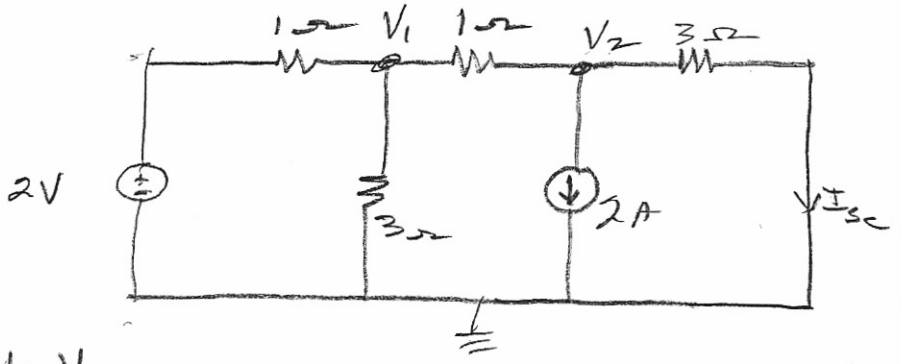
Wlg

ECE301
HW#3

Desk Copy

(1) Problem

(a) Find the short circuit current for the following using Nodal.



At V_1

$$\frac{V_1-2}{1}+\frac{V_1}{3}+\frac{V_1-V_2}{1}=0$$

$$3V_1-6+V_1+3V_1-3V_2=0$$

$$\boxed{7V_1-3V_2=6}$$

At V_2

$$\frac{V_2-V_1}{1}+\frac{V_2}{3}=-2$$

$$3V_2-3V_1+V_2=-6$$

$$\boxed{-3V_1+4V_2=-6}$$

1.263

$$\begin{bmatrix}7 & -3\\ -3 & 4\end{bmatrix}\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}6\\ -6\end{bmatrix}$$

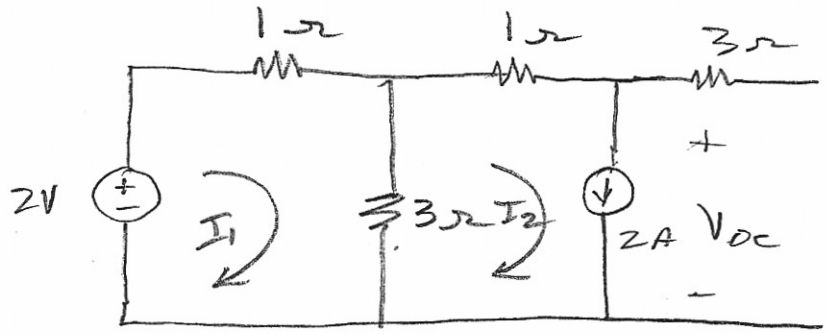
$V_1 = 10.316\ V$

$V_2 = -1.263\ V$

$$I_{sc}=\frac{-1.263}{3}=-0.42\ A$$

(1) cont.

(b) Find the open-circuit voltage. Use mesh analysis



$$4I_1 - 3I_2 = 2$$

$I_2 = 2$ $\quad \therefore 4I_1 = 2 + 3I_2$

$4I_1 = 2 + 6$

$I_1 = 2A$

$V_{oc} = -3(I_2 - I_1) + 1 \cdot I_2$

$= -3(2-2) + 2$

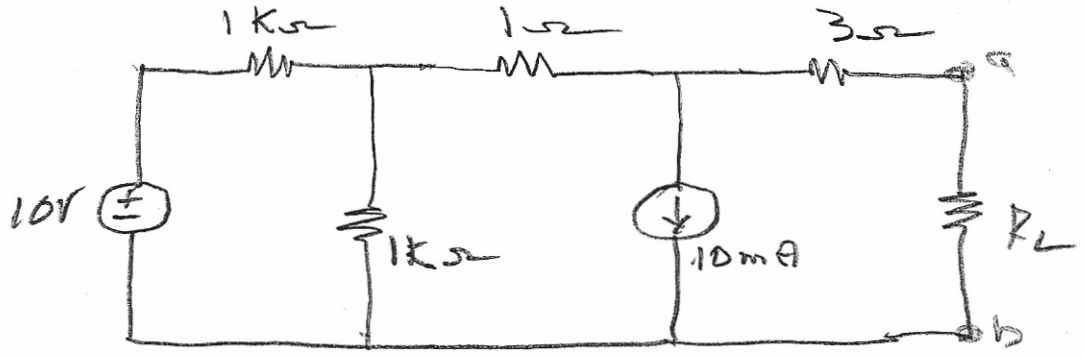
$V_{oc} = -2V$

(c)

