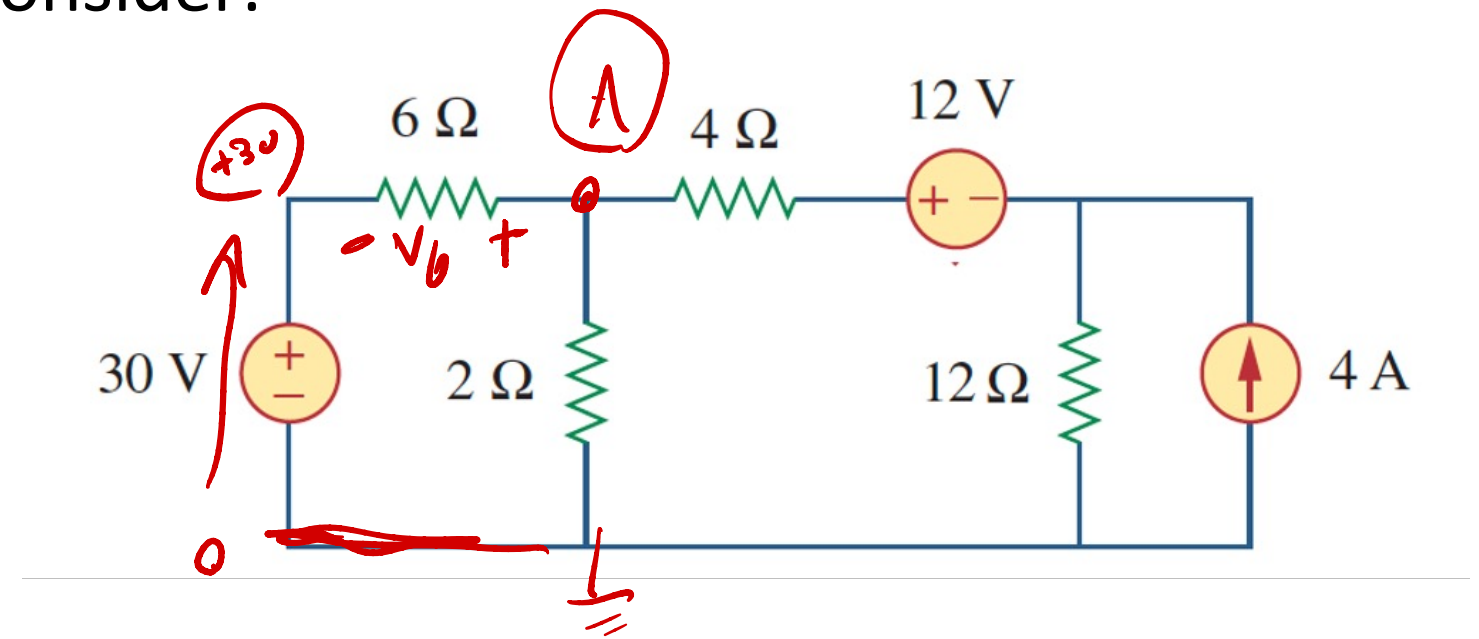
Node – 2

more complex branches

Extension #2 – V + R branches

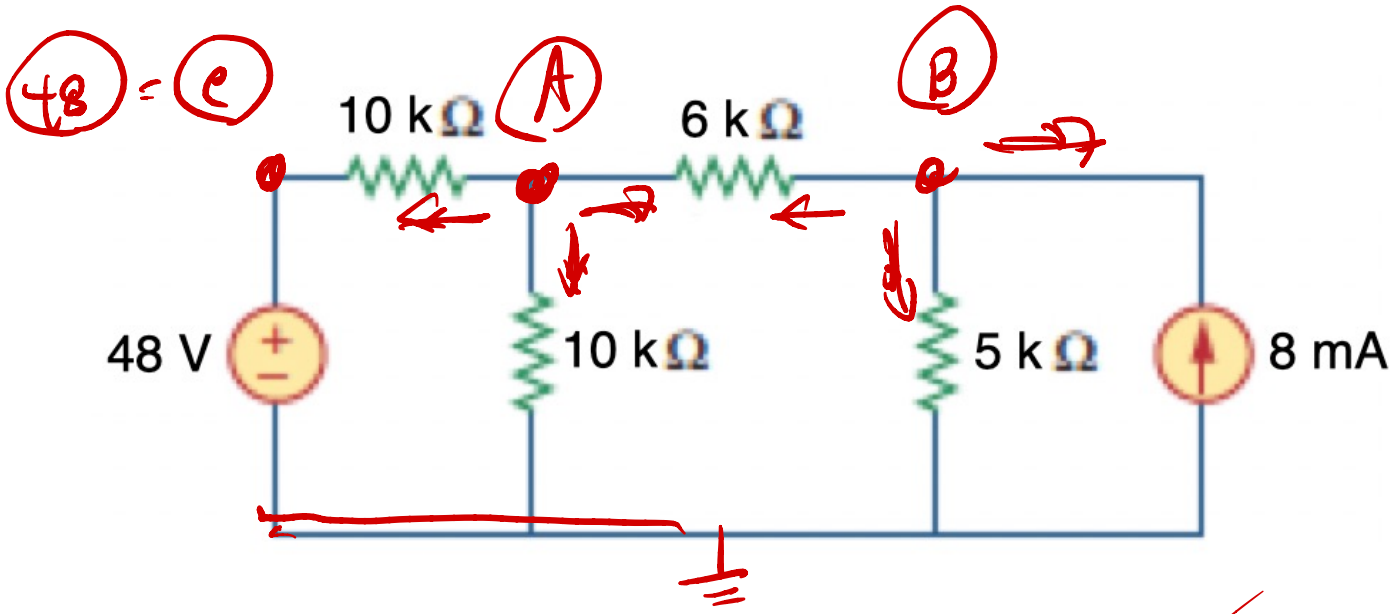
