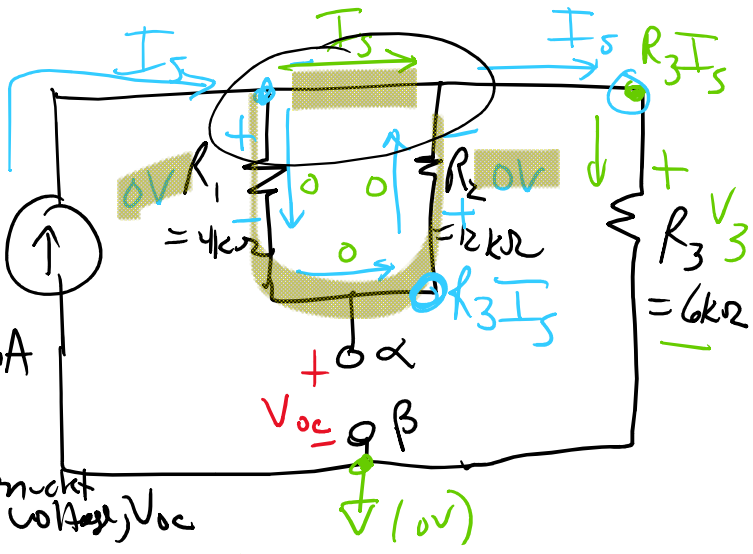
Example

Determine Thevenin & Norton ckt models wrt nodes α & β.



$I_s = 12mA$

Start w/ Thevenin model → V_{TH} ← open-ckt voltage, V_{oc}

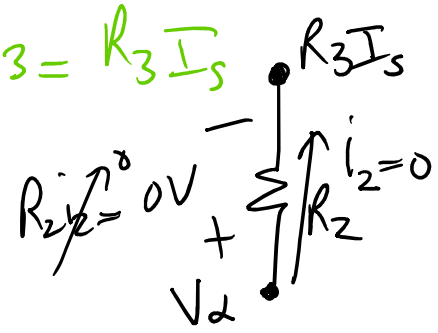
→ R_{TH} ← ?

$V_3 = R_3 I_s$

$V_\alpha - R_3 I_s \overset{must}{=} 0V \; (= R_2 \cancel{i_2}^{\,0} = 0)$

$V_\alpha = R_3 I_s$

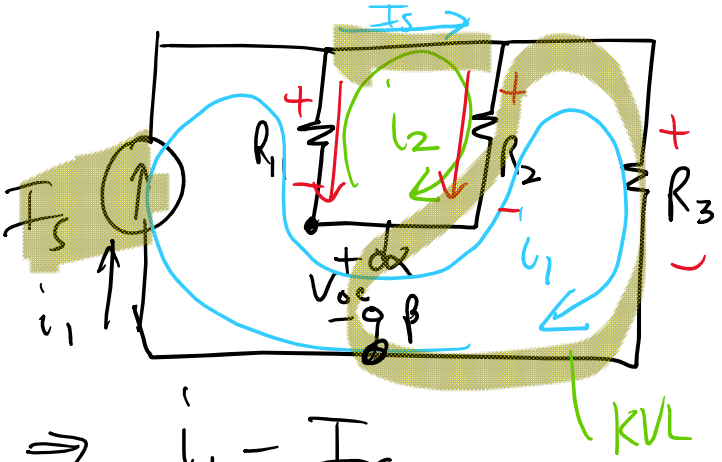
$V_{oc} = V_\alpha - \cancel{V_\beta}^{\,0} = R_3 I_s$



$R_3 I_s$

$V_{TH} \overset{set}{=} V_{oc} = R_3 I_s = 72V$

Now, solve for $V_{oc} (= V_{TH})$ via mesh analysis:



Mesh count = 2; eqns, at most 2

$\Rightarrow i_1 = I_s$

KVL, mesh 2 $\quad -R_1(i_1 - i_2) + R_2(i_2 - i_1) = 0$

$i_1 - i_2 = 0$

$i_2 - i_1 = 0$

$\Rightarrow -R_1 I_s + R_1 i_2 + R_2 i_2 - R_2 I_s = 0$

$\Rightarrow i_2 [R_1 + R_2] = [R_1 + R_2] I_s \Rightarrow i_2 = I_s$ ✓ ckt is solved

$[R_1+R_2]\,i_2 = [R_1+R_2]\,I_S \Rightarrow i_2 = I_S$ ✓ ckt is solved

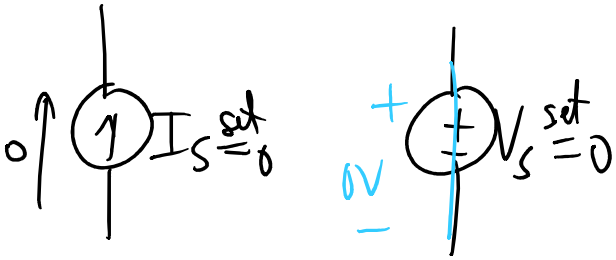
Now, solve for V_{oc}: $-V_{oc} - R_2(i_2 - i_1) + R_3 i_1 = 0 \Rightarrow V_{oc} = R_3 I_S$