$$R_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{-2}{-0.42}$$

$$R_{TH} = 4.76\,\Omega$$

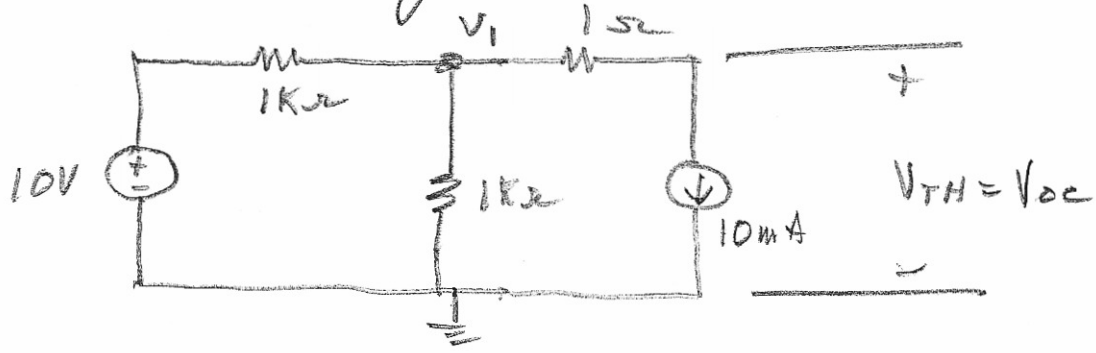
(2) Consider the following circuit



(a) Find the Thevenin equivalent ckt to the left of R_L.

(b) Make $R_L = 300\Omega$ and find V_{ab} using the Thevenin ckt.
(Practically the same as (a).)

(a) Find V_{oc} using nodal



$$\frac{V_1 - 10}{1K} + \frac{V_1}{1K} = -10K^{-1}$$

$$V_1 - 10 + V_1 = -10 \Rightarrow V_1 = 0$$

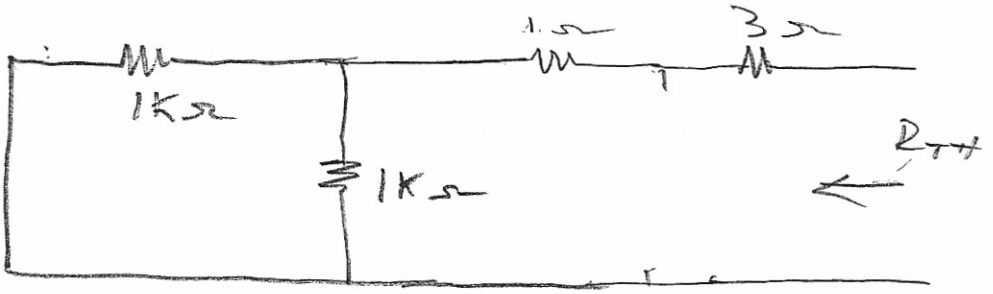
Apply KVL to the outer loop

$$-V_1 + 10mA \times 1 + V_{oc} = 0$$

$$\therefore \boxed{V_{oc} = -.01\,V}$$

(2) cont.

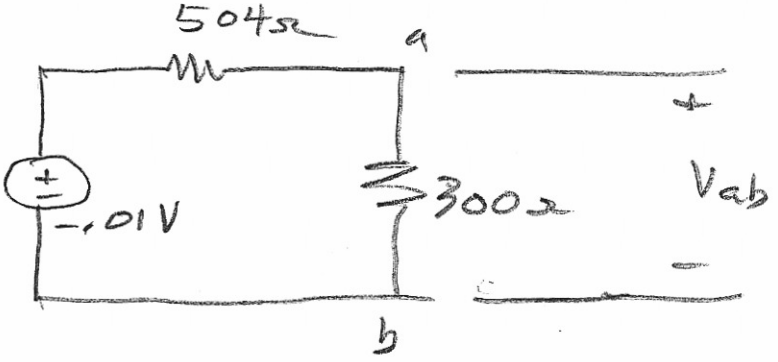
To find R_{TH}: Disable the sources.



