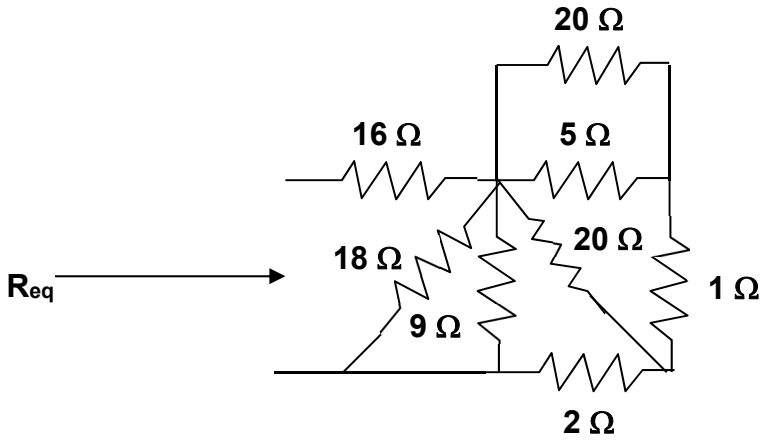
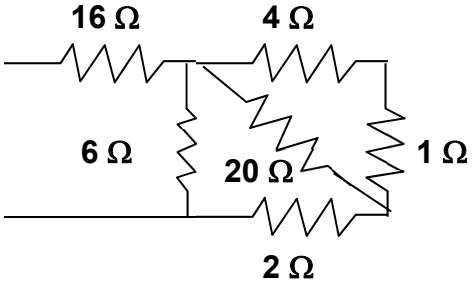
P.P.2.10

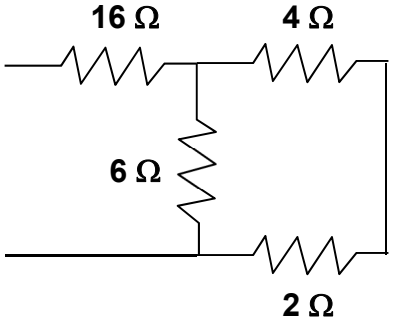


Combining the 9 ohm resistor and the 18 ohm resistor yields [9x18]/[9+18] = 6 ohms.

Combining the 5 ohm and the 20 ohm resistors in parallel produces [5x20/(5+20)] = 4 ohms We now have the following circuit:



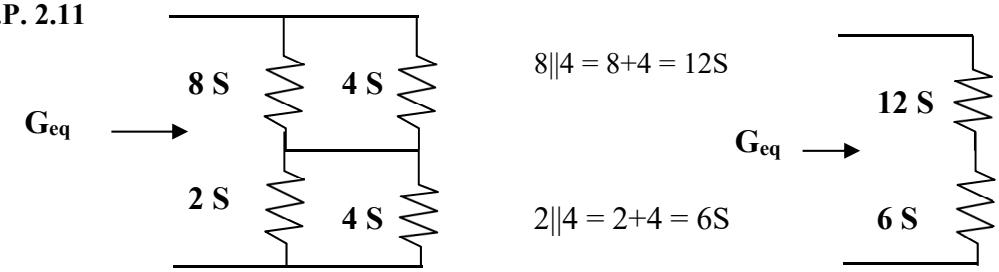
The 4 ohm and 1 ohm resistors can be combined into a 5 ohm resistor in parallel with a 20 ohm resistor. This will result in [5x20/(5+20)] = 4 ohms and the circuit shown below:



