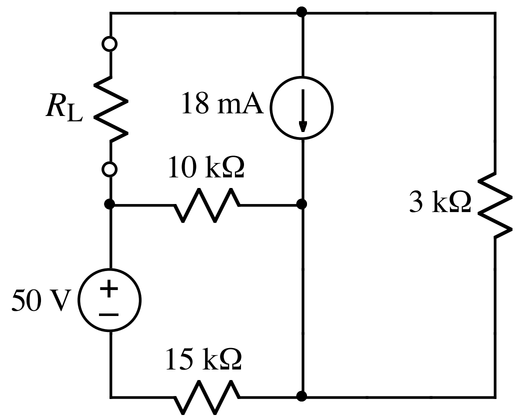
Ex:



a) Calculate the value of R_L that would absorb maximum power.

b) Calculate that value of maximum power R_L could absorb.

SOL'N: a) The value of R_L that will absorb maximum power is always R_{Th} (as seen from the terminals where R_L is connected). Here, we have only independent sources, and we may turn them off and look into the circuit to find R_{Th}:

$$R_{Th} = 10\text{ k}\Omega \| 15\text{ k}\Omega + 3\text{ k}\Omega = 6\text{ k}\Omega + 3\text{ k}\Omega = 9\text{ k}\Omega$$

We set R_L equal to R_{Th}:

$$R_L = R_{Th} = 9\text{ k}\Omega$$

b) The maximum power transferred is always

$$p_{max} = \frac{v_{Th}^2}{4R_{Th}}.$$

We find the Thevenin equivalent voltage by removing R_L and determining the voltage across the terminals where R_L was connected. Superposition is a convenient tool to use here.

If we turn on the 50 V source and turn off the 18 mA source, we have the 3 kΩ resistor dangling with no current and no voltage drop, and we have a voltage divider formed by the 50 V source and the 10 kΩ and 15 kΩ resistors. The voltage across the terminals is the same as the voltage across the 10 kΩ resistor. Measured with the + on the top terminal, the voltage across the terminals will be

$$v_{\text{Th1}} = -50\text{ V} \cdot \frac{10\text{ k}\Omega}{10\text{ k}\Omega + 15\text{ k}\Omega} = -20\text{ V}.$$

If we turn on the 18 mA source and turn off the 50 V source, we have the 10 kΩ and 15 kΩ resistors in parallel, dangling so that no current passes through them. All of the 18 mA will pass through the 3 kΩ resistor. The voltage across the terminals will be equal to the voltage drop across the 3 kΩ resistor, measured with the + on top:

$$v_{\text{Th2}} = -18\text{ mA} \cdot 3\text{ k}\Omega = -54\text{ V}$$

The total Thevenin equivalent voltage is the sum of the above values:

$$v_{\text{Th}} = v_{\text{Th1}} + v_{\text{Th2}} = -20\text{ V} + -54\text{ V} = -74\text{ V}$$

Using this value of v_{Th}, we find the maximum power:

$$p_{\max} = \frac{(-74)^2}{4 \cdot 9\text{ k}}\text{W} = \frac{37^2}{9}\text{mW} \approx 152\text{ mW}$$