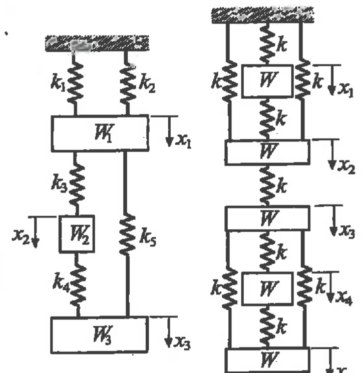
12. ■ The displacement formulation for the mass-spring system shown in Fig. (a) results in the following equilibrium equations of the masses

$$\begin{bmatrix} k_1+k_2+k_3+k_5 & -k_3 & -k_5 \\ -k_3 & k_3+k_4 & -k_4 \\ -k_5 & -k_4 & k_4+k_5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} W_1 \\ W_2 \\ W_3 \end{bmatrix}.$$

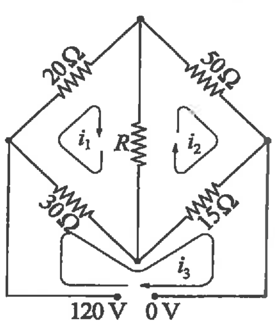
where k_i are the spring stiffnesses, W_i represent the weights of the masses, and x_i are the displacements of the masses from the undeformed configuration of the system. Write a program that solves these equations for given $\mathbf{k}$ and $\mathbf{W}$. Use the program to find the displacements if

$$k_1 = k_3 = k_4 = k \qquad k_2 = k_5 = 2k$$
$$W_1 = W_3 = 2W \qquad W_2 = W$$



(a) (b)

17. ■



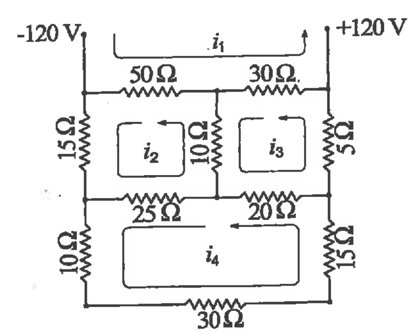
The electrical network shown can be viewed as consisting of three loops. Applying Kirchoff's law ($\sum$voltage drops = $\sum$voltage sources) to each loop yields the following equations for the loop currents i_1, i_2 and i_3:

$$(50+R)i_1 - Ri_2 - 30i_3 = 0$$
$$-Ri_1 + (65+R)i_2 - 15i_3 = 0$$
$$-30i_2 - 15i_2 + 45i_3 = 120$$

$-30i_1$

Compute the three loop currents for $R = 5\ \Omega$, $10\ \Omega$, and $20\ \Omega$.

18. ■



Determine the loop currents i_1 to i_4 in the electrical network shown.