PROBLEM 1: Using source transformations, find $v_o$ when $i = 5/2$ Amps. (10 points)

SOLUTION 1:

Source transformation at left; equivalent resistor for parallel 6 and 3 $\Omega$ resistors:

Equivalents for series resistors, series voltage source at left; series resistors, then source transformation at top:
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Source transformation at left; series resistors at right:

Parallel resistors, then source transformation at left:

Finally, apply KVL to loop

\[-6 + i (9 + 19) - 36 - v_o = 0\]
\[i = \frac{5}{2} \Rightarrow v_o = -42 + 28 \left(\frac{5}{2}\right) = 28 \text{ V}\]

**PROBLEM 2:** Using superposition, find \(i_x\) current in the circuit. (10 points)

**SOLUTION 2:**

Consider 8 V source only (open the 2 A source)

Let \(i_1\) be the part of \(i_x\) due to the 8 V voltage source.

Apply KVL to the supermesh:

\[6 \left( i_1 \right) + 3 \left( i_1 \right) + 3 \left( i_1 \right) - 8 = 0\]

\[i_1 = \frac{8}{12} = \frac{2}{3} \text{ A}\]

Consider 2 A source only (short the 8 V source)

Let \(i_2\) be the part of \(i_x\) due to the 2 A current source.
Apply KVL to the supermesh:

\[ 6 (i_2) + 3 (i_2 + 2) + 3 i_2 = 0 \]

\[ i_2 = \frac{-6}{12} = -\frac{1}{2} \text{ A} \]

Finally, \( i_s = i_1 + i_2 = \frac{2}{3} - \frac{1}{2} = \frac{1}{6} \text{ A} \)

**PROBLEM 3:** Find the Thevenin voltage \( v_{oc} \) and resistance \( R_t \) (shown in (b)) for the circuit shown in (a). (10 points)

**SOLUTION 3:**

The circuit from Figure P5.4-3a can be reduced to its Thevenin equivalent circuit in five steps:
Comparing (e) to Figure P5.4-3b shows that the Thevenin resistance is $R_t = 4 \, \Omega$ and the open circuit voltage, $v_{oc} = 2 \, \text{V}$.

**PROBLEM 4:** Find the load resistance $R_L$ for maximum power transfer. (10 points)

**SOLUTION 4:**

a) For maximum power transfer, set $R_L$ equal to the Thevenin resistance:

$$R_L = R_t = 100 + 1 = 101 \, \Omega$$