The 4 ohm and 2 ohm resistors are in series and can be replaced by a 6 ohm resistor. This gives a 6 ohm resistor in parallel with a 6 ohm resistor, [6x6/(6+6)] = 3 ohms. We now have a 3 ohm resistor in series with a 16 ohm resistor or 3 + 16 = 19 ohms. Therefore:

$$\mathbf{R_{eq} = 19 \text{ ohms}}$$

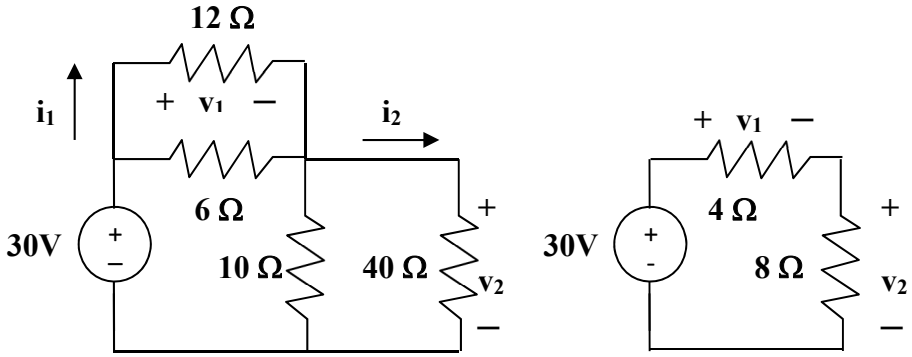
P.P. 2.11



$G_{eq} = 4$ S

12 S in series with 6 S = {12x6/(12+6)] = 4 or:

P.P.2.12



6||12 = [6x12/(6+12)] = 4 ohm and 10||40 = [10x40/(10+40)] = 8 ohm.

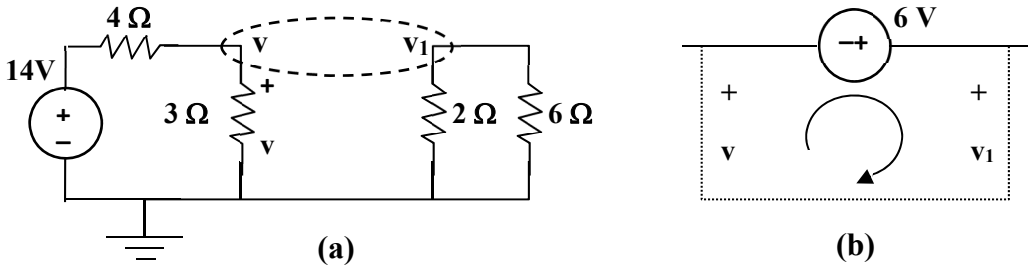
Using voltage division we get:

$v_1 = [4/(4+8)]\ (30) =$ **10 volts**, $v_2 = [8/12]\ (30) =$ **20 volts**

$i_1 = v_1/12 = 10/12 =$ **833.3 mA**, $i_2 = v_2/40 = 20/40 =$ **500 mA**

$P_1 = v_1\, i_1 = 10x10/12 =$ **8.333 watts**, $P_2 = v_2\, i_2 = 20x0.5 =$ **10 watts**

P.P.3.3



At the supernode in Fig. (a),

$$\frac{14 - v}{4} = \frac{v}{3} + \frac{v_1}{2} + \frac{v_1}{6}$$

or $42 = 7v + 8v_1$ (1)

Applying KVL to the loop in Fig. (b),

$$-v - 6 + v_1 = 0 \longrightarrow v_1 = v + 6 \quad (2)$$

Solving (1) and (2),

$$v = \mathbf{-400\ mV}$$

$$v_1 = v + 6 = 5.6,\ i_1 = \frac{v_1}{2} = 2.8$$

$$i_1 = \mathbf{2.8\ A}$$

P.P.3.5 We apply KVL to the two loops and obtain

$-45 + 2i_1 + 12(i_i - i_2) + 4i_1 = 0$ or

$-45 + 18i_i - 12i_2 = 0$ which leads to $3i_i - 2i_2 = 7.5$ (1)

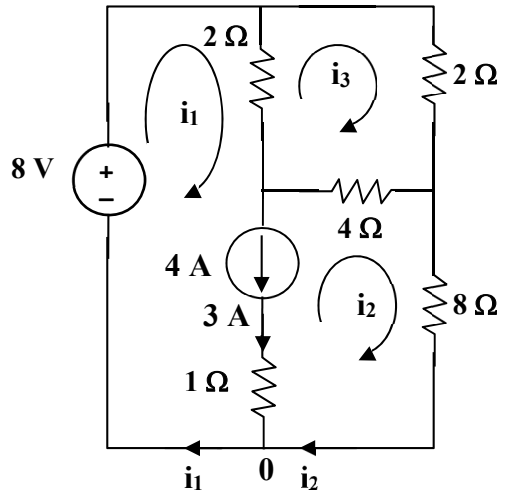
$12(i_2 - i_1) + 9i_2 + 30 + 3i_2 = 0$ or