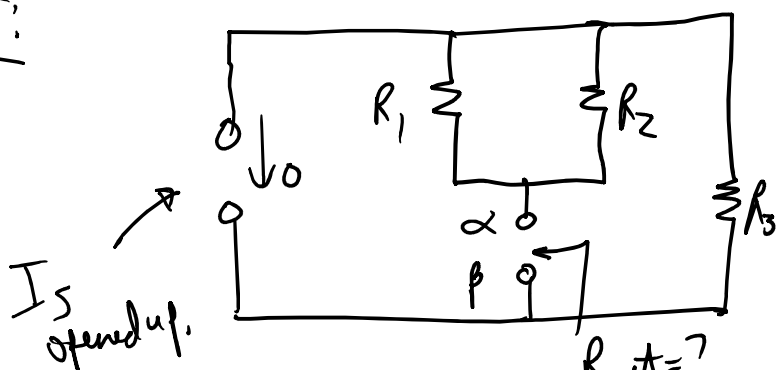
($R_2(i_2-i_1) = 0V$; $i_1 = I_S$; $i_2 = I_S$)

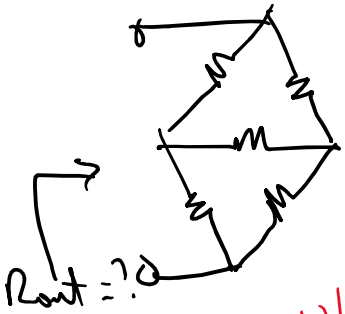
$\Rightarrow V_{TH} \overset{set}{=} V_{oc} = 72V$

$R_{TH} = R_{out}$?

→ Deactivated ckt:





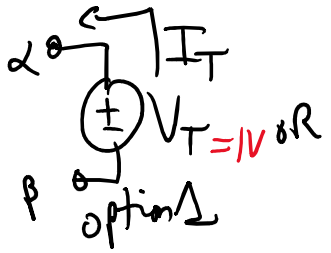


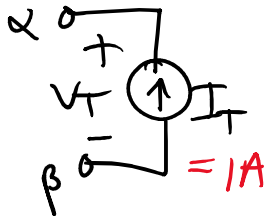
→ I'm going to combine R_S in series/parallel to get R_{out}. Why? I see no dep. sources, & no "wheatstone bridges"

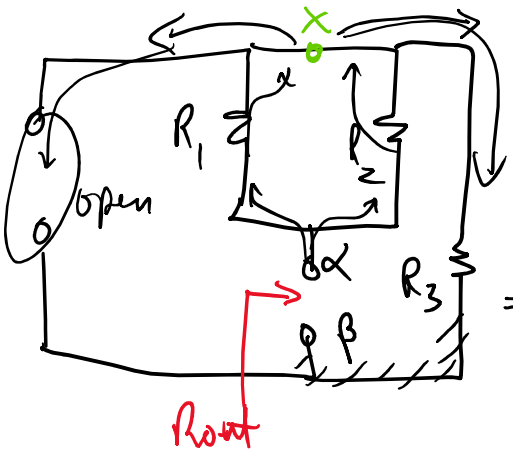
I will choose this one ("easier")

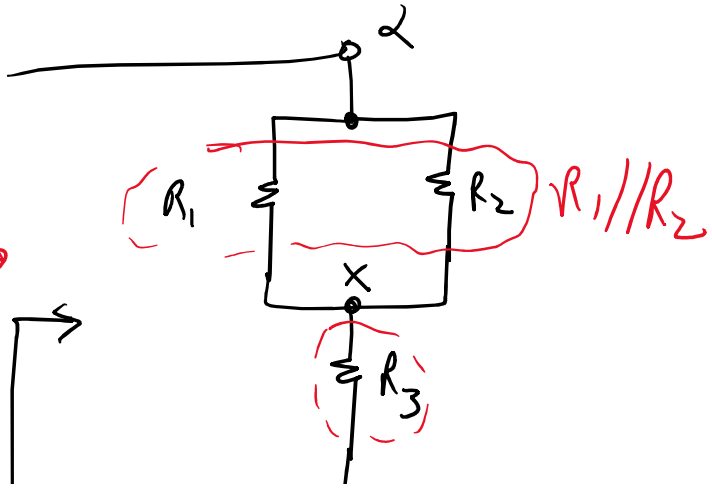
* → But we could attach a test source

$R_{out} = V_T / I_T$









$R_1 // R_2 + R_3$

$R_1 // R_2 + R_3$

$R_{out} = R_1 // R_2 + R_3$ $\qquad$ $R_{out} = ?$

$= 4k // 12k + 6k = \frac{(4k)(12k)}{4k+12k} + 6k = \frac{12k}{4} + 6k = 9k\Omega$

