14. What is the equivalent resistance of three resistors, each of resistance R, if they are connected to an ideal battery (a) in series with one another and (b) in parallel with one another? (c) Is the potential difference across the series arrangement greater than, less than, or equal to that across the parallel arrangement?

64. A circuit containing five resistors connected to a battery with a 12.0 V emf is shown in Fig. 28-57. What is the potential difference across the 5.0 Ω resistor?
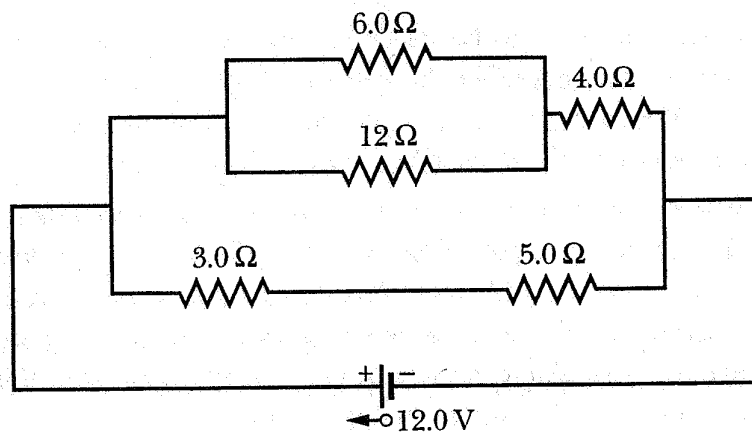

Fig. 28-57 Problem 64.

70. The switch in Fig. 28-61 is left closed for a long time so that the steady state is reached. Then at time $t = 0$ the switch is opened. What is the current through the 15 kΩ resistor at $t = 4.00$ ms?
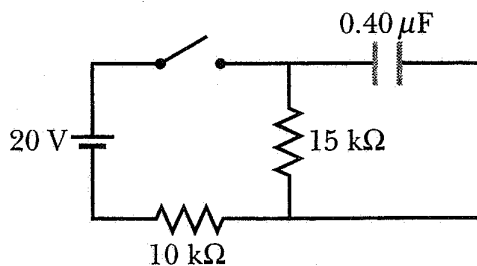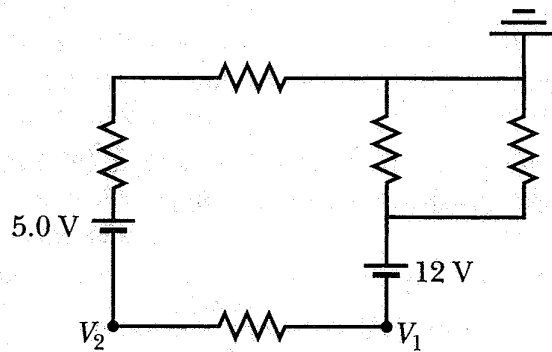

Fig. 28-61 Problem 70.

73. What are the potentials (a) V_1 and (b) V_2 at the points indicated in Fig. 28-64, where each resistance is 2.0 Ω? (The symbol at the upper right indicates that the circuit is grounded there; the potential is defined to be zero at that point.)

28

573

Fig. 28-64 Problem 73.

86. The circuit of Fig. 28-70 shows a capacitor, two ideal batteries, two resistors, and a switch S. Initially S has been open for a long time. If it is then closed for a long time, by how much does the charge on the capacitor change? Assume $C = 10~\mu F$, $\mathscr{E}_1 = 1.0$ V, $\mathscr{E}_2 = 3.0$ V, $R_1 = 0.20~\Omega$, and $R_2 = 0.40~\Omega$.
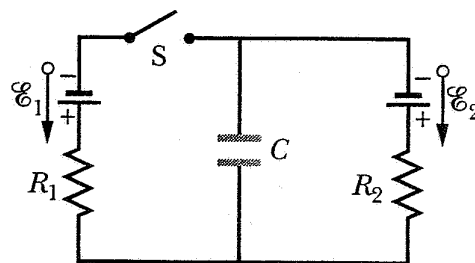
28

586

Fig. 28-70 Problem 86.

88. The capacitor in Fig. 28-72 is uncharged when the switch is closed. What are the initial currents through (a) the 10 kΩ resistor and (b) the 20 kΩ resistor? (c) What is the current through the 10 kΩ resistor a very long time after the switch is closed?
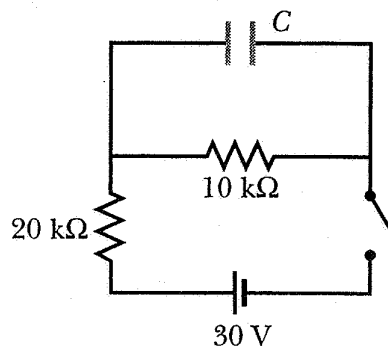
Fig. 28-72 Problem 88.

