## Problems

**2.1** For the circuit shown in Fig. P2.1, select node $d$ as the reference node. (a) Use nodal analysis to find the node voltages. (b) Use the node voltages to determine $i_1$, $i_2$, $i_3$, and $i_4$.

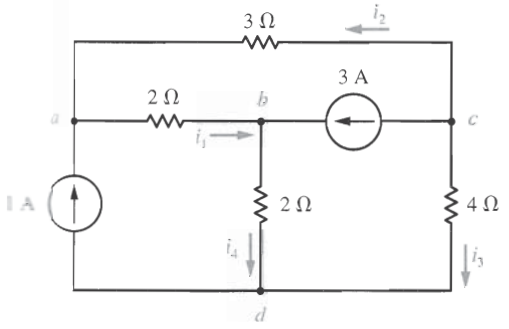


Fig. P2.1

**2.2** For the circuit shown in Fig. P2.1, select node $c$ as the reference node. (a) Use nodal analysis to find the node voltages. (b) Use the node voltages to determine $i_1$, $i_2$, $i_3$, and $i_4$.

**2.3** For the circuit shown in Fig. P2.1, select node $b$ as the reference node. (a) Use nodal analysis to find the node voltages. (b) Use the node voltages to determine $i_1$, $i_2$, $i_3$, and $i_4$.

**2.4** For the circuit shown in Fig. P2.1, select node $a$ as the reference node. (a) Use nodal analysis to find the node voltages. (b) Use the node voltages to determine $i_1$, $i_2$, $i_3$, and $i_4$.

