9. Calculate the power dissipated in the 1 Ω resistor of Fig. 4.35.

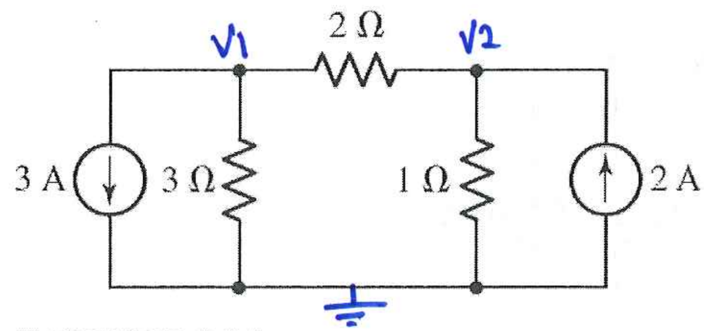


FIGURE 4.35

$-3 = \frac{v_1}{3} + \frac{v_1 - v_2}{2}$

$\left[\frac{v_1}{3} + \frac{v_1}{2} - \frac{v_2}{2} = -3\right] \times 6$

$2v_1 + 3v_1 - 3v_2 = -18$

$5v_1 - 3v_2 = -18$

$\begin{bmatrix} 5 & -3 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} -18 \\ 4 \end{bmatrix}$

$2 = \frac{v_2}{1} + \frac{v_2 - v_1}{2}$

$\left[-\frac{v_1}{2} + \frac{v_2}{1} + \frac{v_2}{2} = 2\right] \times 2$

$-v_1 + 2v_2 + v_2 = 4$

$-1v_1 + 3v_2 = 4$

$\begin{vmatrix} 5 & -3 \\ -1 & 3 \end{vmatrix} = D = (5)(3) - (-3)(-1) = 12$

$\begin{vmatrix} -18 & -3 \\ 4 & 3 \end{vmatrix} = D_{v1} = (-18)(3) - (4)(-3) = -42$

$v_1 = \frac{D_{v1}}{D} = \frac{-42}{12} = \boxed{-3.5\,V = v_1}$

$\begin{vmatrix} 5 & -18 \\ -1 & 4 \end{vmatrix} = D_{v2} = (5)(4) - (-1)(-18) = 2$

$v_2 = \frac{D_{v2}}{D} = \frac{2}{12} = \boxed{\frac{1}{6}\,V = v_2}$

10. With the assistance of nodal analysis, determine $v_1 - v_2$ in the circuit shown in Fig. 4.36.

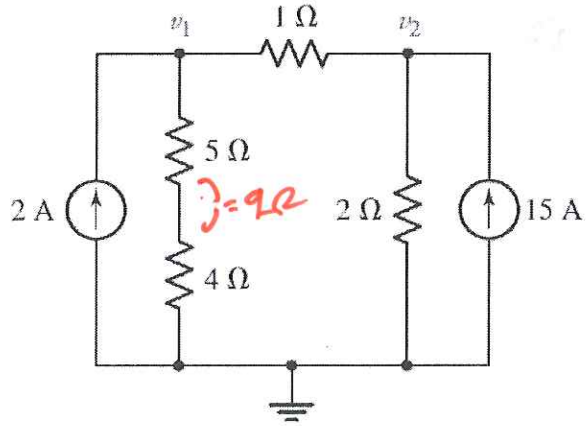


FIGURE 4.36

$$\left[2 = \frac{v_1}{9} + \frac{v_1 - v_2}{1}\right] \times 9$$

$$v_1 + 9v_1 - 9v_2 = 18$$

$$10v_1 - 9v_2 = 18$$

$$\left[15 = \frac{v_2}{2} + \frac{v_2 - v_1}{1}\right] \cdot 2$$

$$-2v_1 + 3v_2 = 30$$

$$-2v_1 + 3v_2 = 30$$

$$\begin{bmatrix} 10 & -9 \\ -2 & 3 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 18 \\ 30 \end{bmatrix}$$

