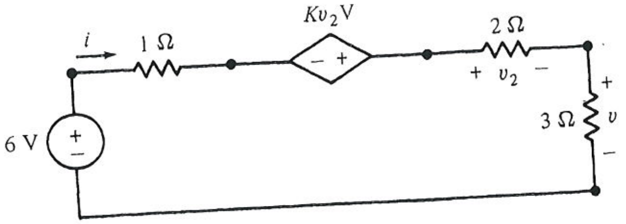

Fig. P1.42

1.42 Repeat Problem 1.41 for the circuit given in Fig. P1.42.

1.43 For the circuit shown in Fig. P1.43, find the output voltage v_2 in terms of the input voltage v_1. Also find $R_{eq} = v_1/i_1$.

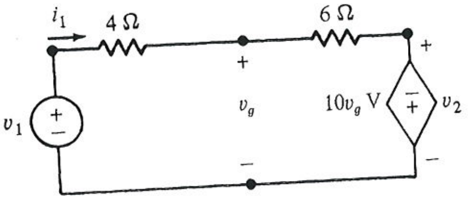

Fig. P1.43

1.44 Consider the circuit given in Fig. P1.44.
(a) Use voltage division to find v in terms of v_g.
(b) Find the output voltage v_2 in terms of the input voltage v_1.

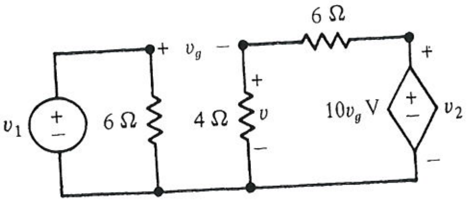

Fig. P1.44

✓**1.45** Given the circuit shown in Fig. P1.45:
(a) Find i_s.
(b) Find the resistance $R_{eq} = v_s/i_s$ seen by the current source.

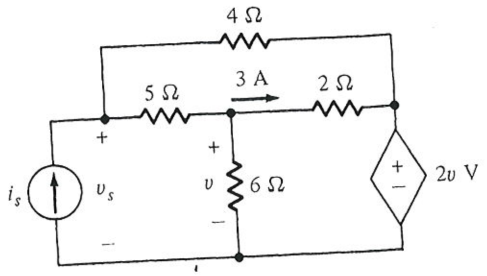

Fig. P1.45

1.46 For the circuit given in Fig. P1.45, change the 3-Ω resistor to a 5-Ω resistor and repeat Problem 1.45.

hwk

1.47 Given the circuit shown in Fig. P1.47:
(a) Find v_s.
(b) Find the resistance $R_{eq} = v_s/i_s$ seen by the voltage source.

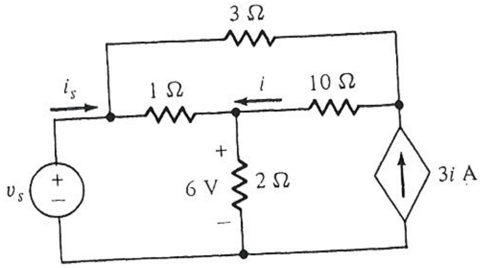

Fig. P1.47

1.48 For the circuit given in Fig. P1.47, change the 10-Ω resistor to an 8-Ω resistor and repeat Problem 1.47.

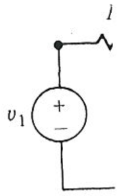

Fig. P1.4

1.49 Th
sin
circ
tive
(a)
(b)
(c)

1.50 Co
1.4
(a)
(b)
(c)

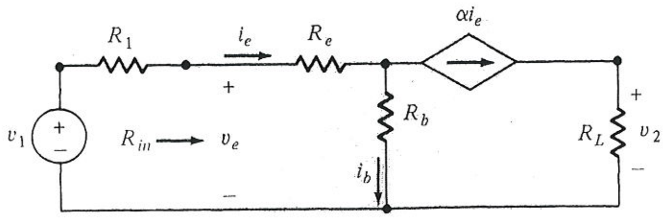

Fig. P1.49

1.49 The circuit in Fig. P1.49 is another single BJT amplifier. The portion of the circuit in the colored box is an alternative model of a BJT.

(a) Find i_e in terms of the various resistors, α, and the input voltage v_1.

(b) Find v_2 in terms of the resistors, α, and v_1.

(c) Given that $R_1 = 40\ \Omega$, $R_e = 27\ \Omega$, $R_b = 150\ \Omega$, $R_L = 1.5\ \text{k}\Omega$, and $\alpha = 0.98$, find the voltage gain v_2/v_1.

1.50 Consider the circuit given in Problem 1.49 and the values given in part (c).

(a) Find the resistance $R_{eq} = v_1/i_e$ seen by the voltage source.

(b) Find the resistance $R_{in} = v_e/i_e$ at the input of the amplifier.

