73. What are the values of effective capacitance which can be obtained by connecting four identical capacitors, each having a capacitance C?

74. The variable capacitance of an old radio tuner consists of four plates connected together placed alternately between four other plates, also connected together (Fig. 19–62). Each plate is separated from its neighbor by 1.5 mm of air. One set of plates can move so that the area of overlap of each plate varies from $2.0\,\text{cm}^2$ to $9.5\,\text{cm}^2$. (*a*) Are these seven capacitors connected in series or in parallel? (*b*) Determine the range of capacitance values.

FIGURE 19–62 Problem 74.

75. A battery produces 40.8 V when 7.40 A is drawn from it and 47.3 V when 2.20 A is drawn. What are the emf and internal resistance of the battery?

76. How many $\frac{1}{2}$-W resistors, each of the same resistance, must be used to produce an equivalent 2.2-kΩ, 3.5-W resistor? What is the resistance of each, and how must they be connected? Do not exceed $P = \frac{1}{2}\,\text{W}$ in each resistor.

77. The current through the 4.0-kΩ resistor in Fig. 19–63 is 3.50 mA. What is the terminal voltage V_{ba} of the "unknown" battery? (There are two answers. Why?) [*Hint*: use conservation of energy or Kirchhoff's rules.]

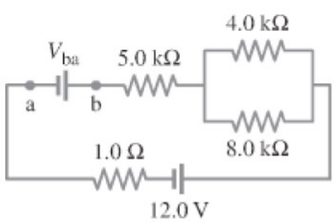

FIGURE 19–63 Problem 77.

78. An air-filled parallel-plate capacitor has capacitance C_0. If two identically sized dielectric slabs of dielectric constants K_1 and K_2 are inserted as shown in Fig. 19–64, what is the new capacitance? [*Hint*: treat this as two capacitors in combination.]

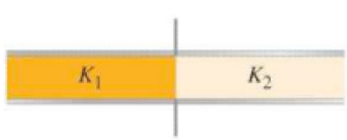

FIGURE 19–64 Problem 78.

79. For the circuit shown in Fig. 19–65, determine (*a*) the current through the 14-V battery and (*b*) the potential difference between points a and b, $V_a - V_b$.

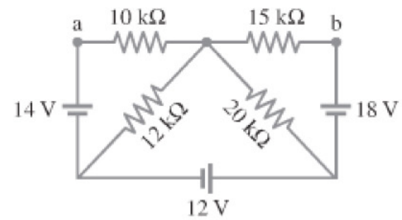

FIGURE 19–65 Problem 79.

80. A solar cell, 3.0 cm square, has an output of 350 mA at 0.80 V when exposed to full sunlight. A solar panel that delivers close to 1.0 A of current at an emf of 120 V to an external load is needed. How many cells will you need to create the panel? How big a panel will you need, and how should you connect the cells to one another? How can you optimize the output of your solar panel?

81. A power supply has a fixed output voltage of 12.0 V, but you need $V_T = 3.0\,\text{V}$ for an experiment. (*a*) Using the voltage divider shown in Fig. 19–66, what should R_2 be if R_1 is 10.0 Ω? (*b*) What will the terminal voltage V_T be if you connect a load to the 3.0-V terminal, assuming the load has a resistance of 7.0 Ω?

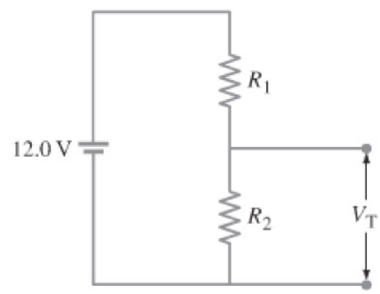

FIGURE 19–66 Problem 81.

82. The circuit shown in Fig. 19–67 uses a neon-filled tube as in Fig. 19–23a. This neon lamp has a threshold voltage V_0 for conduction, because no current flows until the neon gas in the tube is ionized by a sufficiently strong electric field. Once the threshold voltage is exceeded, the lamp has negligible resistance. The capacitor stores electrical energy, which can be released to flash the lamp. Assume that $C = 0.150\,\mu\text{F}$, $R = 2.35 \times 10^6\,\Omega$, $V_0 = 90.0\,\text{V}$ and $\mathscr{E} = 105\,\text{V}$. (*a*) Assuming that the circuit is hooked up to the emf at time $t = 0$, at what time will the light first flash? (*b*) If the value of R is increased, will the time you found in part (*a*) increase or decrease? (*c*) The flashing of the lamp is very brief. Why? (*d*) Explain what happens after the lamp flashes for the first time.

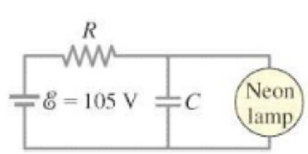

FIGURE 19–67 Problem 82.