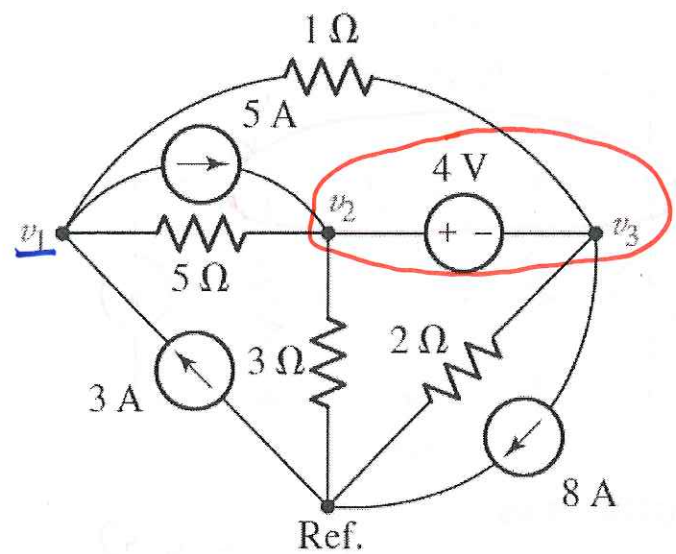
From MATLAB: $v_1 = 27V$

$v_2 = 28V$

$v_1 - v_2 =$ ~~[illegible]~~ $-1V$

②

18. Determine the nodal voltages as labeled in Fig. 4.44, making use of the supernode technique as appropriate.



O = super node

$$\boxed{3 = 5 + \frac{V1 - V3}{1} + \frac{V1 - V2}{5}}$$

$$\boxed{5 = \frac{V2 - V1}{5} + \frac{V3 - V1}{1} + 8 + \frac{V3 - 0}{2} + \frac{V2 - 0}{3}}$$

19. For the circuit shown in Fig. 4.45, determine a numerical value for the voltage labeled v_1.

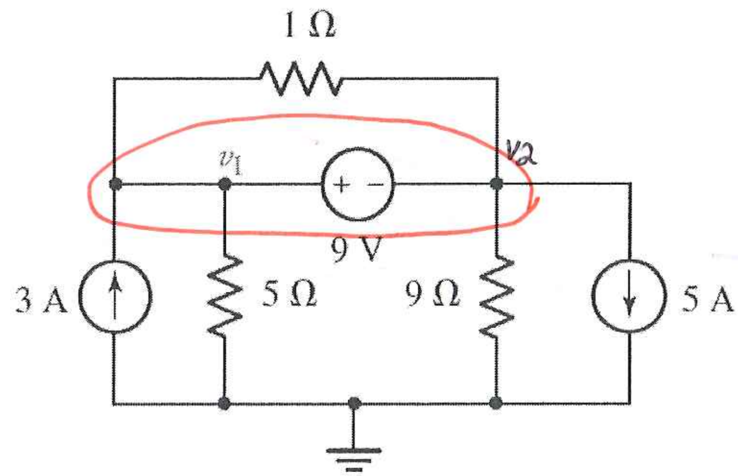


FIGURE 4.45

$V_1 - V_2 = 9V$ $\quad V_1 = \frac{9}{V_2}$ $\quad V_2 = \frac{9}{V_1}$ $\quad V_2 = (V_1 - 9)$