$V_6 = A - 30$

- Consider:



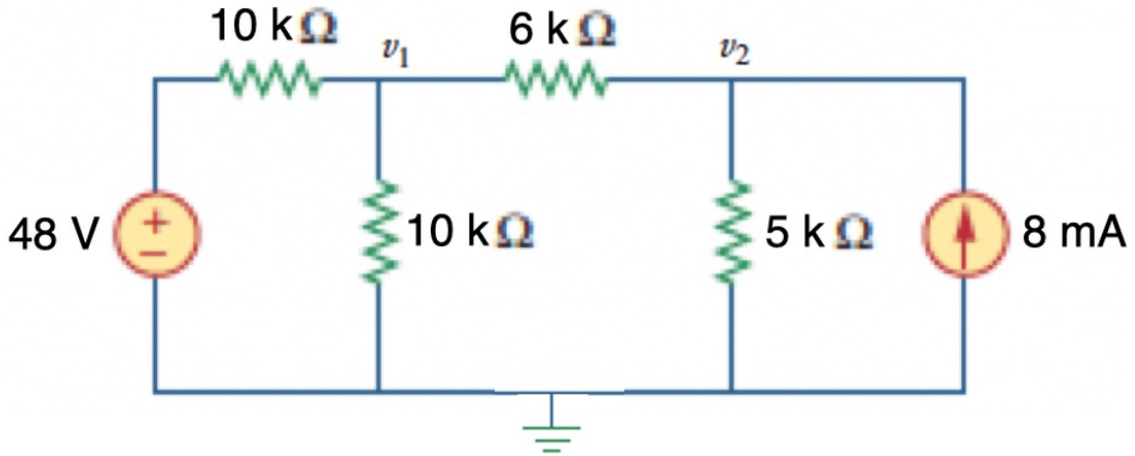
- Solution: Modify the Ohm's Law expression(s) for the individual branch current(s)