68. A metal wire of mass m slides without friction on two horizontal rails spaced a distance d apart, as in Fig. 29-53. The track lies in a vertical uniform magnetic field $\vec{B}$. There is a constant current i through generator G, along one rail, across the wire, and back down the other rail. Find the speed and direction of the wire's motion as a function of time t, assuming it to be stationary at $t = 0$.
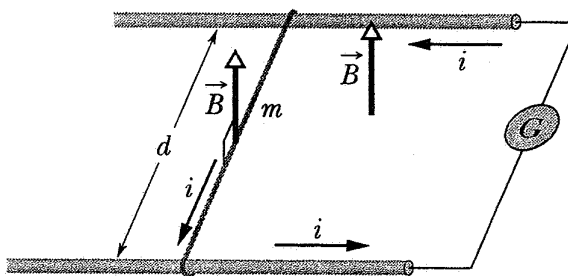

Fig. 29-53 Problem 68.

59. Figure 30-72a shows a cross section of a hollow cylindrical conductor of radii a and b, carrying a uniformly distributed current i. (a) Show that the magnetic field magnitude $B(r)$ for the radial distance r in the range $b < r < a$ is given by

$$B = \frac{\mu_0 i}{2\pi(a^2 - b^2)} \frac{r^2 - b^2}{r}.$$

(b) Show that when $r = a$, this equation gives the magnetic field magnitude B at the surface of a long straight wire carrying current i; when $r = b$, it gives zero magnetic field; and when $b = 0$, it gives the magnetic field inside a solid conductor of radius a carrying current i. (c) Assume that $a = 2.0$ cm, $b = 1.8$ cm, and $i = 100$ A, and plot $B(r)$ for the range $0 < r < 6$ cm.
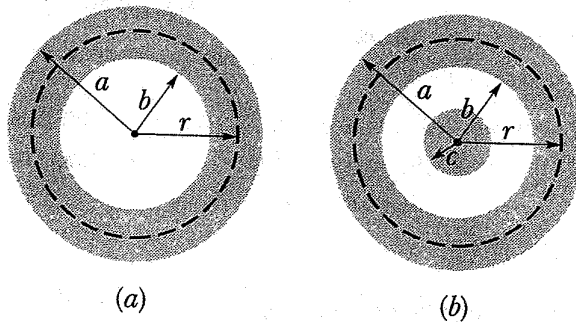

(a) (b)

Fig. 30-72 Problems 59 and 60.

100. In Fig. 31-94 a conducting rod of mass m and length L slides without friction on two long horizontal rails. A uniform vertical magnetic field $\vec{B}$ fills the region in which the rod is free to move. The generator G supplies a constant current i directed as shown. (a) Find the velocity of the rod as a function of time, assuming it to be at rest at $t = 0$. The generator is now replaced with a battery that supplies a constant emf $\mathscr{E}$. (b) Show that the velocity of the rod now approaches a constant terminal value $\vec{v}$ and give its magnitude and direction. (c) What is the current in the rod when this terminal velocity is reached? (d) Analyze this situation and that with the generator from the point of view of energy transfers.
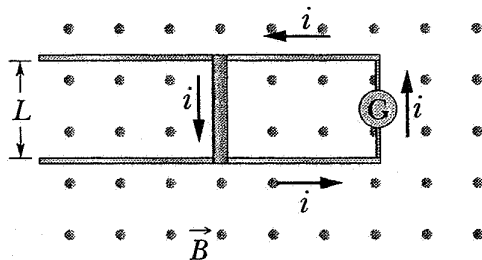
$$\frac{3\,/}{5\,/\,0\,0}$$

Fig. 31-94 Problem 100.

$$\frac{3\,/}{5\,/\,0\,4}$$

104. Figure 31-97 shows a closed loop of wire that consists of a pair of equal semicircles, of radius 3.7 cm, lying in mutually perpendicular planes. The loop was formed by folding a plane circular loop along a diameter until the two halves became perpendicular. A uniform magnetic field $\vec{B}$ of magnitude 76 mT is directed perpendicular to the fold diameter and makes equal angles (of 45°) with the planes of the semicircles. The magnetic field is reduced to zero at a uniform rate during a time interval of 4.5 ms. Determine the magnitude of the induced emf and the direction of the induced current in the loop during this interval.
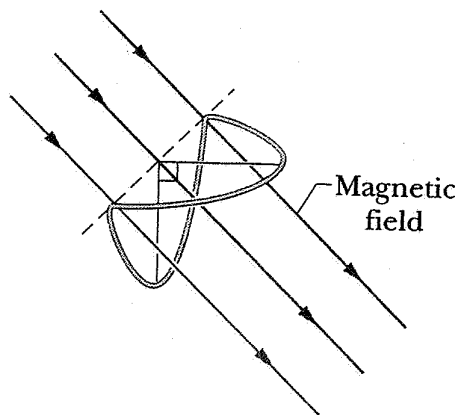

Fig. 31-97 Problem 104.