∴

$$R_{TH} = 504\,\Omega$$

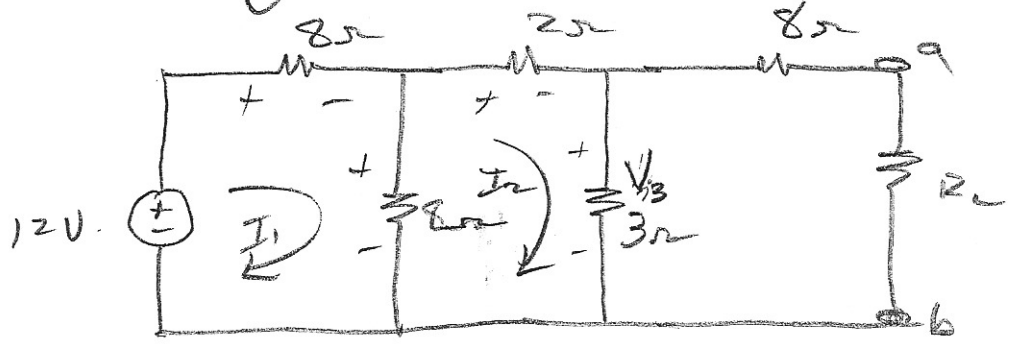
(b)



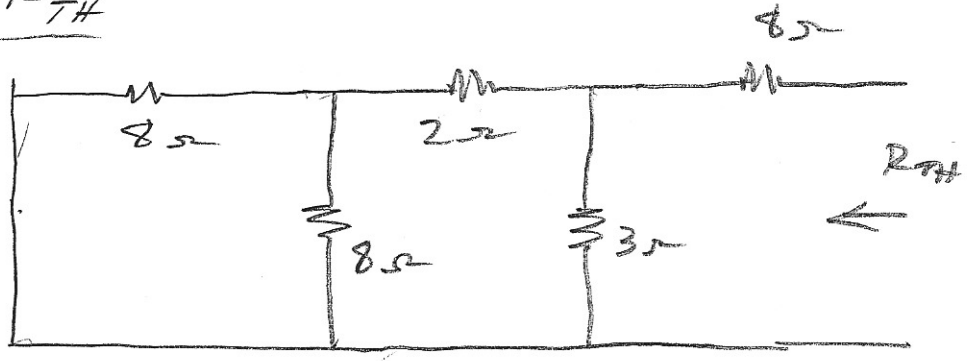
$$V_{ab} = \frac{(-.01)\times 300}{504+300} = -0.00373\ V$$

(3) P 3.57

Find the Thevenin equivalent of the following circuit.



For R_{TH}



$$R_{TH} = 8 + 3 \| 6 = 10\,\Omega$$

For V_{TH}.

$$8I_1 + 8(I_1 - I_2) = 12$$

$$\boxed{16I_1 - 8I_2 = 12}$$

$$-8(I_1 - I_2) + 2I_2 + 3I_2 = 0$$

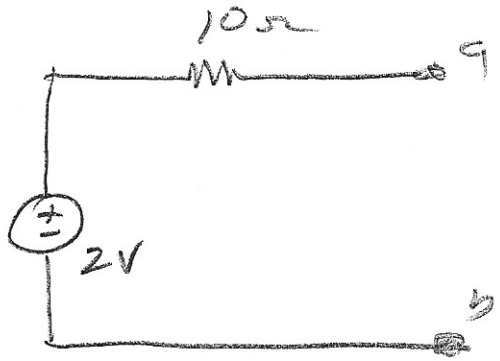
$$\boxed{-8I_1 + 13I_2 = 0}$$

(3)

$$\begin{bmatrix} 16 & -8 \\ -8 & 13 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 0 \end{bmatrix}$$