Example (solved on next slide)



$$B: \quad -\frac{8}{1000} + \frac{B}{5000} + \frac{B-A}{6000} = 0$$

$$A: \quad \frac{A-B}{6000} + \frac{A}{10{,}000} + \frac{A-48}{10{,}000} = 0$$



$$\frac{v_1}{10k} + \frac{v_1 - 48}{10k} + \frac{v_1 - v_2}{6k} = 0$$

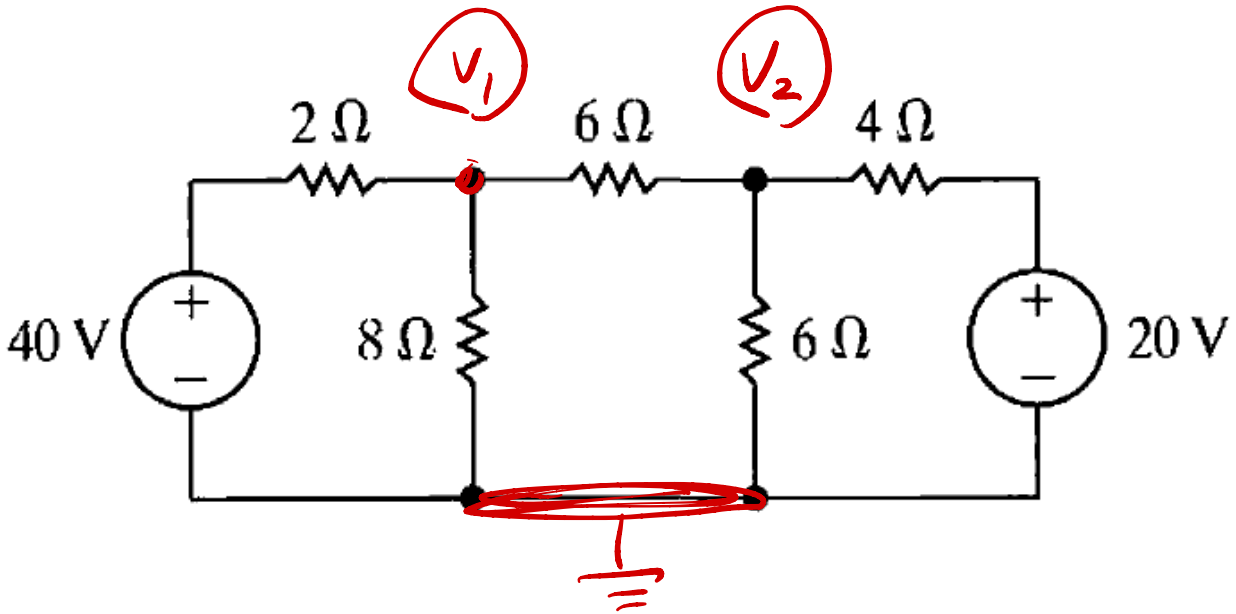
$$\frac{v_2}{5k} + \frac{v_2 - v_1}{6k} - .008 = 0$$