$\left[3 = 5 + \frac{V_1 - 0}{5} + \frac{V_2 - 0}{9} \right] 45$

$135 = 225 + 9V_1 + 5V_2$

$135 = 225 + 9V_1 + 5(V_1 - 9)$

$\frac{-45}{14} = \frac{14V_1}{14}$ $\quad V_1 = -3.214V$

④

20. For the circuit of Fig. 4.46, determine all four nodal voltages.

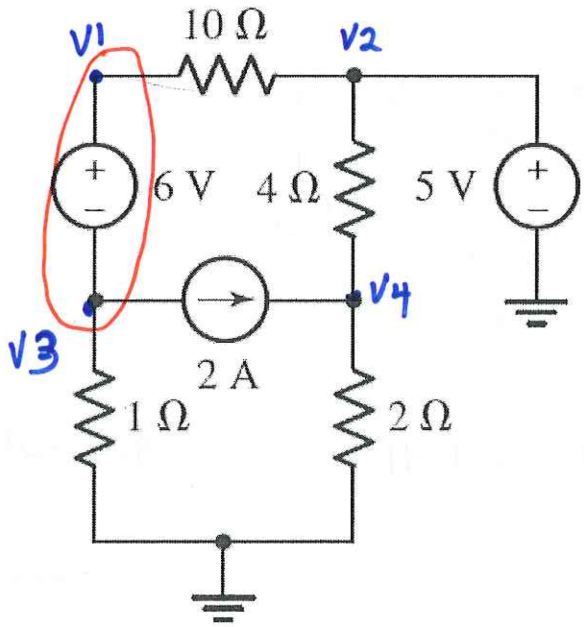


FIGURE 4.46

$\boxed{v_2 = 5V}$

$4\left[2 = \frac{v_4}{2} + \frac{v_4 - v_2}{4}\right] \Rightarrow 8 = 2v_4 + 2v_4 - 2v_2$ $\quad v_2 = 5$

$\cancel{8 = 2v_4 + 2 \cdot 10}$ $\quad \cancel{6v_4 = 18/6 \quad v_4 = 3V}$

$-2 = \frac{v_1 - v_2}{10} + \frac{v_3}{1}$

$8 = 2v_4 + v_4 - v_2$

$\left[v_3 = -2 + \frac{(v_2 - v_1)}{10}\right] 10$

$8 = 3v_4 - 5$

$13 = 3v_4$

$\boxed{v_4 = \frac{13}{3} V}$

$v_1 - v_3 = 6V$

$v_1 = (6 + v_3)$

$\boxed{V_1 = 6 + \frac{-21}{11} = 4.09V}$

$10v_3 = -20 + v_2 - v_1$

$10v_3 = -20 + 5 - 6 - v_3$

$11v_3 = -21$

$\boxed{v_3 = \frac{-21}{11} V}$

31. Use mesh analysis as appropriate to determine the two mesh currents labeled in Fig. 4.57.

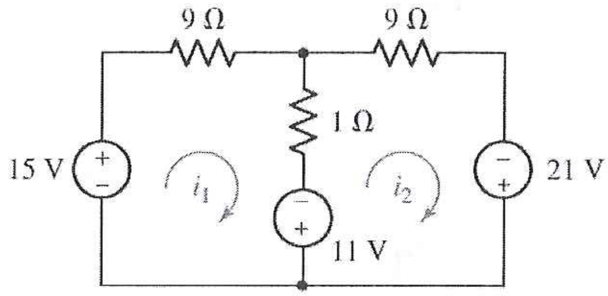


FIGURE 4.57

$$15 = 9i_1 + 1(i_1 - i_2) - 11$$

$$9i_2 - 21 + 11 + (i_2 - i_1) = 0$$

$$10i_1 - i_2 = 26$$

$$-i_1 + 10i_2 = 10$$

$$\begin{bmatrix} 10 & -1 \\ -1 & 10 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} 26 \\ 10 \end{bmatrix}$$

Solved with MATLAB:

