

Problems are from Tipler Chapter 24:

(1) **2** If the charge on an isolated spherical conductor is doubled, its capacitance (a) doubles (b) drops by half (c) remains the same

(2) **8** Two initially uncharged capacitors of capacitance C_o and $2C_o$ respectively, are connected in series across a battery. Which of the following is true?

- (a) The capacitor $2C_o$ carries twice the charge of the other capacitor
- (b) The voltage across each capacitor is the same
- (c) The energy stored by each capacitor is the same
- (d) None of the above statements is correct

For series capacitors, a), b) and c) are False, d) is True.

(3) **8 revisited** Do the above problem again, but for parallel capacitors.

(4) **14** To create the high-energy densities needed to operate a pulsed nitrogen laser, the discharge from a high-capacitance capacitor is used. Typically, the energy requirement per pulse (i.e., per discharge) is 100 J. Estimate the capacitance required if the discharge is applied through a spark gap of 1 cm width. Assume that the dielectric breakdown of nitrogen occurs at $E \approx 3 \times 10^6$ V/m.

(5) **15** Measurements reveal that the earth's electric field extends upward for 1000 m and has an average magnitude of 200 V/m. Estimate the electrical energy stored in the atmosphere. (**Hint: Treat the atmosphere as a flat slab with an area equal to the surface area of earth.**)

(6) **18** Point charges q_1 , q_2 and q_3 are at the corners of an equilateral triangle of side 2.5 m. Find the electrostatic potential energy of this charge distribution if (a) $q_1 = q_2 = q_3 = +4.2 \mu\text{C}$ (b) $q_1 = q_2 = +4.2 \mu\text{C}$ and $q_3 = -4.2 \mu\text{C}$ and (c) $q_1 = q_2 = -4.2 \mu\text{C}$ and $q_3 = +4.2 \mu\text{C}$

(7) **42** Five identical capacitors of capacitance C_o are connected in a bridge network, as shown in Figure 24-32. (a) What is the equivalent capacitance between points a and b ? (b) Find the equivalent capacitance between points a and b if the capacitor at the center is replaced by one with a capacitance of $10 C_o$

(8) **48** A parallel plate air-gap capacitor has a capacitance of $0.14 \mu\text{F}$. The plates are 0.5 mm apart. (a) What is the area of each plate? (b) What is the potential difference if the capacitor is charged to $3.2 \mu\text{C}$? (c) What is the stored energy? (d) How much charge can the capacitor carry before dielectric breakdown of the air between the plates occurs?

(9) **60** Two capacitors $C_1 = 4 \mu\text{F}$ and $C_2 = 12 \mu\text{F}$ are connected in series across a 12-V battery. They are carefully disconnected so that they are not discharged and they are then reconnected to each other, with positive plate to positive plate and negative plate to negative plate. (a) Find the potential difference across each capacitor after they are connected (b) Find the initial energy stored and final energy stored in the capacitors

(10) **72 - slightly revised** Two capacitors, each consisting of two conducting plates of surface area A , with an air gap of width d are connected in parallel, as shown in Figure 24-37, and each has a charge Q . A

slab of width d and area A with dielectric constant κ is inserted between the plates of one of the capacitors. Calculate the new charges on both capacitors.