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Homework Problem 3

Find the Thévenin Equivalent of this circuit.

$I_x = \frac{V_1 - V_2}{4}$

$V_1: \frac{V_1 - 10}{2} - 10 I_x + I_x = 0$

$\frac{V_1 - 10}{2} - 9\left(\frac{V_1 - V_2}{4}\right) = 0$

$V_1 - 10 - \frac{9}{2} V_1 + \frac{9}{2} V_2 = 0$

$-2\left(-\frac{7}{2} V_1 + \frac{9}{2} V_2 = 10\right)$

$7V_1 + 9 V_2 = -20$

$V_2: -I_x - 1 + \frac{V_2 - 0}{5} + 0 = 0$

$20 \times \left(-\left(\frac{V_1 - V_2}{4}\right) - 1 + \frac{V_2}{5} = 0\right)$

$-5V_1 + 5V_2 - 20 + 4V_2 = 0$

② $-5V_1 + 9V_2 - 20 = 0$

① $\begin{cases} 7V_1 + 9V_2 = 20 \\ -5V_1 + 9V_2 = 20 \end{cases}$

$\underline{}$
$2V_1 + 0 = 0 \qquad V_1 = 0$

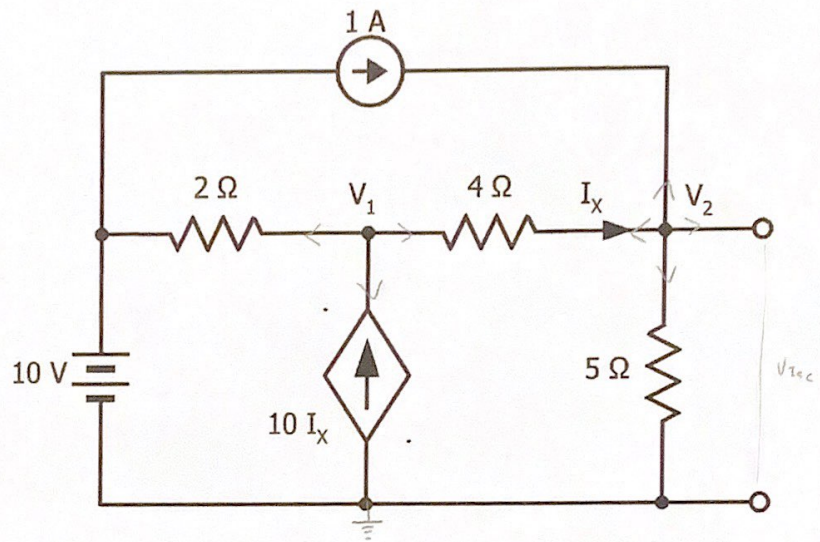② $-5V_1 + 9V_2 = 20$

$9V_2 = 20 + 5V_1$

$9V_2 = 20 + 0$

$V_2 = \frac{20}{9} = 2.2V$

$V_{oc} = 2.2 V$

$R_{th} = \frac{V_{oc}}{I_{sc}}$

$V_2: -I_x - 1 + 0 + I_{sc} = 0$

$I_{sc} = I_x + 1$

$I_{sc} = \frac{V_1 - V_2}{4} + 1$

$I_{sc} = \frac{0 - 2.2}{4} + 1$

$I_{sc} = 0.45 A$

$R_{th} = \frac{V_{oc}}{I_{sc}} = \frac{2.2V}{0.45A}$

$R_{th} = 4.9 \Omega$