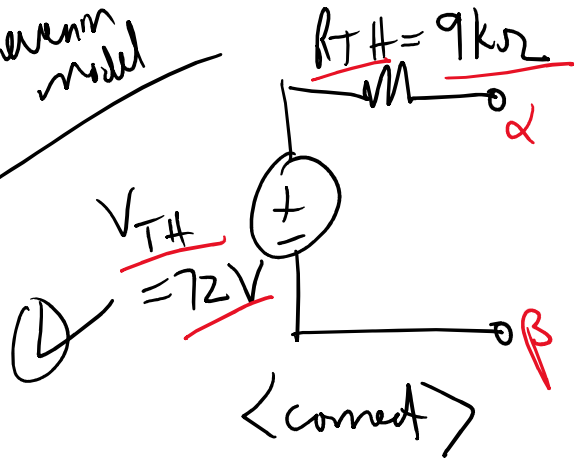
$\frac{12k}{3} = 4k$

3 12k in parallel

4 12k in parallel

$\Rightarrow R_{TH} \overset{set}{=} R_{out} = 9k\Omega$

Thevenin model



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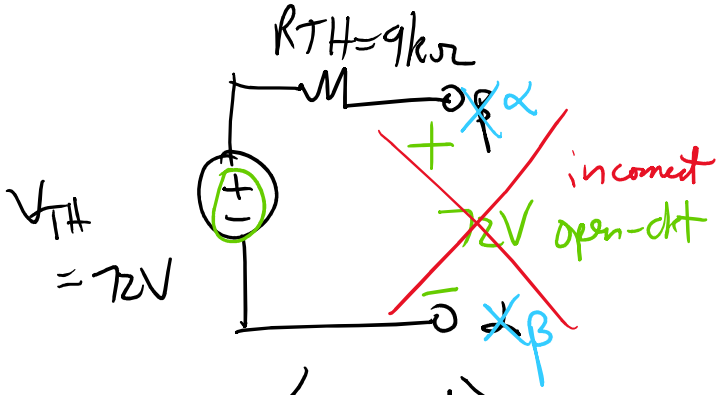

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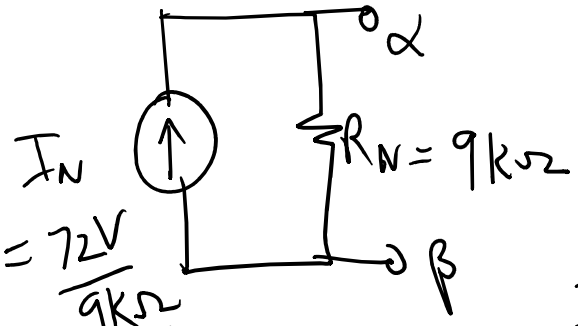
$I_N = V_{TH}/R_{TH}$, $R_N = R_{TH}$

Norton model



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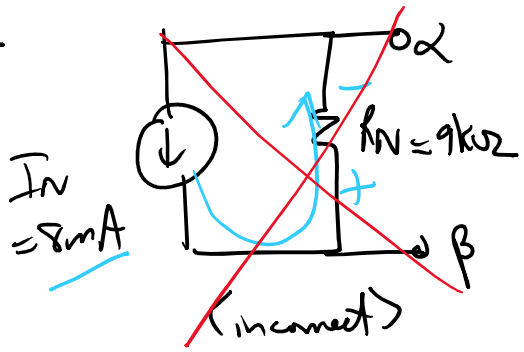

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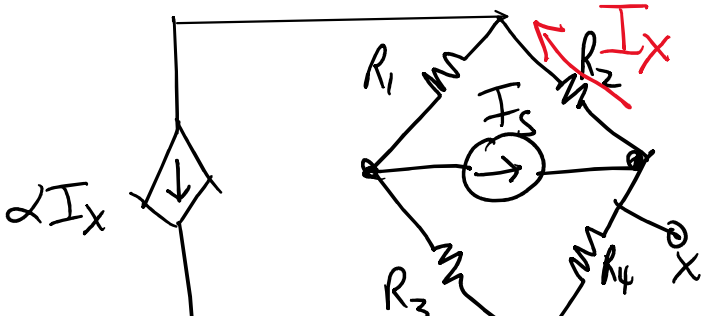
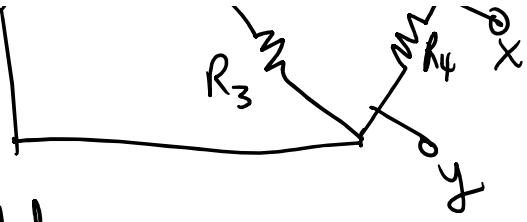
Example

Here, $R_1 = 2\Omega$, $R_2 = 1\Omega$,

$R_3 = 2\Omega$, $R_4 = 2\Omega$, $I_S = 3A$,



$R_3 = 2\Omega$, $R_4 = 2\Omega$, $I_S = 3A$,
$\alpha = 4A/A$



Compute the Thevenin & Norton models wrt nodes x & y: