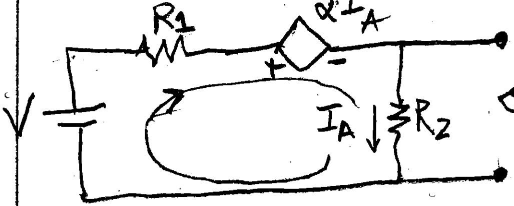
P. 5.4-10



CASE 2 (Independent And Dependent SOURCES)

⇐ Thev.

Find V_{OC} with both Sources ON. A loop Equation is simpliest

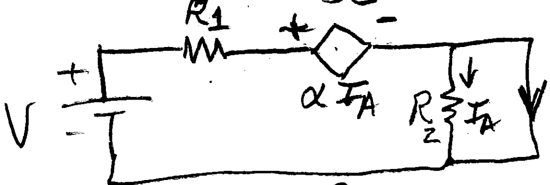
(1) KVL. $-V + R_1 I_A + \alpha I_A + R_2 I_A = 0$

$$(R_1 + \alpha + R_2) I_A = V$$

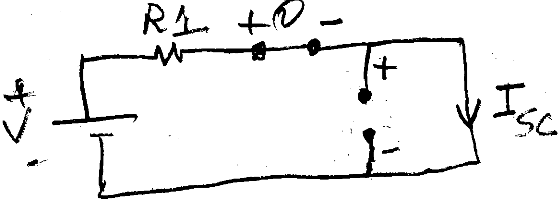
You can see that (2) $V_{OC} = I_A R_2 = \left(\frac{V}{R_1 + \alpha + R_2}\right) R_2$

So, $\boxed{V_{OC} = V\left[\frac{R_2}{R_1 + \alpha + R_2}\right]}$ V_{THEV}

Now, find I_{SC} with both sources on.



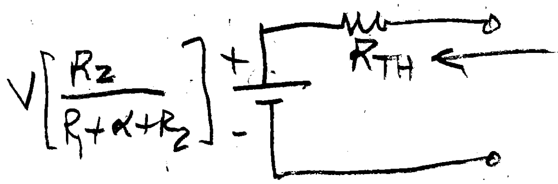
Since the voltage across R_2 is zero, then $I_A = 0$, And $\alpha I_A = 0$



So $\boxed{I_{SC} = \frac{V}{R1} \text{ Amps}}$

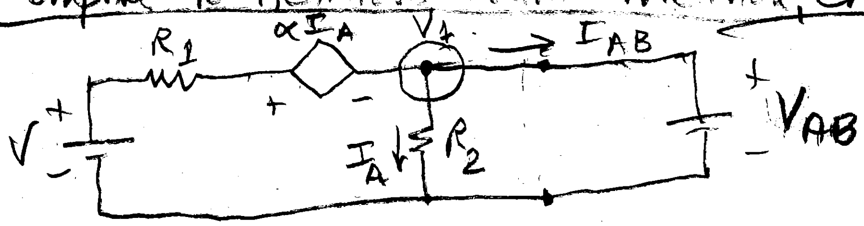
$$R_{TH} = \frac{V_{TH}}{I_{SC}} = \frac{V\left[\frac{R_2}{R_1 + \alpha + R_2}\right]}{\frac{V}{R1}}$$

The Thevenin ckt is



$$\boxed{R_{TH} = \frac{(R1)(R2)}{R_1 + \alpha + R_2} \,\Omega}$$

Compare to Fictitious Source Method, CASE 3



KCL, $\frac{(V_1 + \alpha I_A) - V}{R1} + I_{AB} + I_A = 0$

Use $I_A = \frac{V_1}{R_2}$, $\frac{\left(V_1 + \alpha \frac{V_1}{R_2}\right) - V}{R1} + I_{AB} + \frac{V_1}{R2} = 0$

5.4-10, cont.

