46. (II) Three conducting plates, each of area A, are connected as shown in Fig. 19–54. (*a*) Are the two capacitors formed connected in series or in parallel? (*b*) Determine C as a function of d_1, d_2, and A. Assume $d_1 + d_2$ is much less than the dimensions of the plates.

FIGURE 19–54
Problem 46.

47. (II) A circuit contains a single 250-pF capacitor hooked across a battery. It is desired to store three times as much energy in a combination of two capacitors by adding a single capacitor to this one. How would you hook it up, and what would its value be?

48. (III) A 185-pF capacitor is connected in series with an unknown capacitance, and as a series combination they are connected to a battery with an emf of 25.0 V. If the 185-pF capacitor stores 125 pC of charge on its plates, what is the unknown capacitance?

19–6 *RC* Circuits

49. (I) Electrocardiographs are often connected as shown in Fig. 19–55. The leads are said to be capacitively coupled. A time constant of 3.0 s is typical and allows rapid changes in potential to be recorded accurately. If $C = 3.0\,\mu\text{F}$, what value must R have? [*Hint*: consider each leg as a separate circuit.]

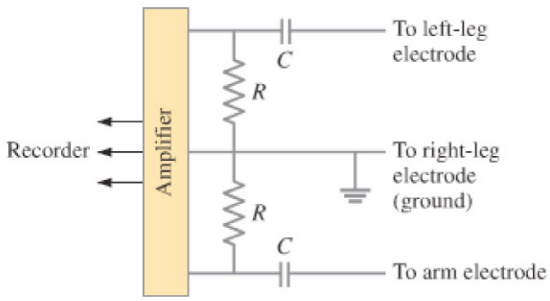

FIGURE 19–55 Problem 49.

50. (II) In Fig. 19–56 (same as Fig. 19–20a), the total resistance is 15.0 kΩ, and the battery's emf is 24.0 V. If the time constant is measured to be 35.0 μs, calculate (*a*) the total capacitance of the circuit and (*b*) the time it takes for the voltage across the resistor to reach 16.0 V after the switch is closed.

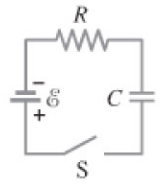

FIGURE 19–56
Problem 50.

51. (II) The RC circuit of Fig. 19–57 (same as Fig. 19–21a) has $R = 6.7\,\text{k}\Omega$ and $C = 3.0\,\mu\text{F}$. The capacitor is at voltage V_0 at $t = 0$, when the switch is closed. How long does it take the capacitor to discharge to 1.0% of its initial voltage?

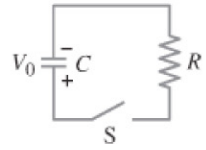

FIGURE 19–57
Problem 51.

52. (III) Two resistors and two uncharged capacitors are arranged as shown in Fig. 19–58. Then a potential difference of 24 V is applied across the combination as shown. (*a*) What is the potential at point a with switch S open? (Let $V = 0$ at the negative terminal of the source.) (*b*) What is the potential at point b with the switch open? (*c*) When the switch is closed, what is the final potential of point b? (*d*) How much charge flows through the switch S after it is closed?

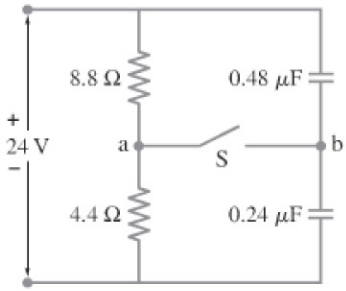

FIGURE 19–58
Problem 52.

* 19–8 Ammeters and Voltmeters

* 53. (I) What is the resistance of a voltmeter on the 250-V scale if the meter sensitivity is 30,000 Ω/V?

* 54. (I) An ammeter has a sensitivity of 20,000 Ω/V. What current in the galvanometer produces full-scale deflection?

* 55. (II) A galvanometer has an internal resistance of 30 Ω and deflects full scale for a 50-μA current. Describe how to use this galvanometer to make (*a*) an ammeter to read currents up to 30 A, and (*b*) a voltmeter to give a full-scale deflection of 250 V.

* 56. (II) A galvanometer has a sensitivity of 35 kΩ/V and internal resistance 20.0 Ω. How could you make this into (*a*) an ammeter that reads 2.0 A full scale, or (*b*) a voltmeter reading 1.00 V full scale?

* 57. (II) A milliammeter reads 10 mA full scale. It consists of a 0.20-Ω resistor in parallel with a 33-Ω galvanometer. How can you change this ammeter to a voltmeter giving a full-scale reading of 10 V without taking the ammeter apart? What will be the sensitivity (Ω/V) of your voltmeter?

* 58. (II) A 45-V battery of negligible internal resistance is connected to a 38-kΩ and a 27-kΩ resistor in series. What reading will a voltmeter, of internal resistance 95 kΩ, give when used to measure the voltage across each resistor? What is the percent inaccuracy due to meter resistance for each case?

* 59. (II) An ammeter whose internal resistance is 63 Ω reads 5.25 mA when connected in a circuit containing a battery and two resistors in series whose values are 750 Ω and 480 Ω. What is the actual current when the ammeter is absent?