e) the energy density between the plates.

Problem 45

A certain parallel-plate capacitor is filled with a dielectric for which $\kappa = 5.5$. The area of each plate is 0.034 m², and the plates are separated by 2.0 mm. The capacitor will fail (short out and burn up) if the electric field between the plates exceeds 200 kN/C. What is the maximum energy that can be stored in the capacitor?

Problem 48

Figure 25-47 shows a parallel-plate capacitor with a plate area A = 5.56 cm² and separation d = 5.56 mm. The left half of the gap is filled with material of dielectric constant $\kappa_1 = 7.00$; the right half is filled with material of dielectric constant $\kappa_2 = 12.0$. What is the capacitance?



Problem 51

A parallel-plate capacitor has a capacitance of 100 pF, a plate area of 100 cm², and a mica dielectric ($\kappa = 5.4$) completely filling the space between the plates. At 50 V potential difference, calculate (a) the electric field magnitude *E* in the mica, (b) the magnitude of the free charge on the plates, and (c) the magnitude of the induced surface charge on the mica.

Problem 57

In Fig. 25-51, V = 9.0 V, $C_1 = C2 = 30 \mu$ F, and $C = C_4 = 15 \mu$ F. What is the charge on capacitor 4?