$I_1 = 1.083\,A \qquad I_2 = 0.667\,A$

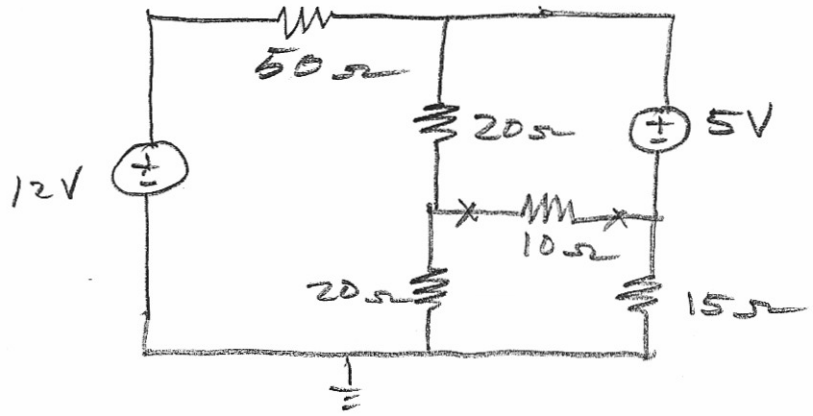
$V_{TH} = V_{oc} = 3 \times I_2 = 2\,V$



THEVENIN Circuit

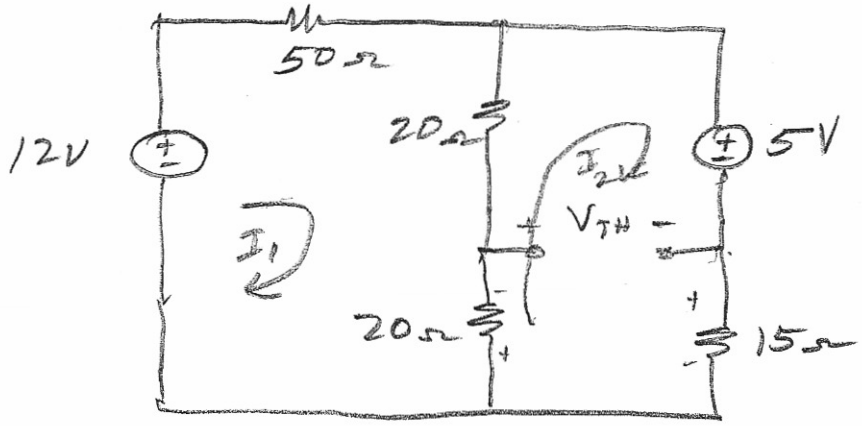
(4) P 3.66

Given the following circuit



Find R_{TH}, V_{TH}, I_N

Find V_{TH}



$$\begin{bmatrix} 90 & -40 \\ -40 & 55 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ -5 \end{bmatrix}$$

$I_1 = 0.137\ A$, $I_2 = .00896\ A$

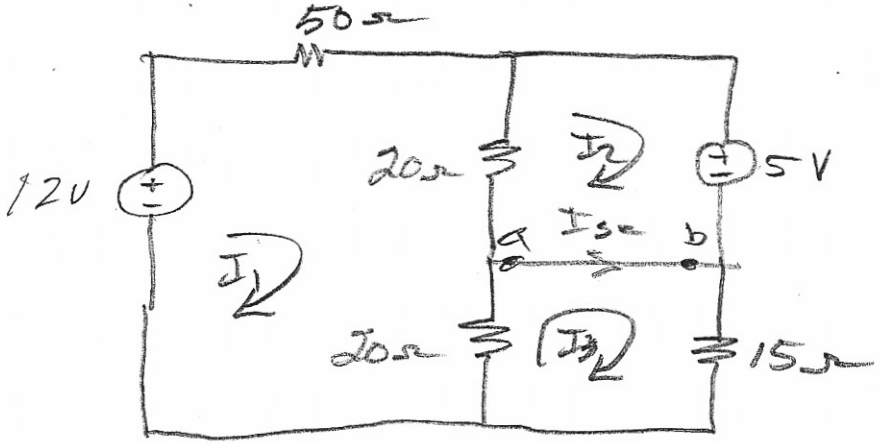
$$-V_{TH} + 20(I_1 - I_2) - 15I_2 = 0$$

(4) cont.

$$V_{TH} = 20(-.137 - .00856) - 15 \times .00856$$

$$\boxed{V_{TH} = 2.43\ V}$$

To find $I_N = I_{sc}$. Analyze the following



$$I_{sc} = I_3 - I_2$$

$$\begin{bmatrix} 90 & -20 & -20 \\ -20 & 20 & 0 \\ -20 & 0 & 35 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 12 \\ -5 \\ 0 \end{bmatrix}$$

