

ECE 109 - EQUIVALENT CIRCUITS - INVESTIGATION 21 THEVENIN'S THEOREM - PART IV

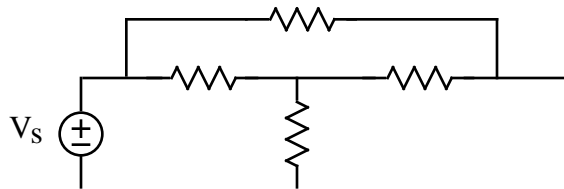
SUMMER 2007

A.P. FELZER

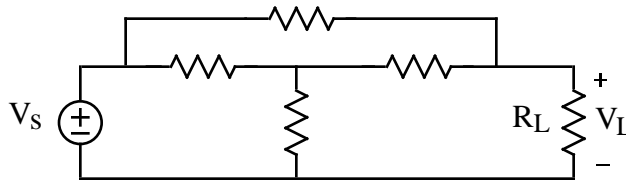
To do "well" on this investigation you must not only get the right answers but must also do neat, complete and concise writeups that make obvious what each problem is, how you're solving the problem and what your answer is. You also need to include drawings of all circuits as well as appropriate graphs and tables.

The main objective of this Investigation is to come up with a way to obtain the Thevenin Equivalent Resistance of a circuit without setting its sources to zero. Be sure to take a look at the **Computer Demos** on Thevenin's Equivalent.

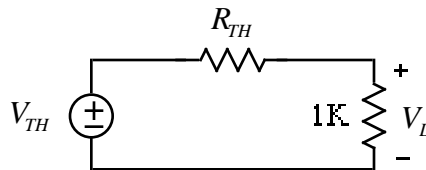
1. We've been finding the Thevenin Equivalent Resistances R_{TH} of circuits like the following



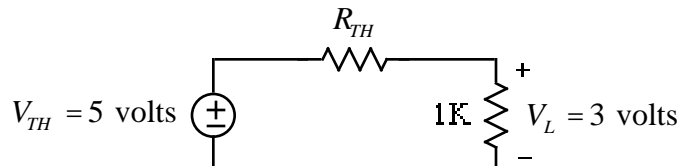
by setting their sources to zero and then calculating the corresponding equivalent resistances. This is fine for calculations. But when we're in the lab, it's not always possible to get inside a circuit and set its sources to zero. To get around this problem, we first obtain V_{TH} by measuring V_{OC} as usual. We then hook up a **known** load resistor R_L as follows



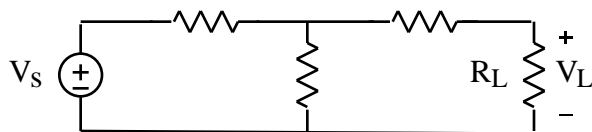
and measure the voltage V_L across it. We can then calculate R_{TH} in the following circuit



by making use of the known values of V_{TH} , V_L and R_L . Analyze the following circuit for R_{TH}

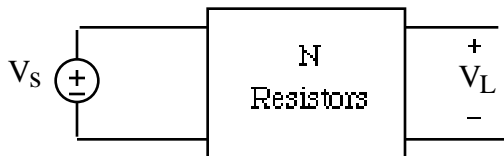


2. Find and draw the Thevenin Equivalent as seen by R_L in the following circuit



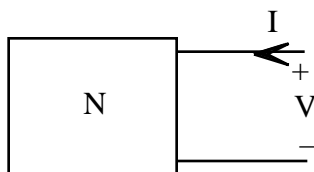
if $V_L = V_{OC} = 5$ volts when R_L is removed and $V_L = 2$ volts when $R_L = 2K$

3. Find and draw the Thevenin Equivalent of



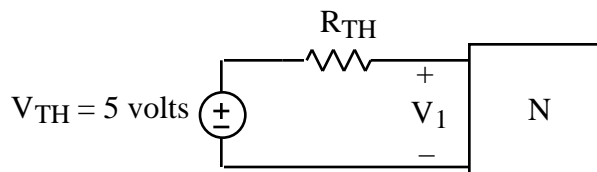
if the open circuit voltage at the output is $V_L = V_{OC} = -5$ volts and $V_L = -3$ volts when an $R_L = 2K$ resistor is connected

4. Find and draw the Thevenin Equivalent of the following circuit



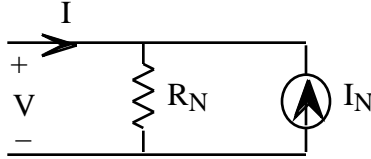
if $V_L = V_{OC} = -8$ volts and $V_L = -5$ volts when a $4K$ resistor is connected at the output

5. Make up and do a problem like one of those above
6. Suppose a resistor circuit with Thevenin Equivalent Voltage $V_{TH} = 5$ volts and Thevenin Equivalent Resistance R_{TH} is connected to a circuit N of resistors with equivalent resistance R_{EQ} as follows



- As always, begin by drawing the equivalent circuit
- Sketch V_1 as a function of the equivalent resistance R_{EQ} of N
- What's a reasonable approximation of V_1 when $R_{EQ} \gg R_{TH}$
- What's a reasonable approximation of V_1 when $R_{EQ} \ll R_{TH}$

7. Find and draw the Thevenin Equivalent of the following circuit



8. The circuit in Problem (7) with a current source I_N in parallel with a resistor R_N is referred to as a **Norton Equivalent**. **Memorize** what we mean by the Norton Equivalent
- Find R_N and I_N in terms of R_{TH} and V_{TH}
 - Find and draw the Norton Equivalent of a circuit with $V = 1000I + 4$
9. Math Review: Given $x(t) = 3\cos(2000t)$
- Sketch three periods - three cycles - of $x(t)$ starting at $t = 0$
 - What is the amplitude of $x(t)$
 - What is the frequency in cycles/sec of $x(t)$