$$\boxed{\begin{aligned} i_1 &= 2.7A \\ i_2 &= 1.3A \end{aligned}}$$

32. Determine numerical values for each of the three mesh currents as labeled in the circuit diagram of Fig. 4.58.

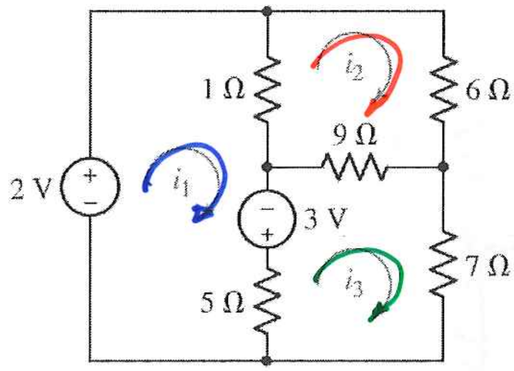


FIGURE 4.58

$2 = 1(i_1 - i_2) - 3 + 5(i_1 - i_3)$

$1(i_2 - i_1) + 6i_2 + 9(i_2 - i_3) = 0$

$5(i_3 - i_1) + 3 + 9(i_3 - i_2) + 7i_3 = 0$

$6i_1 - i_2 - 5i_3 = 5$

$-i_1 + 16i_2 + 9i_3 = 0$

$-5i_1 + 9i_2 + 21i_3 = -3$

See MATLAB

$i_1 = 989.2\,mA$

$i_2 = 150.1\,mA$

$i_3 = 157.0\,mA$

$$\begin{bmatrix} 6 & -1 & -5 \\ -1 & 16 & -9 \\ -5 & -9 & 21 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 0 \\ -3 \end{bmatrix}$$

4.4 The Supermesh

42. Determine values for the three mesh currents of Fig. 4.67.

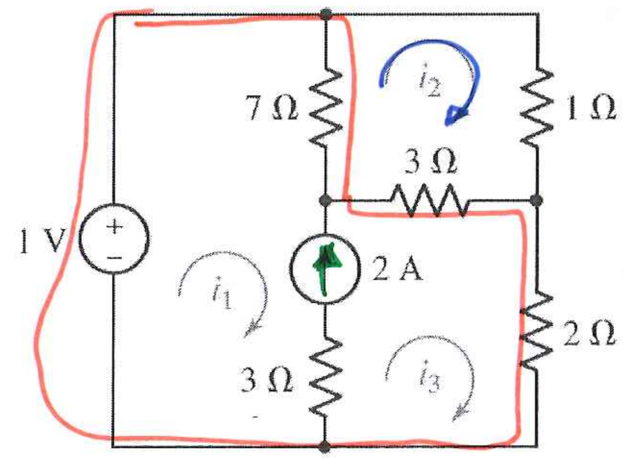


FIGURE 4.67

$1 = 7(i_1 - i_2) + 3(i_3 - i_2) + 2i_3$ $\quad 7i_1 - 10i_2 + 5i_3 = 1$

$0 = 1i_2 + 3(i_2 - i_3) + 7(i_2 - i_1)$ $\quad -7i + 11i_2 - 3i_3 = 0$

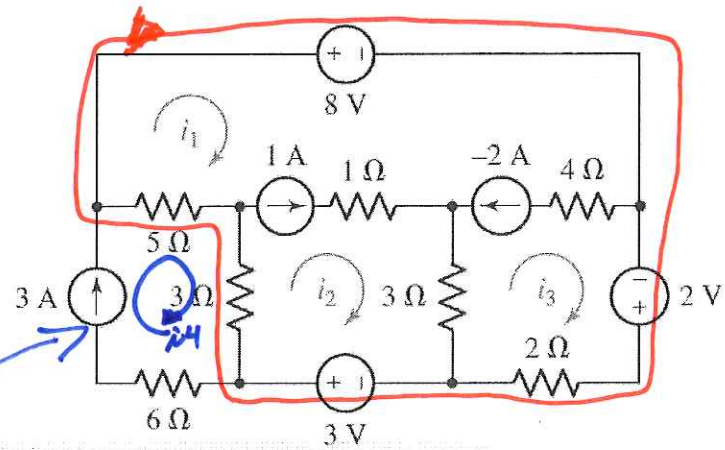
$i_3 - i_2 = 2$ $\quad -i_2 + i_3 = 2$

$$\begin{bmatrix} 7 & -10 & 5 \\ -7 & 11 & -3 \\ -\phi & 0 & 1 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}$$

See MATLAB

$i_1 = -1.2A$
$i_2 = -562.5mA$
$i_3 = 781.3mA$

46. Employing the supermesh technique to best advantage, obtain numerical values for each of the mesh currents identified in the circuit depicted in Fig. 4.71.



For super mesh analysis, follow paths without current sources.

= super mesh Eq ①

Define $i_4 = 3A$ Eq ②

Eq ③ relationship between i_2 + i_1

Eq ④ relationship between i_3 + i_1