$I_1 = .11951A$, $I_2 = -0.13049$, $I_3 = 0.06829$

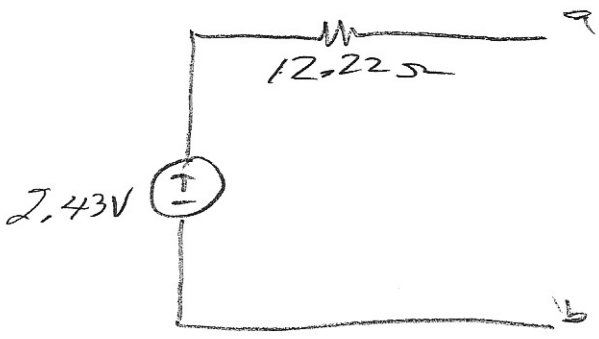
$\therefore$ $I_{sc} = .06829 + .13049 = .1988$

$$I_N = I_{sc} = 198.8\ mA$$

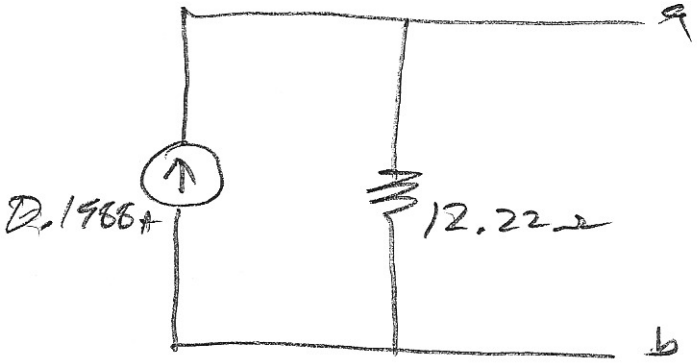
$$R_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{2.43}{.1988} = 12.22\Omega$$

(4) cont.

