Problem 3.83  Simulate the circuit found in Fig. P3.83 with a 10-Ω resistor placed across the terminals \((a,b)\). Then either by hand or by using tools in Multisim (see Multisim Demo 3.3), find the Thévenin and Norton equivalent circuits and simulate both of those circuits in Multisim with 10-Ω resistors across their output terminals. Show that the voltage drop across and current through the 10-Ω load resistor is the same in all three simulations.

**Figure P3.83:** Circuit for Problem 3.83.

Solution: When the circuit is built and simulated, the following values for the voltage across and current into the 10-Ω load resistor can be seen below:

There are several ways to find the short-circuit current and the open-circuit voltage. You can do it with current probes, if you’d like, or you can do it using a multimeter (Multisim Demo 3.3 in the Tutorial). We’ll do it with probes here.

To get the open-loop voltage, remove the 10-Ω load resistor, put a probe right at node 2, and simulate as shown below:
The voltage value of 1.58 V obtained is the open-circuit voltage (the current value displayed is of no use to us). Now, short the output, put a probe on the short, and simulate as shown below:

The current value of 240 mA obtained is the short-circuit current (the voltage is 0 V, of course, since we're shorting to ground).

So of course with the open-circuit voltage and short-circuit current we can obtain the Thévenin Resistance

\[ R_{Th} = \frac{1.58}{0.240} = 6.5833 \Omega. \]

So now we have all three critical values:

\[ V_{Th} = 1.58 \text{ V} \]
\[ I_N = 240 \text{ mA} \]
\[ R_{Th} = 6.583 \Omega. \]

Building each circuit and running it through a 10-Ω load resistor as well as including the original circuit with the 10-Ω load resistor results in the three circuits shown below:
As we can see, the voltage and current across the load resistors in each circuit are almost identical. Any difference is due to rounding errors and significant digits.