Get V_1 terms on one side

$$\frac{V_1\left(1+\frac{\alpha}{R_2}\right)-V}{R1}+I_{AB}+\frac{V_1}{R2}=0$$

$$\frac{V_1\left(1+\frac{\alpha}{R_2}\right)}{R1}+\frac{V1}{R2}-\frac{V}{R1}+I_{AB}=0$$

$$V_1\left[\frac{1}{R1}+\frac{\alpha}{R_1R_2}+\frac{1}{R_2}\right]-\frac{V}{R1}+I_{AB}=0$$

Now, from the circuit, $V_1 \equiv V_{AB}$

$$V_{AB}\left[\frac{1}{R1}+\frac{\alpha}{R_1R_2}+\frac{1}{R_2}\right]=\frac{V}{R1}-I_{AB}$$

$$V_{AB}=\boxed{\frac{V}{R1\left[\frac{1}{R1}+\frac{\alpha}{R_1R_2}+\frac{1}{R_2}\right]}}-\left[\frac{1}{\frac{1}{R1}+\frac{\alpha}{R1R2}+\frac{1}{R2}}\right]I_{AB}$$

$$\Updownarrow$$

$$V_{AB}=V_{TH}-\left[R_{TH}\right]I_{AB}$$

$$R_{TH}=\frac{1}{\frac{1}{R1}+\frac{\alpha}{R1R2}+\frac{1}{R_2}}=\frac{R1}{1+\frac{\alpha}{R_2}+\frac{R1}{R2}}=\frac{(R1)(R2)}{R2+\alpha+R1}$$

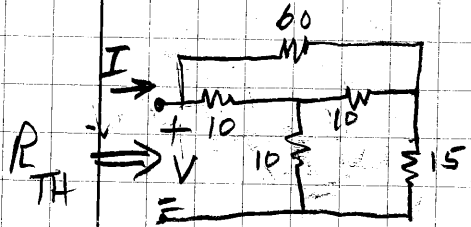
Matches Case 2

$$\downarrow$$

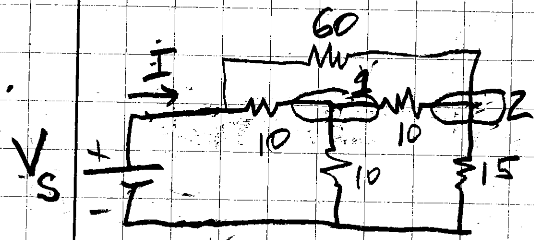
$$V_{TH}=\frac{V}{R1}\cdot\underbrace{\frac{1}{\frac{1}{R1}+\frac{1}{R1R2}+\frac{1}{R2}}}_{R_{TH}}=V\left[\frac{R_{TH}}{R1}\right]=V\underbrace{\left[\frac{R2}{R1+\alpha+R2}\right]}$$

Matches Case 2

Prob. 5.8-1. No Pspice. Reduce the Right half to one Resistor. Then solve for the Numbers



Find V_{TH} - Apply a voltage on the left, find the current, then $R_{TH} = \frac{V}{I}$



① $\frac{V_1 - V_S}{10} + \frac{V_1 - V_2}{10} + \frac{V_1}{10} = 0$, ② $\frac{V_2 - V_1}{10} + \frac{V_2 - V_S}{60} + \frac{V_2}{15} = 0$

$$\begin{bmatrix} \frac{1}{10}+\frac{1}{10}+\frac{1}{10} & -\frac{1}{10} \\ -\frac{1}{10}-\frac{1}{60} & \frac{1}{10}+\frac{1}{60}+\frac{1}{15} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} \frac{V_S}{10} \\ \frac{V_S}{60} \end{bmatrix}$$

x60 $\begin{bmatrix} 6+6+6 & -6 \\ -6-1 & 6+1+4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 6V_S \\ 1V_S \end{bmatrix}$, $\begin{bmatrix} 18 & -6 \\ -7 & 11 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 6V_S \\ 1V_S \end{bmatrix}$

$\begin{bmatrix} 18V_1 - 6V_2 = 6V_S \\ -7V_1 + 11V_2 = 1V_S \end{bmatrix}$, $V_2 = \frac{V_S + 7V_1}{11}$

$18V_1 - 6\left[\frac{7V_1 + 1V_S}{11}\right] = 6V_S$

$3V_1 - \left[\frac{7V_1 + 1V_S}{11}\right] = 1V_S$ $\qquad V_2 = \frac{7}{11}V_1 + \frac{V_S}{11}$

