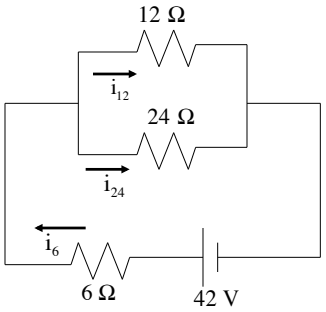
Problem 18.16a

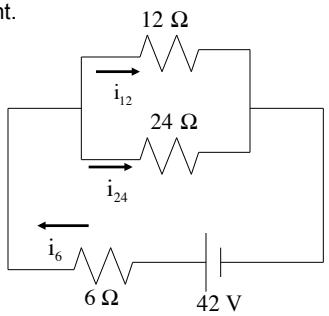
Use seat of pants to determine each current.

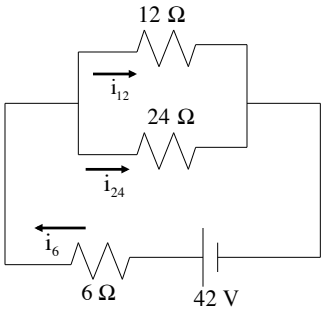


18.16a) Use seat of pants to determine each current.

$$R_{eq} = 6 + \left(\frac{1}{12} + \frac{1}{24}\right)^{-1}$$
$$= 6 + \left(\frac{1}{12} + \frac{1}{24}\right)^{-1}$$
$$= 14\ \Omega$$

$$V = i_6 R_{eq}$$
$$\Rightarrow \quad 42 = i_6 (14)$$
$$\Rightarrow \quad i_6 = \frac{42\ \text{V}}{14\ \Omega}$$
$$\Rightarrow \quad i_6 = 3\ \text{A}$$





The voltage across the two parallel resistors is:

$$V_{parallel} = 42 - (6\ \Omega)(3\ \text{A})$$
$$= 24\ \text{V}$$

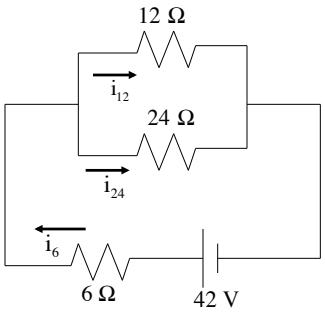
For the 12 ohm resistor, then:

$$V_{parallel} = 24 = (i_{12})(12\ \Omega)$$
$$\Rightarrow \quad i_{12} = 2\ \text{A}$$

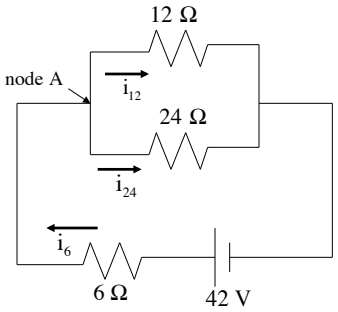
For the 24 ohm resistor, then:

$$V_{parallel} = 24 = (i_{12})(24\ \Omega)$$
$$\Rightarrow \quad i_{24} = 1\ \text{A}$$

Note that this makes sense. Because its resistance is lower by half, the 12 ohm resistor should have twice the current as the 24 ohm resistor . . . and the two currents have to sum to 3 amps.



b) Using Kirchoff's Laws:



node equation:

$$\sum i_{\text{into node A}} = \sum i_{\text{out of node A}}$$

$$i_6 = i_{12} + i_{24}$$

Loop I (including 24 ohm resistor):

$$\sum V = 0$$

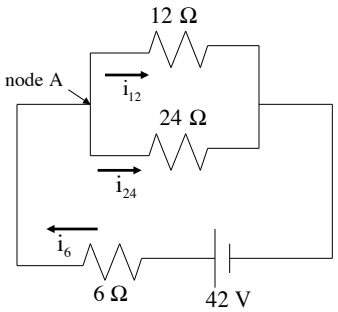
$$\Rightarrow \quad 42 - 6\, i_6 - 24\, i_{24} = 0$$

Loop 2 (including 12 ohm and 24 ohm resistor):

$$\sum V = 0$$

$$\Rightarrow \quad -12\, i_{12} + 24\, i_{24} = 0$$

b) Solving:



From Loop I:

$$42 - 6\, i_6 - 24\, i_{24} = 0$$

$$\Rightarrow \quad i_6 = \frac{42 - 24 i_{24}}{6}$$

$$\Rightarrow \quad i_6 = 7 - 4 i_{24}$$

From Loop 2:

$$-12\, i_{12} + 24\, i_{24} = 0$$

$$\Rightarrow \quad i_{12} = 2 i_{24}$$

From Node Equ:

$$i_6 = i_{12} + i_{24}$$

$$\Rightarrow \quad (7 - 4 i_{24}) = (2 i_{24}) + i_{24}$$

$$\Rightarrow \quad i_{24} = 1 \text{ A}$$

$$\Rightarrow \quad i_{12} = 2 \text{ A}$$

$$\Rightarrow \quad i_6 = 3 \text{ A}$$