$$3v_1 + 3v_1 + 5v_1 - 5v_2 = 144$$

$$6v_2 + 5v_2 - 5v_1 = 240$$

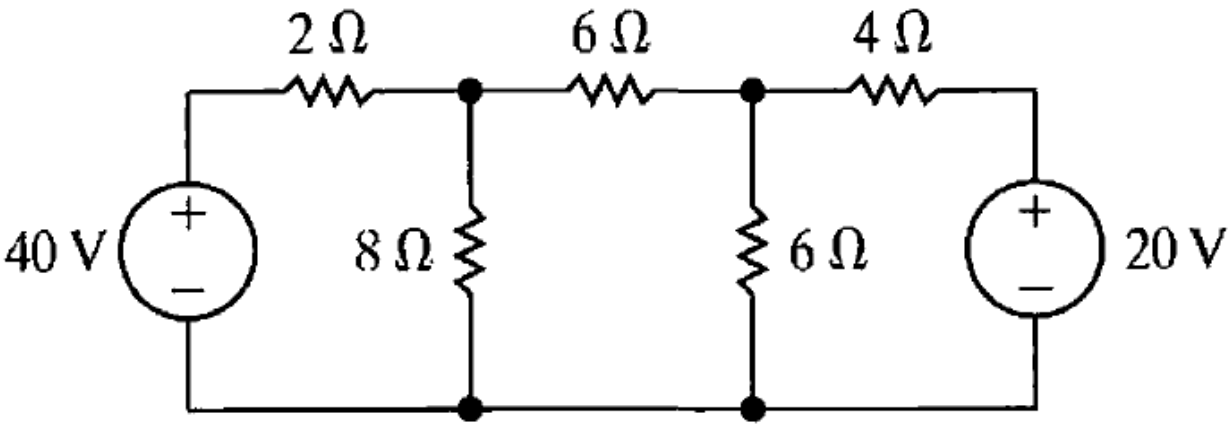
$$\begin{aligned} 11v_1 - 5v_2 &= 288 \\ -5v_1 + 11v_2 &= 240 \end{aligned} \Rightarrow \begin{aligned} v_1 &= 29\ V \\ v_2 &= 35\ V \end{aligned}$$

Example



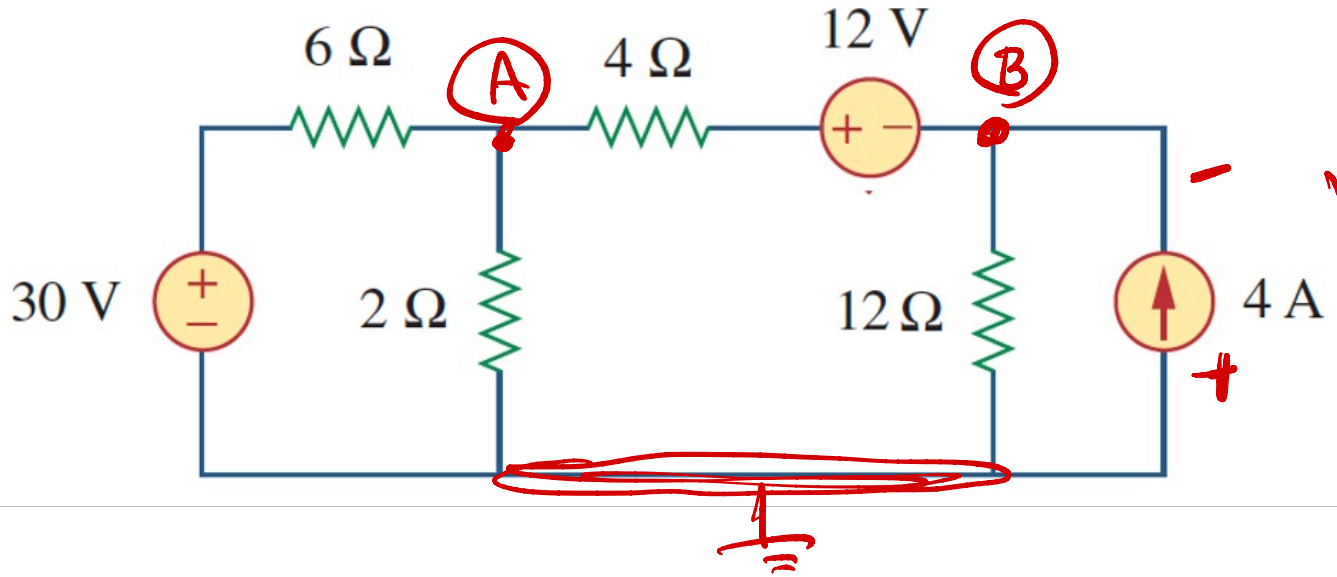
node V_1 : $\frac{V_1}{8} + \frac{V_1 - V_2}{6} + \frac{V_1 - 40}{2} = 0$

