ECE 2210 / 00 Thevenin & Norton Examples

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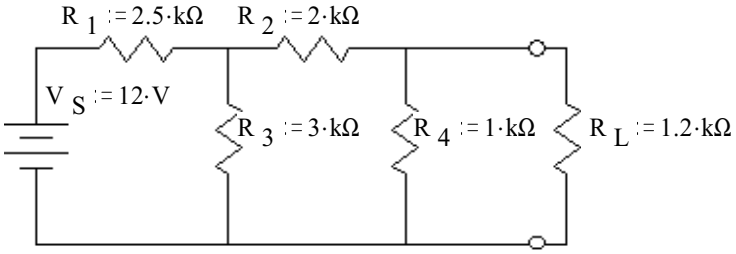
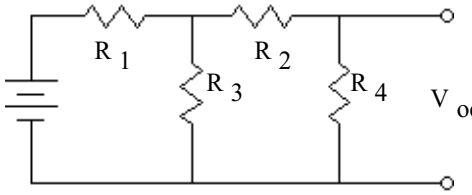
1/23/03,
9/6/05

Ex 1 a) Find and draw the Thevenin equivalent circuit.

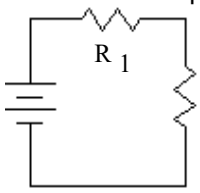


Find the open circuit voltage:



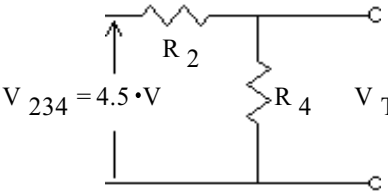
$V_{oc} = V_{Th}$

First do some simplification:



$$R_{eq234} := \frac{1}{\frac{1}{R_3} + \frac{1}{R_2 + R_4}} \qquad R_{eq234} = 1.5 \cdot k\Omega$$

$$V_{234} := \frac{R_{eq234}}{R_1 + R_{eq234}} \cdot V_S$$

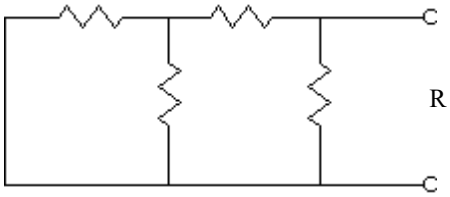


$V_{234} = 4.5 \cdot V$

$$V_{Th} := \frac{R_4}{R_2 + R_4} \cdot V_{234} \qquad V_{Th} = 1.5 \cdot V$$

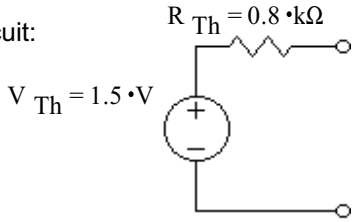
Find the Thevenin resistance:

Zero the source



$$R_{Th} := \frac{1}{\frac{1}{R_4} + \frac{1}{R_2 + \frac{1}{\left(\frac{1}{R_1} + \frac{1}{R_3}\right)}}} \qquad R_{Th} = 770.8 \cdot \Omega$$

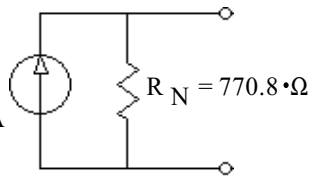
Thevenin equivalent circuit:



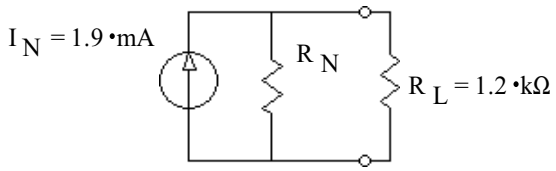
b) Find and draw the Norton equivalent circuit.

$$R_N := R_{Th}$$

$$I_N := \frac{V_{Th}}{R_{Th}} \qquad I_N = 1.9 \cdot mA$$

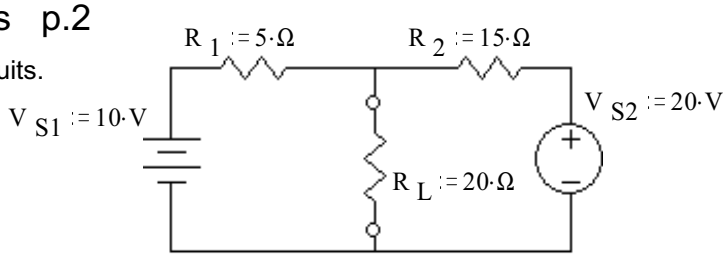


c) Use your Norton equivalent circuit to find the current through the load.



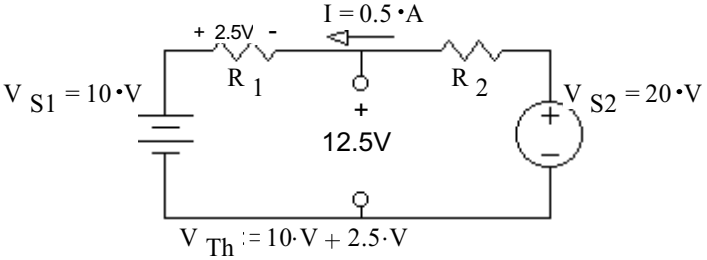
$$I_L := \frac{\frac{1}{R_L}}{\left(\frac{1}{R_N} + \frac{1}{R_L}\right)} \cdot I_N \qquad I_L = 0.761 \cdot mA$$

Ex 2 a) Find and draw the Thevenin & Norton equivalent circuits.

