2.49 For the circuit shown in Figure P2.49, find the equivalent resistance, where $R_1 = 5\ \Omega$, $R_2 = 1\text{ k}\ \Omega$, $R_3 = R_4 = 100\ \Omega$, $R_5 = 9.1\ \Omega$ and $R_6 = 1\text{ k}\ \Omega$.

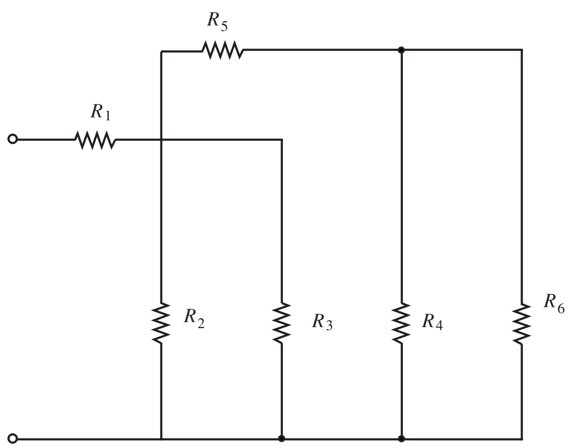

Figure P2.49

2.50 Cheap resistors are fabricated by depositing a thin layer of carbon onto a nonconducting cylindrical substrate (see Figure P2.50). If such a cylinder has radius a and length d, determine the thickness of the film required for a resistance R if

$$a = 1\text{ mm} \qquad R = 33\text{ k}\Omega$$
$$\sigma = \frac{1}{\rho} = 2.9\text{ M}\frac{\text{S}}{\text{m}} \qquad d = 9\text{ mm}$$

Neglect the end surfaces of the cylinder and assume that the thickness is much smaller than the radius.

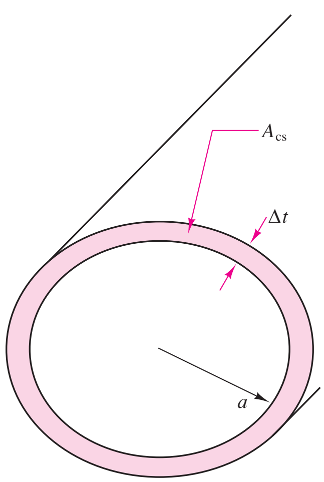

Figure P2.50

2.51 The resistive elements of fuses, lightbulbs, heaters, etc., are significantly nonlinear (i.e., the resistance is dependent on the current through the element). Assume the resistance of a fuse (Figure P2.51) is given by the expression $R = R_0[1 + A(T - T_0)]$ with $T - T_0 = kP$; $T_0 = 25°\text{C}$; $A = 0.7[°\text{C}]^{-1}$; $k = 0.35°\text{C/W}$; $R_0 = 0.11\ \Omega$; and P is the power dissipated in the resistive element of the fuse. Determine the rated current at which the circuit will melt and open, that is, "blow" (*Hint:* The fuse blows when R becomes infinite.)

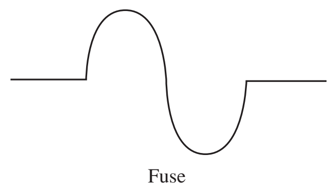

Figure P2.51

2.52 Use Kirchhoff's current law and Ohm's law to determine the current in each of the resistors R_4, R_5, and R_6 in the circuit of Figure P2.52. $V_S = 10$ V, $R_1 = 20\ \Omega$, $R_2 = 40\ \Omega$, $R_3 = 10\ \Omega$, $R_4 = R_5 = R_6 = 15\ \Omega$.

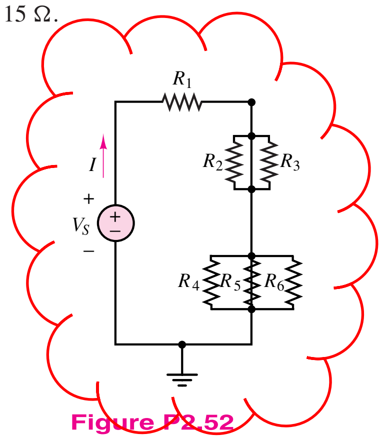

Figure P2.52

2.53 With reference to Problem 2.13, use Kirchhoff's current law and Ohm's law to find the resistances R_1, R_2, R_3, R_4, and R_5 if $R_0 = 2\ \Omega$. Assume $R_4 = \frac{2}{3}R_1$ and $R_2 = \frac{1}{3}R_1$.

2.54 Assuming $R_1 = 2\ \Omega$, $R_2 = 5\ \Omega$, $R_3 = 4\ \Omega$, $R_4 = 1\ \Omega$, $R_5 = 3\ \Omega$, $I_2 = 4$ A, and $V_S = 54$ V in the circuit of Figure P2.13, use Kirchhoff's current law and Ohm's law to find

a. I_0, I_1, I_3, and I_S. b. R_0.

2.55 Assuming $R_0 = 2\ \Omega$, $R_1 = 1\ \Omega$, $R_2 = 4/3\ \Omega$, $R_3 = 6\ \Omega$, and $V_S = 12$ V in the circuit of Figure P2.55, use Kirchhoff's voltage law and Ohm's law to find

a. i_a, i_b, and i_c.

b. The current through each resistance.