**2.5** Find the node voltages for the circuit shown in Fig. P2.5.

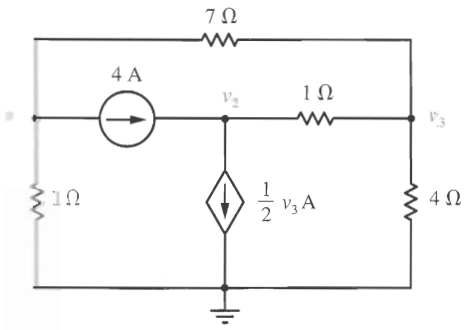


Fig. P2.5

**2.6** Find the node voltages for the circuit shown in Fig. P2.6.

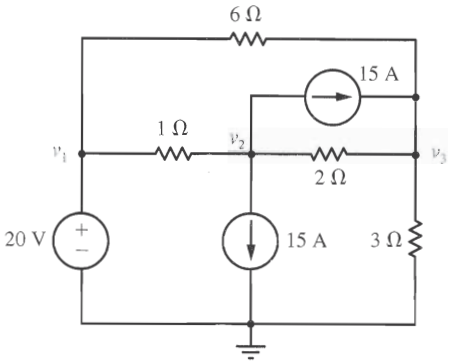


Fig. P2.6

**2.7** Find the node voltages for the circuit shown in Fig. P2.7. (See p. 100.)

**2.8** Find the node voltages for the circuit shown in Fig. P2.8.

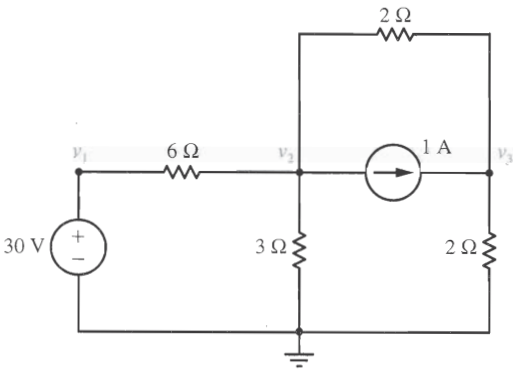


Fig. P2.8

**2.9** Find the node voltages for the circuit shown in Fig. P2.9.

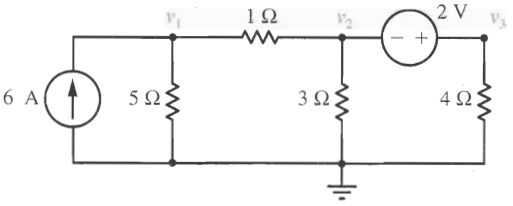


Fig. P2.9

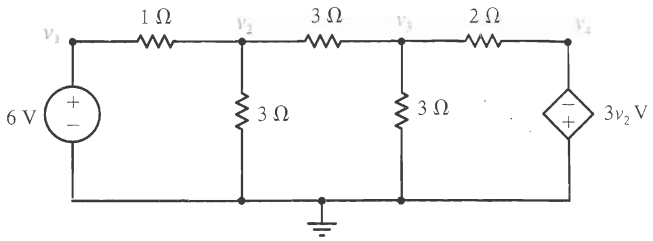


Fig. P2.7

**2.10** Find the node voltages for the circuit shown in Fig. P2.10.

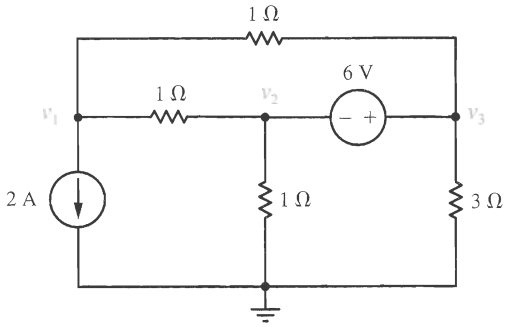


Fig. P2.10

**2.11** Fig. P2.11 shows a single transistor amplifier circuit where the portion in the shaded box is the ***hybrid-*** or ***h-parameter model*** of a bipolar junction transistor (BJT). Note that $h_i$ is a resistance and $h_o$ is a conductance. Suppose that $h_i = 1$ kΩ, $h_r = 2.5 \times 10^{-4}$, $h_f = 50$, and $h_o = 25$ μ℧. (a) Use nodal analysis to find the voltage gain $v_2/v_1$ of this amplifier. (b) Determine the input resistance $v_1/i_1$ of this amplifier.

**2.12** Fig. P2.11 shows a single transistor amplifier circuit where the portion in the shaded box is the hybrid- or *h*-parameter model of a BJT. Note that $h_i$ is a resistance and $h_o$ is a conductance. Use nodal analysis to show that the voltage gain $v_2/v_1$ of this amplifier is

$$\frac{v_2}{v_1} = \frac{-h_f R_L}{h_i + (h_i h_o - h_f h_r)R_L}$$

**2.13** Fig. P2.11 shows a single transistor amplifier circuit where the portion in the shaded box is the hybrid- or *h*-parameter model of a BJT. Note that $h_i$ is a resistance and $h_o$ is a conductance. Use the result given in Problem 2.12 to show that the input resistance $v_1/v_1$ of this amplifier is

$$\frac{v_1}{i_1} = h_i - \frac{h_f h_r}{h_o + 1/R_L}$$

**2.14** The circuit shown in Fig. P2.14 is a single BJT amplifier with "feedback." The portion of the circuit in the shaded box is an approximate T-model of a transistor in the common-emitter configuration. (a) Use nodal analysis to find the voltage gain

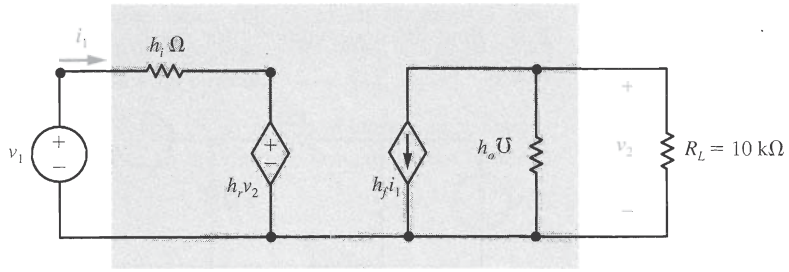


Fig. P2.11