node V_2 : $\frac{V_2}{6} + \frac{V_2 - V_1}{6} + \frac{V_2 - 20}{4} = 0$



$28\ V, 16\ V$

Example: find the power of the current source



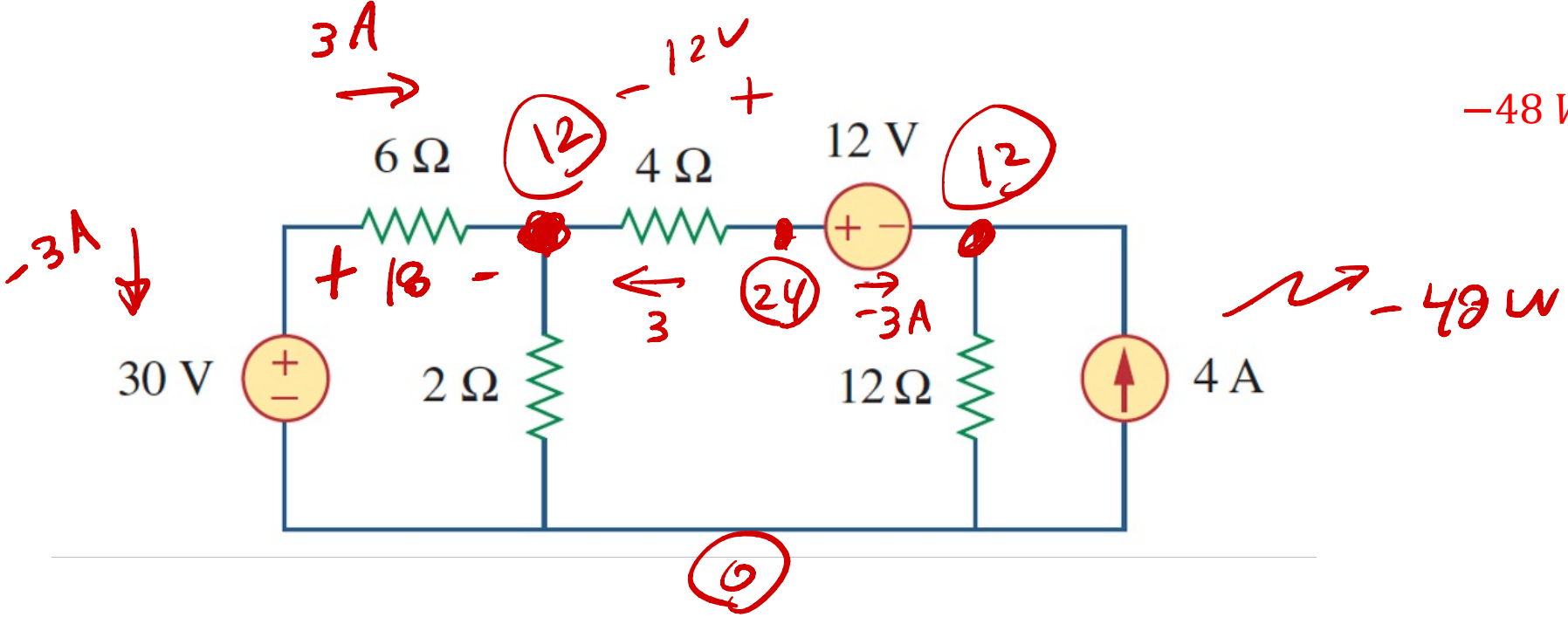
$V_4 = -B$

$P = V_4 \cdot 4$

$= -4B$

node A: $\frac{A}{2} + \frac{A-30}{6} + \frac{A-(B+12)}{4} = 0$

node B: $-4 + \frac{B}{12} + \frac{B+12-A}{4} = 0$

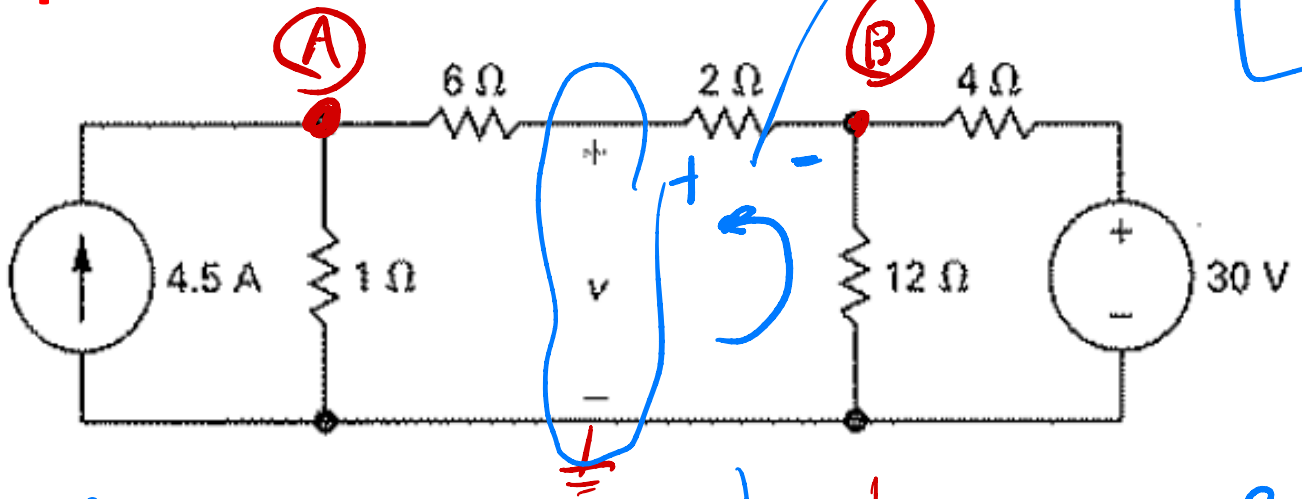


$-48\ W$

$P_{30} = ?\ (-3)(30) = -90\ W$

$P_{12} = (-3)(12) = -36\ W$

Example: find v



$\frac{A-B}{8} =$ → $\frac{A-B}{4}$

$V_1 = B + \frac{A-B}{4}$

node A: $8\left(-4.5 + \frac{A}{1} + \frac{A-B}{8} = 0\right)$

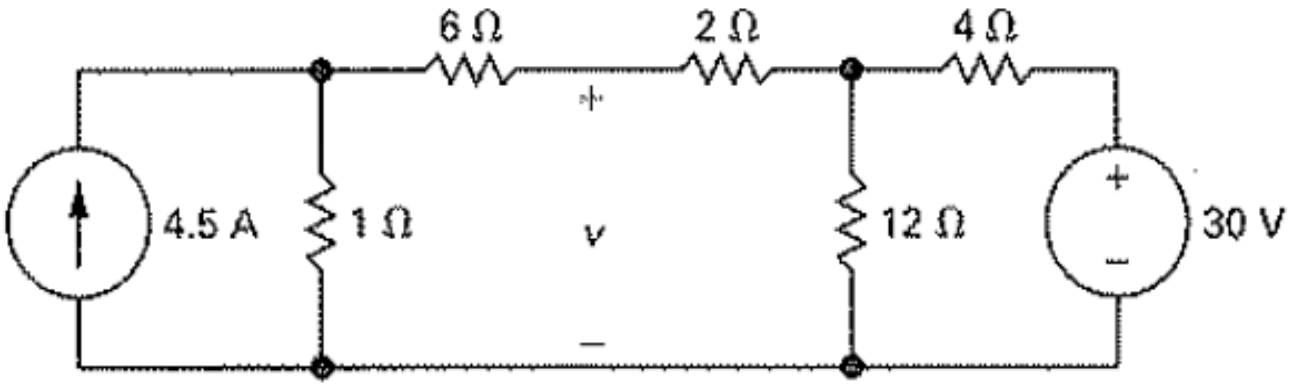
node B: $24\left(\frac{B-30}{4} + \frac{B}{12} + \frac{B-A}{8} = 0\right)$

$9A - 8B = 36$

$-3A + 11B = 180$

$A = \frac{\begin{vmatrix} 36 & -8 \\ 180 & 11 \end{vmatrix}}{\begin{vmatrix} 9 & -8 \\ -3 & 11 \end{vmatrix}} = \frac{396 + 1440}{99 - 24} = \frac{1836}{75}$

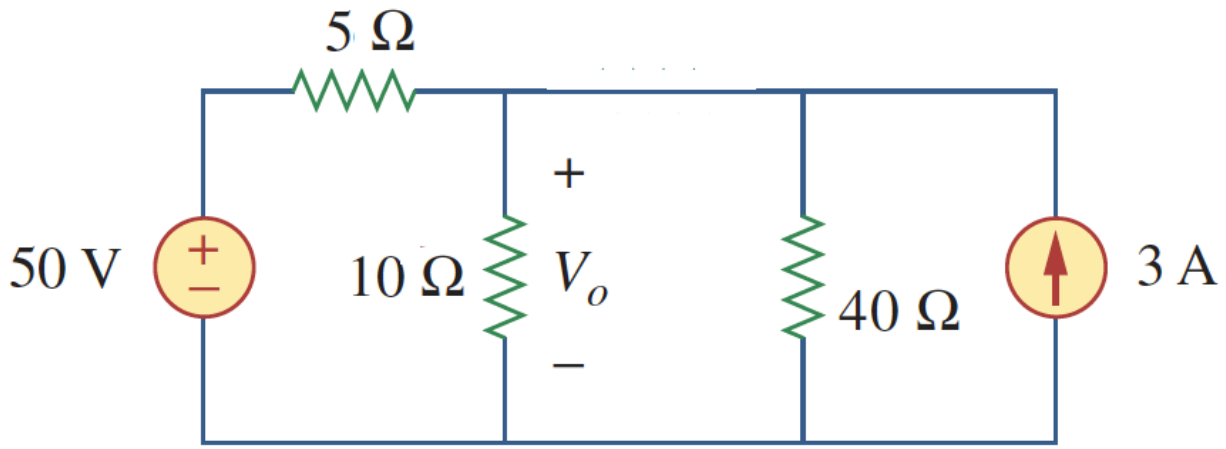
$A =$ $B =$



15 V

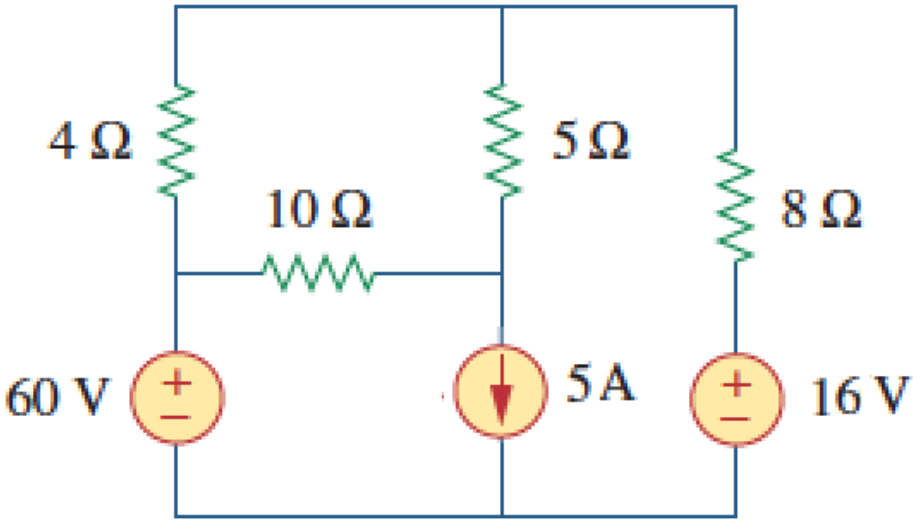
$40\ V$

Practice problem: find V_o



$v_T = 40\ V, v_M = 30\ V$

Practice problem: find the node voltages to the top and bottom of the 5 Ω resistor relative to the bottom



$-46\ A$

Practice problem: find i_o