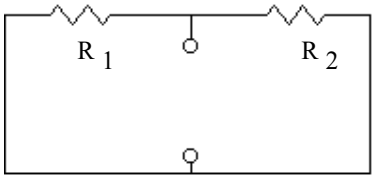


$$I := \frac{V_{S2} - V_{S1}}{R_1 + R_2}$$

$I = 0.5 \cdot A$



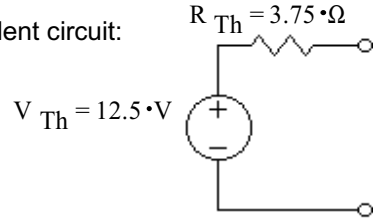
$V_{Th} := 10 \cdot V + 2.5 \cdot V$



$$R_{Th} := \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

$R_{Th} = 3.75 \cdot \Omega$

Thevenin equivalent circuit:

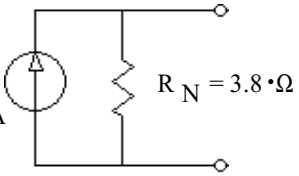


Norton equivalent circuit:

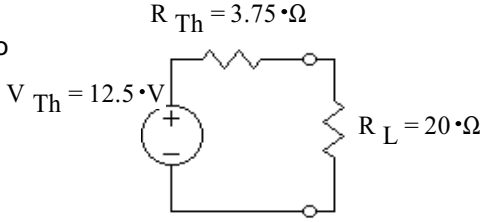
$R_N := R_{Th}$

$$I_N := \frac{V_{Th}}{R_{Th}}$$

$I_N = 3.333 \cdot A$



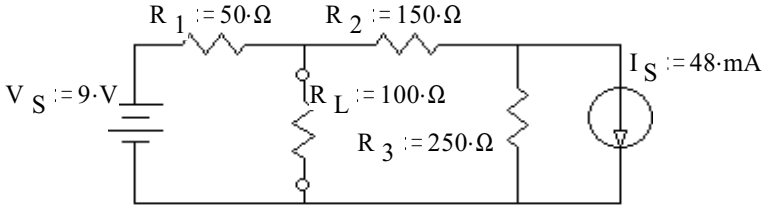
b) Use your Thevenin equivalent circuit to find the voltage across the load.



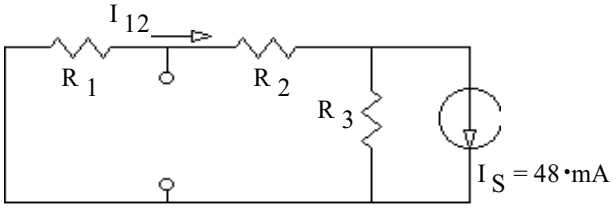
$$V_L := \frac{R_L}{R_{Th} + R_L} \cdot V_{Th}$$

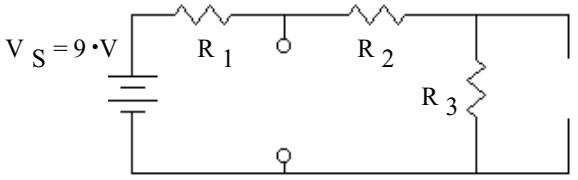
$V_L = 10.53 \cdot V$

Ex 3 a) Find and draw the Thevenin & Norton equivalent circuits.



Use superposition to find V_{Th}.





$$I_{12} := \frac{\frac{1}{R_1 + R_2}}{\frac{1}{R_1 + R_2} + \frac{1}{R_3}} \cdot I_S$$

$I_{12} = 26.667 \cdot mA$

$V_{Th.I} := -I_{12} \cdot R_1$

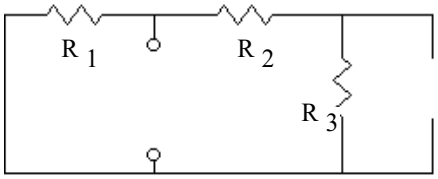
$V_{Th.I} = -1.333 \cdot V$

$$V_{Th.V} := \frac{R_2 + R_3}{R_1 + R_2 + R_3} \cdot V_S$$

$V_{Th.V} = 8 \cdot V$

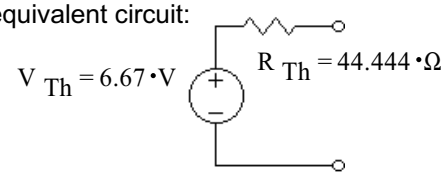
$V_{Th} := V_{Th.V} + V_{Th.I}$

$V_{Th} = 6.667 \cdot V$



$$R_{Th} := \frac{1}{\frac{1}{R_1} + \frac{1}{R_2 + R_3}}$$

Thevenin equivalent circuit:



Norton equivalent circuit:

$$I_N := \frac{V_{Th}}{R_{Th}}$$

$I_N = 150 \cdot mA$

$R_N := R_{Th}$