$30 + 24i_2 - 12i_1 = 0$ which leads to $-3i_1 + 6i_2 = -7.5$ (2)

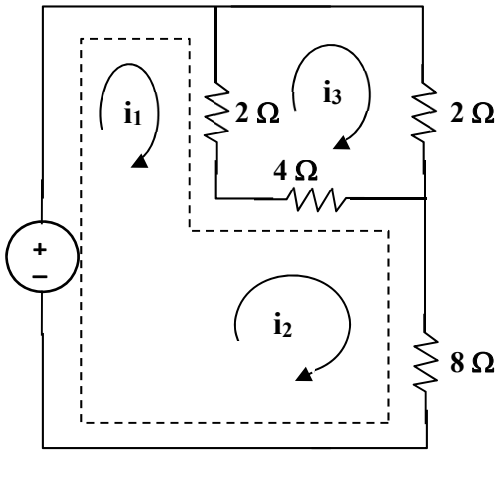
From (1) and (2) we get

$$i_1 = \mathbf{2.5\ A},\ i_2 = \mathbf{0A}$$

P.P.3.7



(a)



(b)

For the supermesh,

$$-8 + 2i_1 - 2i_3 + 12i_2 - 4i_3 = 0 \text{ or } i_1 + 6i_2 - 3i_3 = 4 \quad (1)$$

For mesh 3,

$$8i_3 - 2i_1 - 4i_2 = 0 \text{ or } -i_1 - 2i_2 + 4i_3 = 0 \quad (2)$$

At node 0 in Fig. (a),

$$i_1 = 4 + i_2 \longrightarrow i_1 - i_2 = 4$$

Solving (1) to (3) yields

$$i_1 = \mathbf{4.632\ A}, i_2 = \mathbf{631.6\ mA}, i_3 = \mathbf{1.4736\ A}$$

P.P.3.8 $G_{11} = 1/(1) + 1/(20) + 1/(5) = 1.25,\ G_{12} = -1/(5) = -0.2,$

$G_{33} = 1/(4) + 1 = 1.25, G_{44} = 1/(1) + 1/(4) = 1.25,$

$G_{12} = -1/(5) = -0.2, G_{13} = -1, G_{14} = 0,$

$G_{21} = -0.2, G_{23} = 0 = G_{26},$

$G_{31} = -1, G_{32} = 0, G_{34} = -1/4 = -0.25,$

$G_{41} = 0, G_{42} = 0, G_{43} = 0.25,$

$i_1 = 0, i_2 = 3+2 = 5, i_3 = -3, i_4 = 2.$

Hence,

$$\begin{bmatrix} \mathbf{1.25} & \mathbf{-0.2} & \mathbf{-1} & \mathbf{0} \\ \mathbf{-0.2} & \mathbf{0.2} & \mathbf{0} & \mathbf{0} \\ \mathbf{-1} & \mathbf{0} & \mathbf{1.25} & \mathbf{-0.25} \\ \mathbf{0} & \mathbf{0} & \mathbf{-0.25} & \mathbf{1.25} \end{bmatrix} \begin{bmatrix} \boldsymbol{v_1} \\ \boldsymbol{v_2} \\ \boldsymbol{v_3} \\ \boldsymbol{v_4} \end{bmatrix} = \begin{bmatrix} \mathbf{0} \\ \mathbf{5} \\ \mathbf{-3} \\ \mathbf{2} \end{bmatrix}$$

