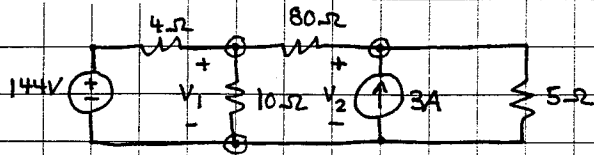


ex:

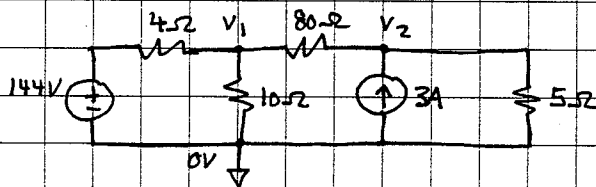


Use Node-V method to find V_1 & V_2 .

nodes are marked by dots. Essential nodes are marked by \odot . Note that node under 3A source is considered to be part of essential node under 10Ω Resistor, (because they are connected by a wire).

3 essential nodes \Rightarrow 3-1=2 equations needed.

Put ref V of 0V, (i.e. \downarrow), at bottom so top nodes are V_1 and V_2 .



Node-V eqns give sum of currents out of node = 0:

$$\text{node 1: } \frac{V_1 - 144V}{4\Omega} + \frac{V_1 - 0V}{10\Omega} + \frac{V_1 - V_2}{80\Omega} = 0A$$

(V_1)

$$\text{node 2 } \frac{V_2 - V_1}{80\Omega} + -3A + \frac{V_2 - 0V}{5\Omega} = 0A$$

(V_2)

$$\text{or node 1: } V_1 \left(\frac{1}{4\Omega} + \frac{1}{10\Omega} + \frac{1}{80\Omega} \right) - \frac{V_2}{80\Omega} = \frac{144V}{4\Omega}$$

$$\text{node 2: } -V_1 \frac{1}{80\Omega} + V_2 \left(\frac{1}{80\Omega} + \frac{1}{5\Omega} \right) = 3A$$

$$\text{or node 1: } \frac{V_1}{4\Omega \parallel 10\Omega \parallel 80\Omega} - \frac{V_2}{80\Omega} = \frac{144V}{4\Omega}$$

$$\text{node 2: } -\frac{V_1}{80\Omega} + \frac{V_2}{80\Omega \parallel 5\Omega} = 3A$$

$$4\Omega \parallel 10\Omega \parallel 80\Omega = (4\Omega \parallel 10\Omega) \parallel 80\Omega$$

$$= \frac{40}{14}\Omega \parallel 80\Omega$$

$$= 40\Omega \cdot \frac{1}{14} \parallel 2$$

$$= 40\Omega \cdot \frac{2/14}{2 + 1/14}$$

$$= 40\Omega \cdot \frac{2}{29} \quad (\text{mult top \& bottom by 14})$$

$$= \frac{80}{29}\Omega$$

$$80\Omega \parallel 5\Omega = 5\Omega \cdot \frac{16}{17} = \frac{80}{17}\Omega$$

Thus, we have: node 1
$$v_1 \frac{29}{80\Omega} - \frac{v_2}{80\Omega} = 36 \text{ A}$$

node 2
$$-\frac{v_1}{80\Omega} + v_2 \frac{17}{80\Omega} = 3 \text{ A}$$

or node 1
$$29v_1 - v_2 = 2880 \text{ V}$$

node 2
$$-v_1 + 17v_2 = 240 \text{ V}$$

From node 1: $-v_2 = 2880 \text{ V} - 29v_1$; substitute this into Node 2:

node 2:
$$-v_1 - 17(2880 \text{ V} - 29v_1) = 240 \text{ V}$$

$$492v_1 = 240 \text{ V} + 48960$$

$$v_1 = 100 \text{ V}$$

$$v_2 = \frac{240 \text{ V} + v_1}{17} = \frac{340 \text{ V}}{17} = 20 \text{ V}$$