

1. A parallel-plate capacitor has circular plates of 8.2 cm radius and 1.3 mm separation. (a) Calculate the capacitance. (b) What charge will appear on the plates if they are connected across a 12-volt battery?
2. A small capacitor in a computer memory has a capacitance of 0.055 pF. It is charged by a 5.3-V battery. How many electrons are transferred during the charging process?
3. A spherical capacitor consists of an inner spherical conductor of radius  $a$  and a concentric outer spherical conductor of radius  $b$ . The inner conductor has a charge  $+Q$  and the outer conductor has charge  $-Q$ . (a) By integrating the electric field between the inner and outer conductors, show that for this combination  $C = 4\pi\epsilon_0 ab / (b - a)$ . [Hint: Recall that for spherical charge distributions, the charges inside the point of observation can be replaced with a point charge and the charges outside the point of observation do not contribute to the electric field.] (b) Calculate the capacitance of the isolated Earth. (Consider the Earth to be the inner conductor and let the radius of the outer conductor go to infinity.)

Ans: 710  $\mu$ F

4. A cylindrical capacitor consists of an inner cylindrical conductor of length  $L$  and radius  $a$ , and a coaxial outer cylindrical conductor of length  $L$  and radius  $b$ . The inner conductor has a charge  $+Q$  and the outer conductor has charge  $-Q$ . (a) By integrating the electric field between the inner and outer conductors, show that for this combination  $C = 2\pi\epsilon_0 L / \ln(b/a)$ . [Hint: For a line of charge, the field is  $E = (Q/L) / 2\pi\epsilon_0 r$ . The same considerations apply here as for the spherical charge distribution: the inner cylinder can be replaced with a line of charge and the outer cylinder doesn't contribute to the field.] (b) A coaxial cable, such as one that is used to transmit TV signals, consists of two cylindrical conductors of inner radius 0.15 mm and outer radius 2.1 mm. What is the capacitance of a length of 1 m of this cable?

Ans: 21 pF