P.P.3.9 $R_{11} = 50 + 20 + 80 = 150, R_{22} = 20 + 30 + 15 = 65,$
$R_{33} = 30 + 20 = 50, R_{44} = 15 + 80 = 95,$

$R_{55} = 20 + 60 = 80, R_{12} = -20, R_{13} = 0, R_{14} = -80,$

$R_{15} = 0, R_{21} = -20, R_{23} = -30, R_{24} = -15, R_{25} = 0,$

$R_{31} = 0, R_{32} = -30, R_{34} = 0, R_{35} = -20,$

$R_{41} = -80, R_{42} = -15, R_{43} = 0, R_{45} = 0,$

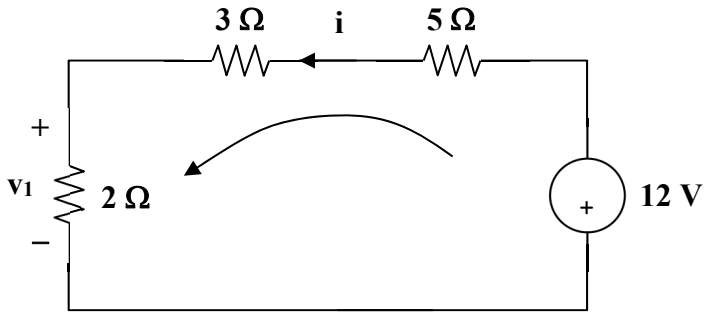
$R_{51} = 0, R_{52} = 0, R_{53} = -20, R_{54} = 0,$

$v_1 = 30, v_2 = 0, v_3 = -12, v_4 = 20, v_5 = -20$

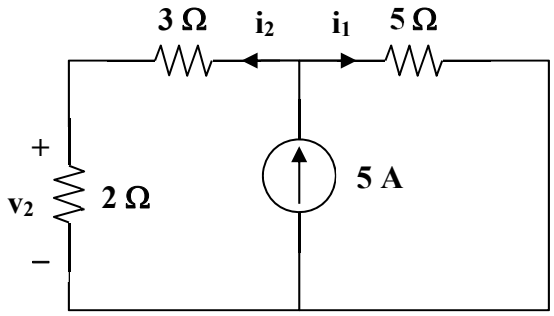
Hence the mesh-current equations are

$$\begin{bmatrix} 150 & -20 & 0 & -80 & 0 \\ -20 & 65 & -30 & -15 & 0 \\ 0 & -30 & 50 & 0 & -20 \\ -80 & -15 & 0 & 95 & 0 \\ 0 & 0 & -20 & 0 & 80 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \\ i_5 \end{bmatrix} = \begin{bmatrix} 30 \\ 0 \\ -12 \\ 20 \\ -20 \end{bmatrix}$$

P.P.4.3 Let $v_0 = v_1 + v_2$, where v_1 and v_2 are contributions to the 12–V and 5–A sources respectively.



(a)



(b)

To get v_1, consider the circuit in Fig. (a).

$(2 + 3 + 5)i - 12 = 0$ or $i = 12/(10) = 1.2$ A

$v_1 = 2i = 2.4$ V

To get v_2, consider the circuit in Fig. (b).

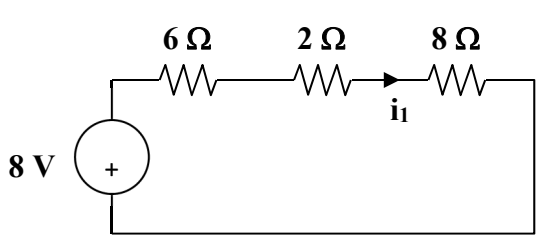
Since the resistors are equal (5 = 2 + 3) then the current divides equally and

$i_1 = i_2 = 5/2 = 2.5$ and $v_2 = 2i_2 = 5$ V

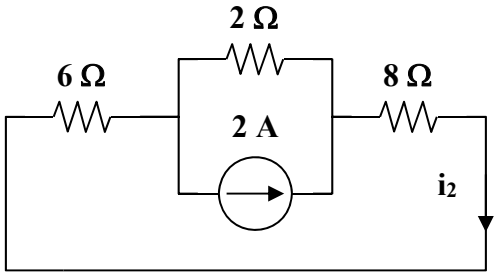
Thus, $v = v_1 + v_2 = 2.4 + 5 =$ **7.4 V**