(c) Find the voltage gain v_2/v_e.

1.51 For the circuit in Fig. 1.45 (p. 28), find the power absorbed by each element.

1.52 For the circuit in Fig. 1.46 (p. 29), find the power absorbed by each element.

1.53 For the circuit in Fig. 1.47 (p. 30), find the power absorbed by each element.

1.54 For the circuit given in Fig. P1.41, find the power absorbed by each element for (a) $K = 2$ and (b) $K = 4$.

1.55 For the circuit given in Fig. P1.42, find the power absorbed by each element for (a) $K = 2$ and (b) $K = 4$.

hwk 4

1.56 For the single BJT amplifier given in Problem 1.49, find the power gain p_2/p_1 from source to load, where p_1 is the power supplied by the independent voltage source v_1 and p_2 is the power absorbed by the load $R_L = 1.5\ \text{k}\Omega$.

V

P1.45,
sistor

P1.47:

$_s$ seen

i A

P1.47,
resis-

In general, when an independent voltage source is connected between a nonreference node and the reference node, the voltage of the nonreference node is constrained by the voltage source and therefore is obtained by inspection.

To determine the remaining voltage variables v_2 and v_3, we proceed as before. By KCL at node v_2,

$$2(v_2 - v_1) + 2v_2 + 4(v_2 - v_3) = 0$$

Using the fact that $v_1 = 3$ V, simplifying this expression results in

$$8v_2 - 4v_3 = 6 \tag{2.14}$$

At node v_3, by KCL,

$$4(v_3 - v_2) + \tfrac{1}{2}v_2 + 4v_3 = 0$$

from which

$$-7v_2 + 16v_3 = 0 \tag{2.15}$$

(Note the simplicity of dealing with the voltage-dependent current source.)

Solving Equations (2.14) and (2.15) results in

$$v_2 = 0.96 \text{ V} \qquad \text{and} \qquad v_3 = 0.42 \text{ V}$$

Since $i_1 = 2(v_1 - v_2) = 2(3 - 0.96) = 4.08$ A, then the conductance seen by the voltage source is

$$G_{eq} = \frac{i_1}{v_1} = \frac{4.08}{3} = 1.36 \text{ S}$$

Furthermore, now we can use KCL at node v_1 to determine i_2. Specifically,

$$i_2 = -i_1 = -4.08 \text{ A}$$

A dependent voltage source that is connected between the reference node and a nonreference node is treated similarly to that for an independent voltage source. Specifically, the value and polarity of the dependent source determines, by inspection, the equation for that nonreference node—KCL is not applied at that node. However, after the nodal analysis of the circuit is completed, KCL can be applied at that nonreference node in order to determine the current through the dependent voltage source.

h.w 4

DRILL EXERCISE 2.4

For the circuit shown in Fig. DE2.4, find the node voltages v_1, v_2, v_3, and v_4. In addition, find the conductance seen by the independent voltage source and the current going down through the dependent voltage source.

Answer: 25 V; 3 V; −6 V; −1 V; 0.88 S; 20 A nwb 4

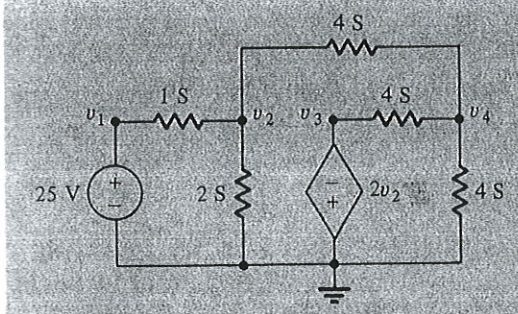

Fig. DE2.4

Now let us consider the situation that a circuit contains a voltage source that is connected between two nonreference nodes.

EXAMPLE 2.5

The circuit shown in Fig. 2.10 has an independent voltage source connected between two nonreference nodes. Let us determine the node voltages v_1, v_2, and v_3 by using nodal analysis.

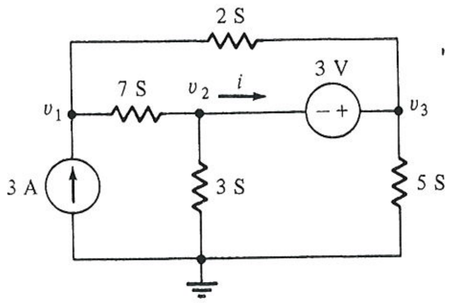

Fig. 2.10 Circuit with voltage source connected between nonreference nodes.

By KCL at node v_1 we get

$$7(v_1 - v_2) + 2(v_1 - v_3) - 3 = 0$$

from which

$$9v_1 - 7v_2 - 2v_3 = 3 \tag{2.16}$$

and this is the first of the three equations needed to solve for the three voltage variables v_1, v_2, and v_3.