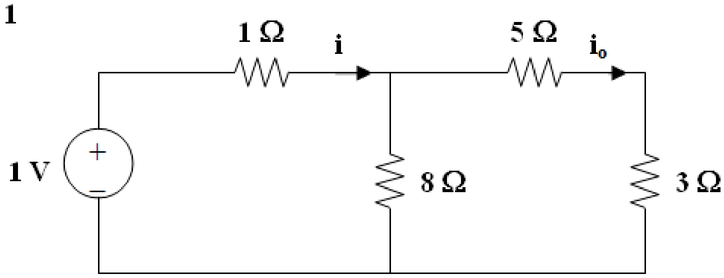
ENGR 12 Assignment 5 SOLNS

Part I. Drills -- 1 point each

1

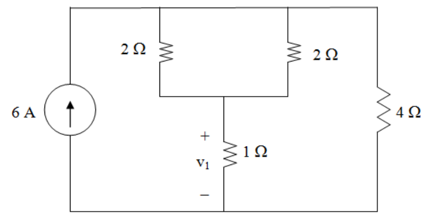


$$8\|(5+3) = 4\Omega,\ \ i = \frac{1}{1+4} = \frac{1}{5}$$

$$i_o = \frac{1}{2}i = \frac{1}{10} = \underline{\mathbf{0.1A}}$$

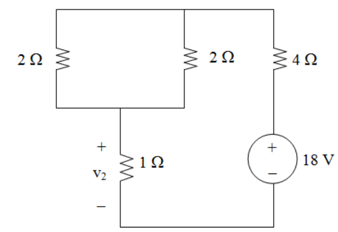
Since the resistance remains the same we get $i = 10/5 = 2A$ which leads to $i_o = (1/2)i = (1/2)2 = \underline{\mathbf{1A}}$.

2) Let $v_o = v_1 + v_2$, where v_1 and v_2 are due to 6-A and 20-V sources respectively. We find v_1 using the circuit below.



$2//2 = 1\ \Omega$, $\quad v_1 = 1x\frac{4}{4+2}(6A) = 4\text{ V}$

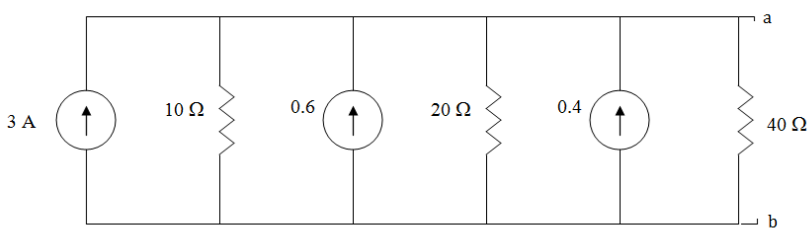
We find v_2 using the circuit below.



$$v_2 = \frac{1}{1+1+4}(18) = 3\text{ V}$$

$v_o = v_1 + v_2 = 4 + 3 = \underline{7\text{ V}}$

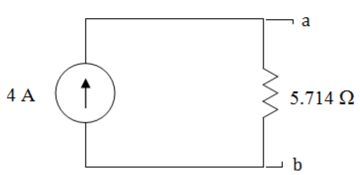
3) Convert the voltage sources to current sources and obtain the circuit shown below.

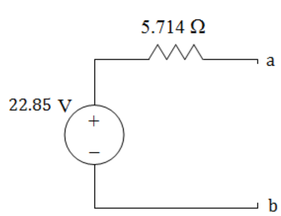


$$\frac{1}{R_{eq}} = \frac{1}{10} + \frac{1}{20} + \frac{1}{40} = 0.1 + 0.05 + 0.025 = 0.175 \longrightarrow R_{eq} = 5.714\ \Omega$$

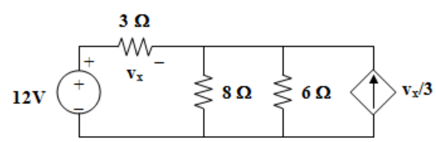
$I_{eq} = 3 + 0.6 + 0.4 = 4$

Thus, the circuit is reduced as shown below.

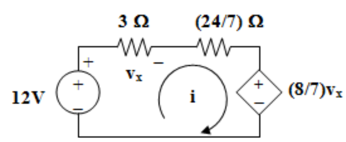




4) Transform the dependent source so that we have the circuit in Fig. (a). $6\|8 = (24/7)$ ohms. Transform the dependent source again to get the circuit in Fig. (b).



(a)



(b)

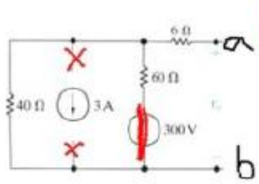
From Fig. (b) $v_x = 3i$, or $i = v_x/3$.