P.P.4.5 Let $i = i_1 + i_2 + i_3$

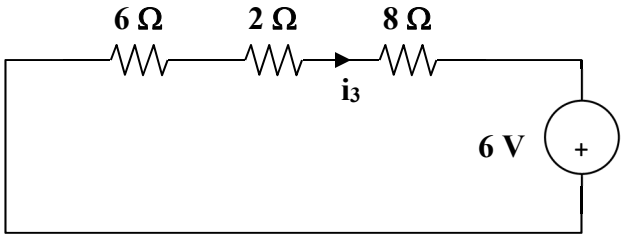
where i_1, i_2, and i_3 are contributions due to the 8-V, 2-A, and 6-V sources respectively.



(a)



(b)



(c)

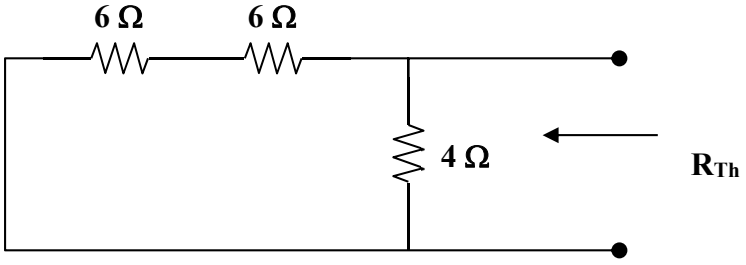
For i_1, consider Fig. (a), $i_1 = \dfrac{8}{6+2+8} = 0.5\,\text{A}$

For i_2, consider Fig. (b). By current division, $i_2 = \dfrac{2}{2+14}(2) = 0.25$

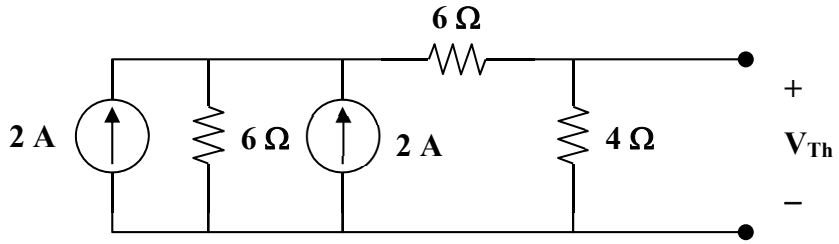
For i_3, consider Fig. (c), $i_3 = \dfrac{-6}{16} = -0.375\text{A}$

Thus, $i = i_1 + i_2 + i_3 = 0.5 + 0.25 - 0.375 =$ **375 mA**

.P.4.8 To find R_{Th}, consider the circuit in Fig. (a).



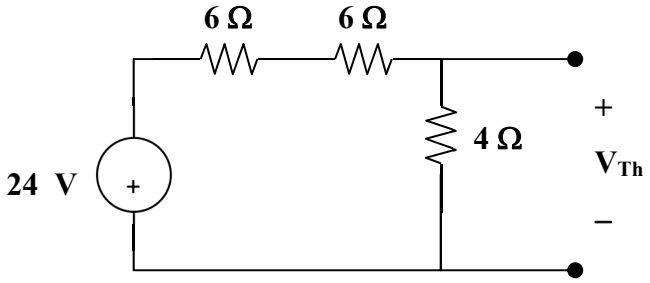
(a)



(b)

$$R_{Th} = (6+6)\|4 = \frac{12x4}{18} = \mathbf{3\Omega}$$

To find V_{Th}, we use source transformations as shown in Fig. (b) and (c).



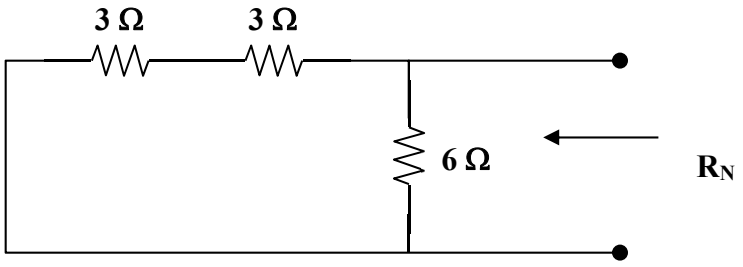
(c)

Using current division in Fig. (c),

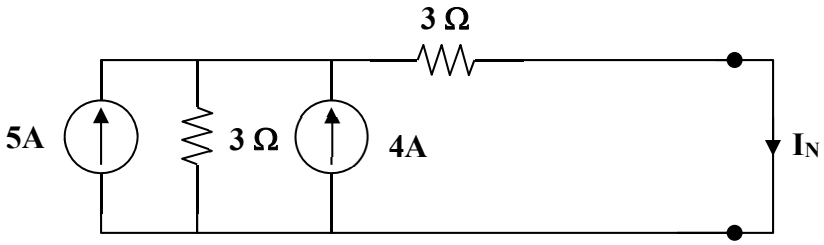
$$V_{Th} = \frac{4}{4+12}(24) = \mathbf{6\ V}$$

$$i = \frac{V_{Th}}{R_{Th}+1} = \frac{6}{3+1} = \mathbf{1.5\ A}$$

P.P.4.11



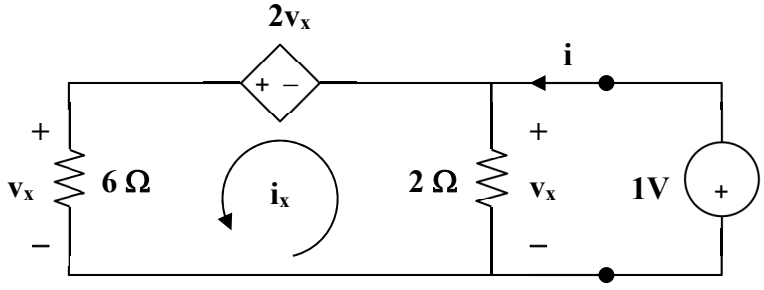
(a)



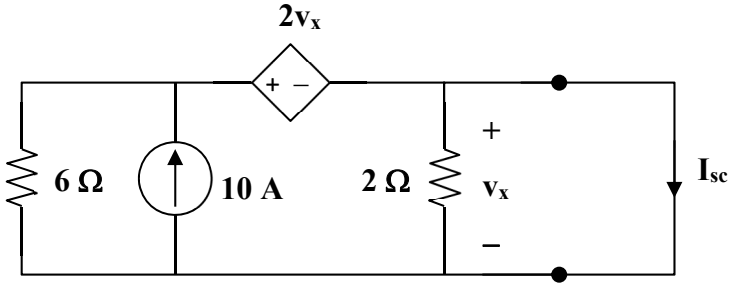
(b)

From Fig. (a), R_N = $(3+3)\|6 =$ **3 Ω**

From Fig. (b), I_N = $\frac{1}{2}(5+4) =$ **4.5A**

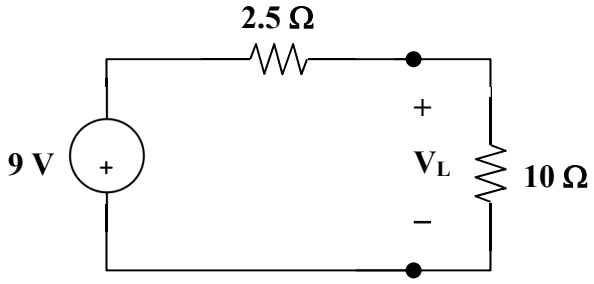


(a)



(b)

P.P.4.16 $V_{Th} = 9V$, $R_{Th} = \left(v_{oc} - V_L\right)\dfrac{R_L}{V_L} = (9-1)\dfrac{20}{8} = 2.5\Omega$



$$V_L = \frac{10}{10+2.5}(9) = \textbf{7.2 V}$$