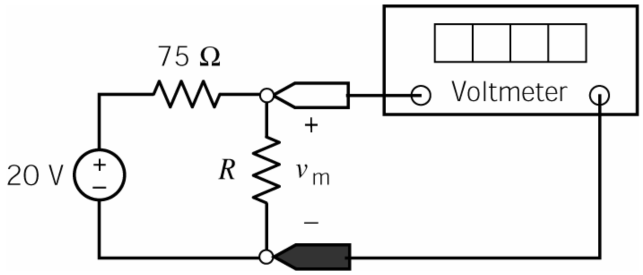
Example
Consider the voltage divider circuit



The resistor represents a temperature sensor. Suppose the resistance *R*, in Ω, is related to the temperature *T*, in °C, by the equation

$$R = 50 + \frac{1}{2}T$$

Suppose the temperature is expected to be in the range $0\,°\text{C} \le T \le 100\,°\text{C}$.

a) Determine the meter voltage, v_m, corresponding to temperatures 0 °C, 75 °C and 100 °C.

b) Determine the temperature, *T*, corresponding to the meter voltages 8 V, 10 V and 15 V.

Solution

Using voltage division $$v_m = \left(\frac{R}{75+R}\right)20$$

Solving for *R* yields $$R = \frac{75 v_m}{20 - v_m}$$

The temperature can be calculated from the resistance using

$$T = 2(R-50) = 2\left(\frac{75 v_m}{20 - v_m} - 50\right) = \frac{150 v_m}{20 - v_m} - 100$$

a) At 0 °C the resistance is *R* = 50 Ω so $v_m = \left(\frac{50}{75+50}\right)20 = 8\text{ V}$. At 75 °C the resistance is *R* = 87.5 Ω so $v_m = \left(\frac{87.5}{75+87.5}\right)20 = 10.77\text{ V}$. At 100 °C the resistance is *R* = 100 Ω so $v_m = \left(\frac{100}{75+100}\right)20 = 11.43\text{ V}$.

b) When $v_m = 8$ V, the temperature is $T = \frac{150(8)}{20-8} - 100 = 0\ °\text{C}$. When $v_m = 10$ V, the temperature is $T = \frac{150(10)}{20-10} - 100 = 50\ °\text{C}$. When $v_m = 15$ V, the temperature is $T = \frac{150(15)}{20-15} - 100 = 350\ °\text{C}$.