Ex:

Calculate $v_3$, $i_4$, and $i_5$.

**Sol'n:** Current $i_5$ is the total current flowing in the resistors. The value of $i_5$ is that same as the current that will flow in the equivalent resistance for all the resistors when that equivalent resistance is placed across the 120 V source. Thus, we want to find the equivalent resistance of all the resistors.

\[ R_{eq} = 12 \Omega + 180 \Omega \parallel (2 \Omega + 18 \Omega) + 10 \Omega = 12 \Omega + 180 \Omega \parallel 20 \Omega + 10 \Omega \]

\[ = 12 \Omega + 20 \Omega \cdot \frac{9}{9+1} + 10 \Omega \]

\[ = 12 \Omega + 18 \Omega + 10 \Omega = 40 \Omega \]

Thus, by Ohm's law we have the following result:

\[ i_5 = \frac{120 \text{ V}}{40 \text{ A}} = 3 \text{ A} \]

Now that we know the total current in the circuit, we may observe that this current divides and flows through the 180 $\Omega$ and the $2 \Omega + 18 \Omega = 20 \Omega$. That is, we have a current divider. We can find $i_4$ using the current divider formula:

\[ i_4 = i_5 \cdot \frac{180 \Omega}{180 \Omega + 20 \Omega} = 3 \text{ A} \cdot \frac{180}{200} = 2.7 \text{ A} \]

Finally, we find $i_3$ by multiplying the current in the 180 $\Omega$ resistor (from the current divider formula) by the resistance of 180 $\Omega$. That is, we use Ohm's law:

\[ v_3 = i_5 \cdot \frac{20 \Omega}{180 \Omega + 20 \Omega} \cdot 180 \Omega = 3 \text{ A} \cdot \frac{1}{10} \cdot 180 \Omega = 54 \text{ V} \]