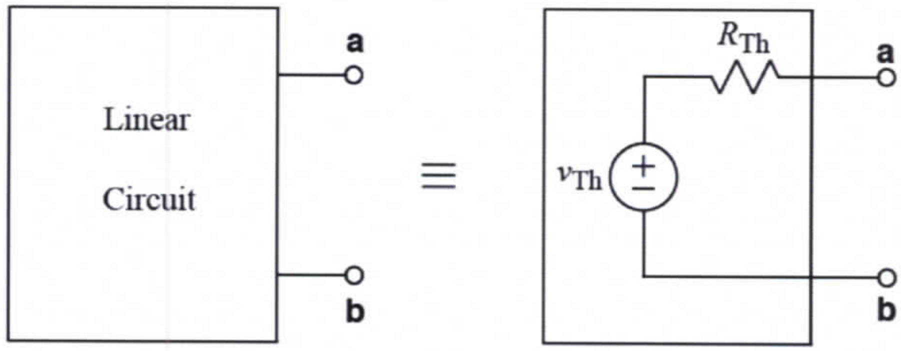
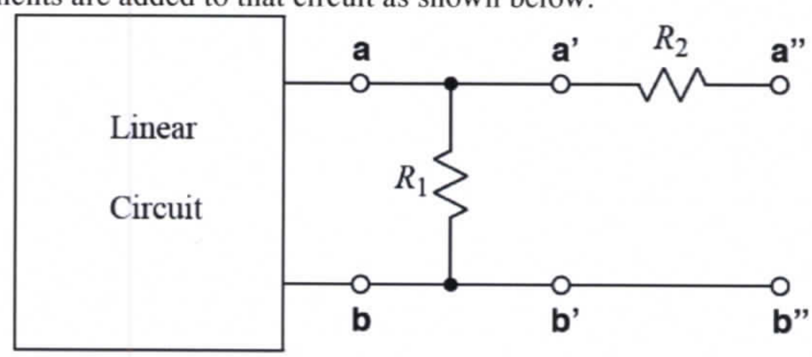
ECE 2240 **HOMEWORK #6 prob 4 solution**
N. Cotter F13

**Ex:**



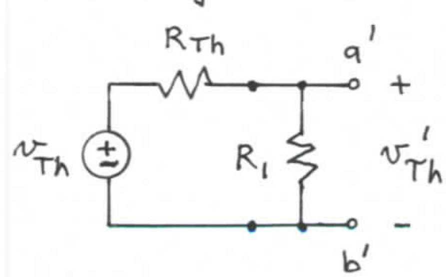

A linear circuit has a Thevenin equivalent, as shown above. Now suppose that components are added to that circuit as shown below.




a) Find the Thevenin equivalent circuit at terminals a'-b' in terms of the original $v_{Th}$ and $R_{Th}$ and the added $R_1$. (Note that this is the circuit with only $R_1$ added to it.)

b) Find the Thevenin equivalent circuit at terminals a"-b" in terms of the original $v_{Th}$ and $R_{Th}$ and the added $R_1$ and $R_2$.

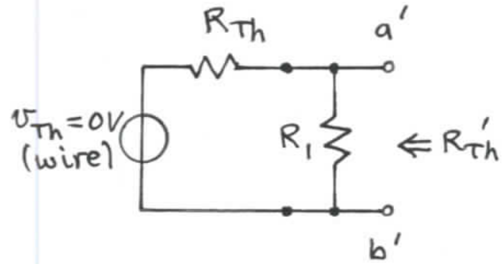
**SOL'N:** a) The $v_{Th}'$ for a', b' is the voltage across a', b' with nothing connected as a load across a', b'.



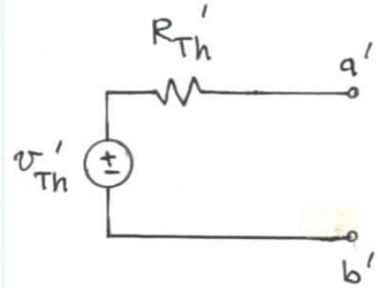
This is a voltage divider.

$$v'_{Th} = v_{Th}\frac{R_1}{R_1 + R_{Th}} \quad \text{or} \quad v'_{Th} = v_{Th}\frac{1}{1 + R_{Th}/R_1}$$

To find $R'_{Th}$, we turn off $v_{Th}$ and look in from a', b'.



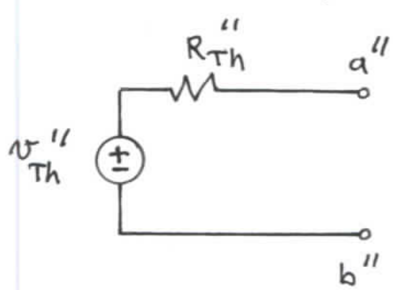

$$R_{Th} = R_1 \parallel R_{Th} \quad \text{or} \quad R'_{Th} = \frac{R_{Th}}{1 + R_{Th}/R_1}$$




$$v'_{Th} = v_{Th}\frac{R_1}{R_1 + R_{Th}}$$

$$R'_{Th} = R_1 \parallel R_{Th}$$

b) With $R_2$ connected to the output of the Thevenin equivalent, the Thevenin equivalent voltage remains $v'_{Th}$, and the Thevenin equivalent resistance is $R'_{Th} + R_2$, since the R's are in series.




$$v''_{Th} = v'_{Th} = v_{Th}\frac{R_1}{R_1 + R_{Th}}$$

$$R''_{Th} = R'_{Th} + R_2 = R_1 \parallel R_{Th} + R_2$$