Applying KVL, $-12 + (3 + 24/7)i + (24/21)v_x = 0$

$12 = [(21 + 24)/7]v_x/3 + (8/7)v_x$, leads to

$v_x = 84/23 = \underline{\mathbf{3.652\ V}}$

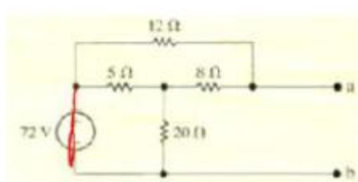
5) Find just the "Lookback" resistance (turn off sources) from terminals a-b



$R = 6 + 60\|40$

$= 6 + 24$

$= \underline{30\Omega}$

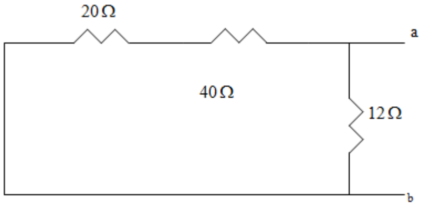


$R = 12\|(8 + 20\|5)$

$= 12\|(8+4)$

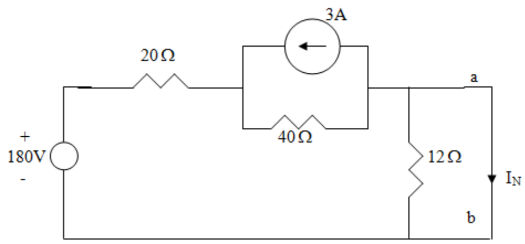
$= 12\|12 = \underline{\underline{6\Omega}}$

6) R_N is found from the circuit below.

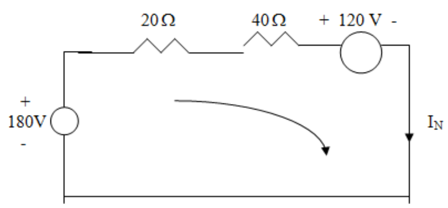


$R_N = 12 // (20 + 40) = \underline{10\Omega}$

I_N is found from the circuit below.



Applying source transformation to the current source yields the circuit below.



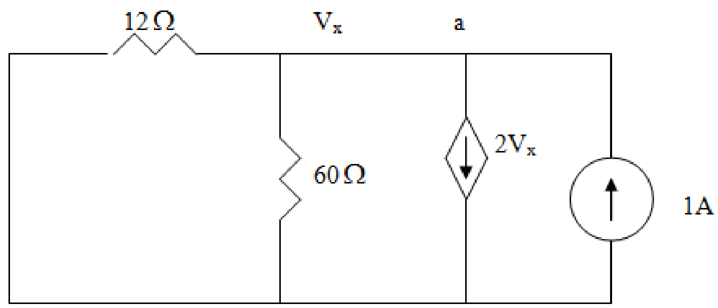
Applying KVL to the loop yields

$-180 + 120 + 60I_N = 0 \quad \longrightarrow \quad I_N = 60/60 = \underline{1\text{ A}}$

7) Since $V_{Th} = V_{ab} = V_x$, we apply KCL at the node a and obtain

$$\frac{50 - V_{Th}}{12} = \frac{V_{Th}}{60} + 2V_{Th} \quad \longrightarrow \quad V_{Th} = 250/126 = 1.9841\text{ V}$$

To find R_{Th}, consider the circuit below.



At node a, KCL gives

$$1 = 2V_x + \frac{V_x}{60} + \frac{V_x}{12} \quad \longrightarrow \quad V_x = 60/126 = 0.4762$$

$$R_{Th} = \frac{V_x}{1} = 0.4762\Omega, \qquad I_N = \frac{V_{Th}}{R_{Th}} = 1.9841/0.4762 = 4.167\text{A}$$

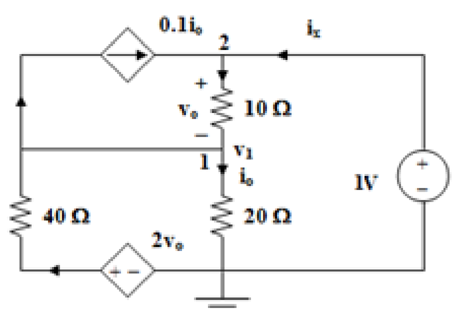
Thus,

$V_{Th} = 1.9841$ V, $R_{eq} = R_{Th} = R_N = 476.2$ mΩ, $I_N = 4.167$ A

Pmax = $(V_{Th})^2/(4R_{Th})$ = 2.11 W

8) Since there are no independent sources, $V_{Th} = 0$ V

To obtain R_{Th}, consider the circuit below.



At node 2,

$$i_x + 0.1i_o = (1 - v_1)/10, \text{ or } 10i_x + i_o = 1 - v_1 \qquad (1)$$

At node 1,

$$(v_1/20) + 0.1i_o = [(2v_o - v_1)/40] + [(1 - v_1)/10] \qquad (2)$$

But $i_o = (v_1/20)$ and $v_o = 1 - v_1$, then (2) becomes,

$$1.1v_1/20 = [(2 - 3v_1)/40] + [(1 - v_1)/10]$$

$$2.2v_1 = 2 - 3v_1 + 4 - 4v_1 = 6 - 7v_1$$

or

$$v_1 = 6/9.2 \qquad (3)$$

From (1) and (3),

$$10i_x + v_1/20 = 1 - v_1$$

$$10i_x = 1 - v_1 - v_1/20 = 1 - (21/20)v_1 = 1 - (21/20)(6/9.2)$$

i_x = 31.52 mA, $R_{Th} = 1/i_x$ = **31.73 ohms.**