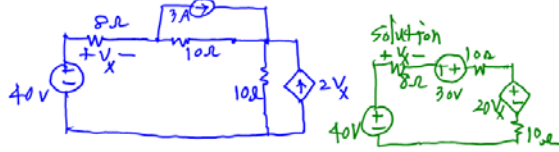


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Circuit theorems (continued)

[Prob. 4.24] Use source transformation to find V_X in the circuit below.



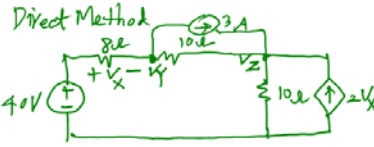
Solution

$$40V = V_X - 30 + 10\left(\frac{V_X}{8}\right) + 2V_X$$

$$70 = V_X\left(1 + \frac{5}{4} + 2\right) + \frac{30}{4}$$

$$V_X = \frac{70}{1 + \frac{5}{4} + 2} = \frac{4 \times 70}{7 + 5 + 8} = \frac{280}{20} = 14V$$

$$= \frac{140}{10} = 14V$$



At Y, $\frac{40 - V_X}{8} = 3 + \frac{1}{10}(V_Y - V_Z)$ (1)

At Z, $\frac{V_Z}{10} = 3 + \frac{1}{10}(V_Y - V_Z) + 2V_X (= 40 - V_Y)$ (2)

$10 \times (1) \rightarrow 5(40 - V_X) = 30 + 4(V_Y - V_Z)$

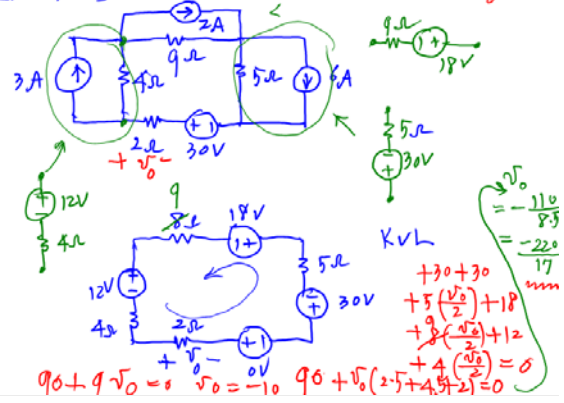
$10 \times (2) \rightarrow V_Z = 30 + V_Y - V_Z + 800 - 20V_Y$

$$\begin{bmatrix} 9 & -4 \\ 19 & 2 \end{bmatrix} \begin{bmatrix} V_Y \\ V_Z \end{bmatrix} = \begin{bmatrix} 80 \\ 830 \end{bmatrix}$$

$$V_Y = \frac{\begin{vmatrix} 80 & -4 \\ 830 & 2 \end{vmatrix}}{\begin{vmatrix} 9 & -4 \\ 19 & 2 \end{vmatrix}} = \frac{160 - (830)(-4)}{18 - (19)(4)} = \frac{3480}{-64} = -54.375V$$

$$V_X = 40 - V_Y = 40 - (-54.375) = 94.375V$$

[Prob. 4.25] Use source transformation to find V_0 .



KVL

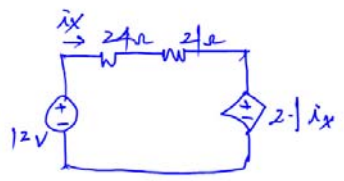
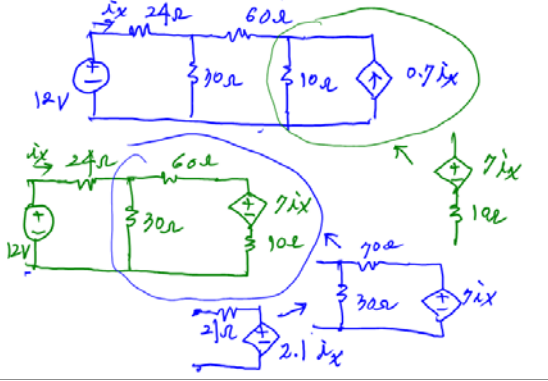
$$90 + 9V_0 = 0 \quad V_0 = -10$$

$$90 + V_0(2.5 + 4.5 + 2) = 0$$

$$90 + V_0(9.5) = 0$$

$$V_0 = -\frac{90}{9.5} = -9.47V$$

[Prob. 4.30] Find i_X by source transformation



$$12 = (24 + 2)i_X + 2i_X = 47i_X$$

$$i_X = \frac{12}{47} = \frac{120}{471} = \frac{40}{157} [A]$$