$V_1\left[3 - \frac{7}{11}\right] = \left(1 + \frac{1}{11}\right)V_S$ $\qquad V_2 = \frac{7}{11}\left(\frac{6}{13}\right)V_S + \frac{V_S}{11}$

$V_1\left[\frac{26}{11}\right] = \left[\frac{12}{11}\right]V_S$ $\qquad 11V_2 = \frac{42}{13}V_S + V_S$

$V_1 = \frac{12}{26}V_S = \frac{6}{13}V_S$ $\qquad 11V_2 = \frac{1}{13}(42V_S + 13V_S)$

$11V_2 = \frac{55}{13}V_S$, $V_2 = \frac{5}{13}V_S$

From CKT

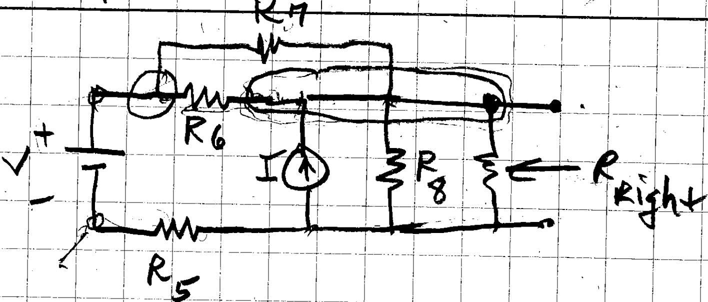
$I = \frac{V_S - V_1}{10} + \frac{V_S - V_2}{60} = \frac{V_S - \frac{6}{13}V_S}{10} + \frac{V_S - \frac{5}{13}V_S}{60}$

$I = V_S\left[\frac{7/13}{10} + \frac{8/13}{60}\right] = V_S\left(\frac{1}{13}\right)\left(\frac{7}{10} + \frac{8}{60}\right) = V_S\left(\frac{1}{13}\right)\left(\frac{42+8}{60}\right) = V_S\left(\frac{1}{13}\right)\left(\frac{5}{6}\right)$

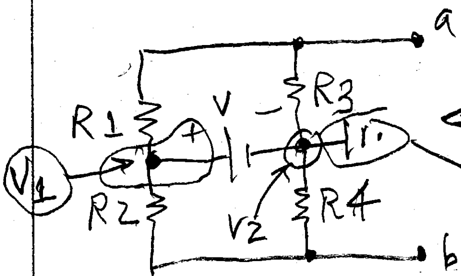
$= V_S\left(\frac{5}{78}\right)$, $R = \frac{78}{5} = 15.6\ \Omega$

HW#12

5.8-1 (LEFT-HAND SIDE)



P. 5.4-15

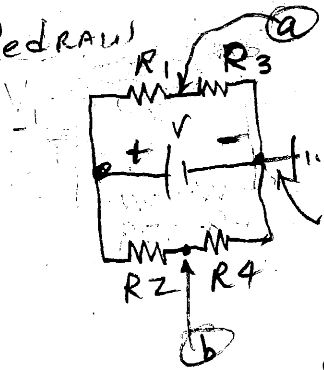


$\leftarrow$ Thev.

Case 1. $V_{TH} = V_{OC}$;
Turn off sources,
Find R_{ab}

GND Reference,
No current in it.

Redraw



Voltage divider on top and bottom

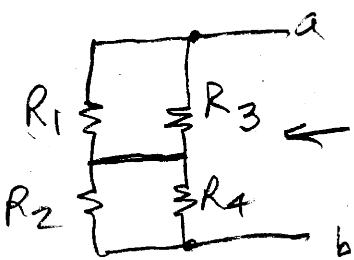
$$V_a = V\left[\frac{R_3}{R_1+R_3}\right]$$

$$V_b = V\left[\frac{R_4}{R_2+R_4}\right]$$

$$\boxed{V_a - V_b = V\left[\frac{R_3}{R_1+R_3} - \frac{R_4}{R_2+R_4}\right] = V_{OC} = V_{TH}}$$

can't simplify

Now, turn off the sources and find R_{ab}



$$R_{ab} = [R_1 \| R_3] + [R_2 \| R_4]$$

$$= \boxed{\frac{R_1 R_3}{R_1+R_3} + \frac{R_2 R_4}{R_2+R_4} = R_{THEV}}$$

can't simplify