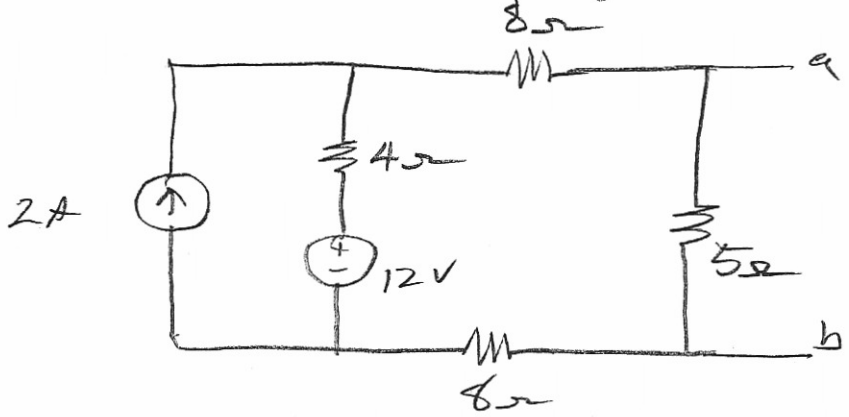
Thevenin circuit



Norton Circuit

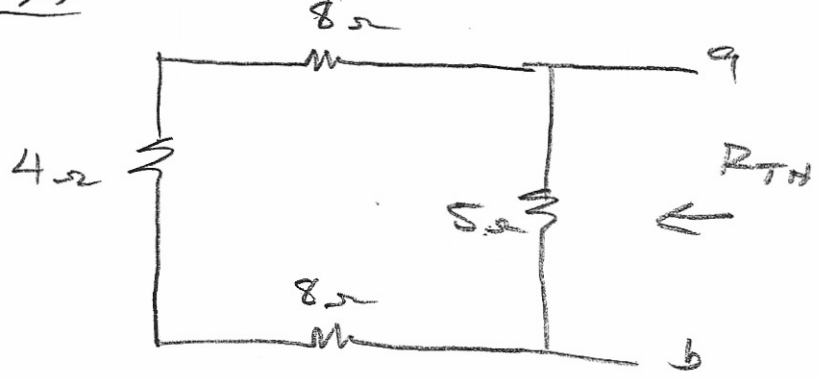


(5) Given the following circuit



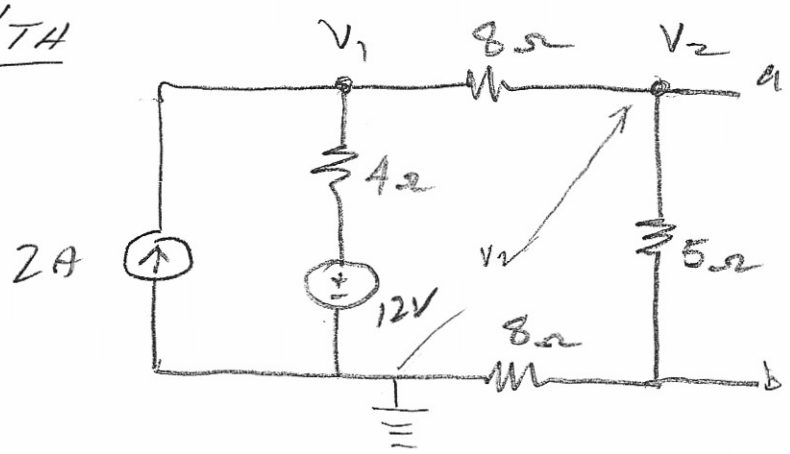
(a) Develop & Draw the Thevenin circuit.

R_{TH}



$R_{TH} = 5 \parallel 20 = 4\Omega$

V_{TH}



$V_{TH} = V_2 \times 5$

(5) cont

At V_1

$$\frac{V_1 - 12}{4} + \frac{V_1 - V_2}{8} = 2$$

$$2V_1 - 24 + V_1 - V_2 = 16$$

$$\boxed{3V_1 - V_2 = 40}$$

At V_2

$$\frac{V_2 - V_1}{8} + \frac{V_2}{13} = 0$$

$$13V_2 - 13V_1 + 8V_2 = 0$$

$$-13V_1 + 21V_2 = 0$$

$$\begin{bmatrix} 3 & -1 \\ -13 & 21 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 40 \\ 0 \end{bmatrix}$$

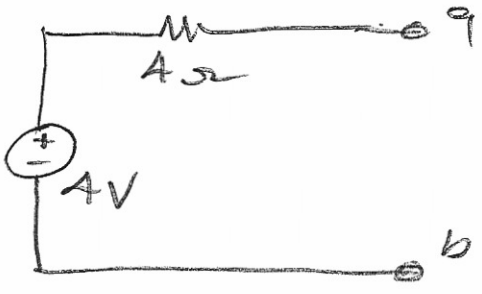
$V_1 = 16.8\ V$ $\quad V_2 = 10.4$

$$V_{TH} = V_{OC} = \frac{10.4 \times 5}{5+8} = 4$$

$$V_{TH} = 4V$$

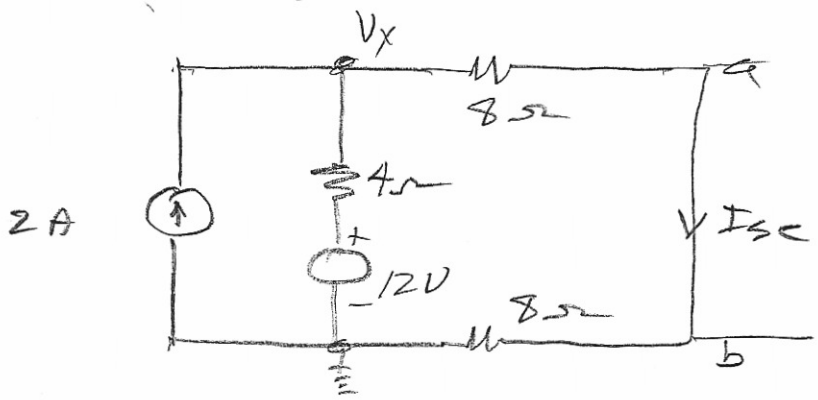
(5) cont

Thevenin ckt



(b) Norton

To find $I_{sc} = I_N$. Analyze the following ckt.



$$\frac{V_x - 12}{4} + \frac{V_x}{16} = 2$$

$$4V_x - 48 + V_x = 32$$

$$5V_x = 80$$

$$V_x = 16\ V$$

$$I_{sc} = \frac{16}{16} = 1A$$

(5) cont.

The Norton ckt,