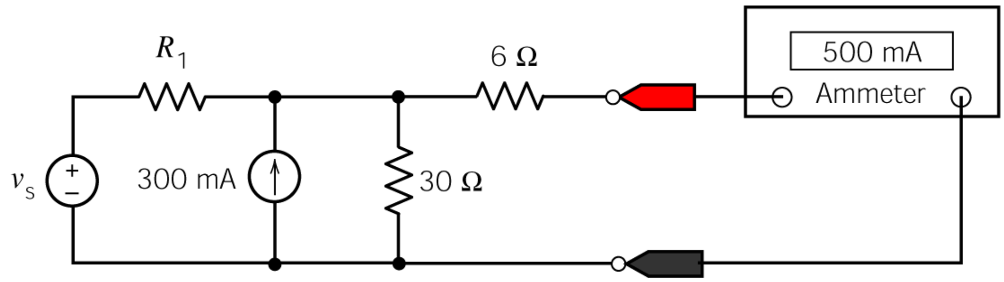
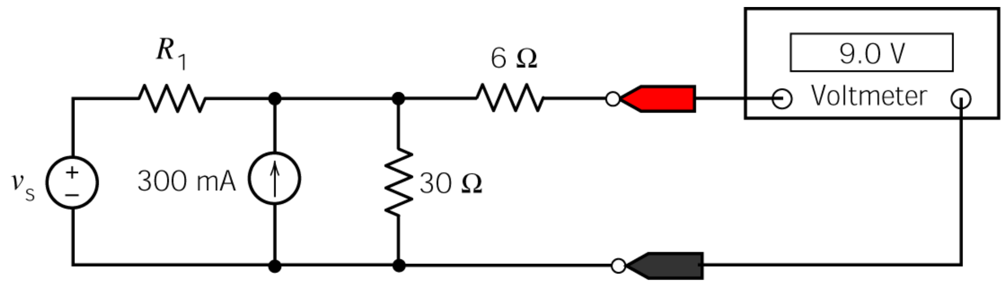
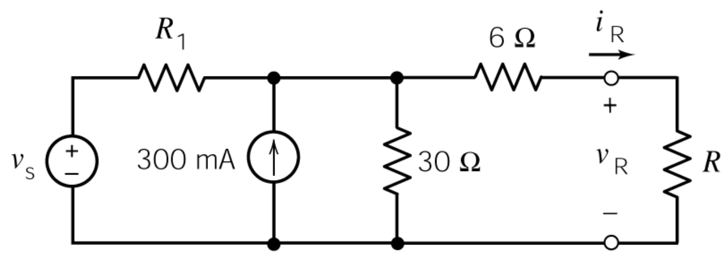
Given



and



Consider



Fill in the blanks in the following statements:

a. When $R = 9\ \Omega$ then $v_R =$ __________V.

b. When $R =$ __________Ω then $v_R = 2.52$ V.

c. When $R =$ __________Ω then $i_R = 300$ mA.

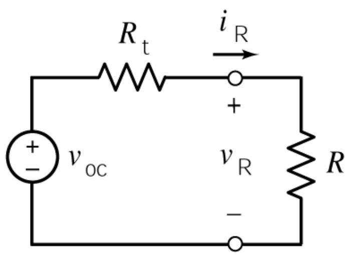
d. $R_1 =$ __________Ω and $v_s =$ __________V.

Solution

Recognize that the ammeter measures the short circuit current and the voltmeter measures the open circuit voltages. Consequently

$$i_{sc} = 500\text{ mA}, \quad v_{oc} = 9\text{ V} \quad \text{and} \quad R_t = \frac{v_{oc}}{i_{sc}} = \frac{9}{0.5} = 18\ \Omega$$

Replace the part of the circuit to the left of the terminals by its Thevenin equivalent circuit to get



$$\Rightarrow \quad v_R = \left(\frac{R}{R_t + R}\right) v_{oc} \quad \text{and} \quad i_R = \frac{v_{oc}}{R_t + R}$$

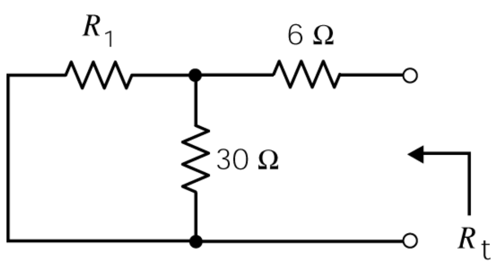
Using $v_{oc} = 9$ V and $R_t = 18\ \Omega$ we have $v_R = \dfrac{9R}{18+R}$ and $i_R = \dfrac{9}{18+R}$.

a. When $R = 9\ \Omega$ then $v_R =$ ____3_____V.

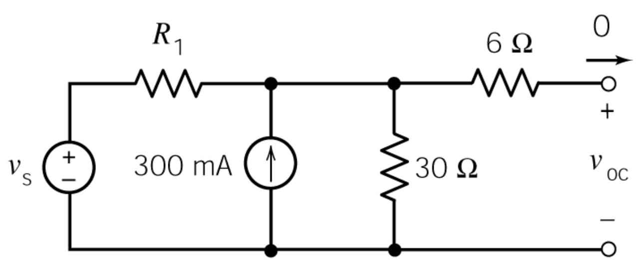
b. When $R =$ _____7____Ω then $v_R = 2.52$ V.

c. When $R =$ _____9____Ω then $i_R = 300$ mA.

d.



$$\Rightarrow \quad R_t = 6 + \frac{30\,R_1}{30 + R_1}$$



$$\Rightarrow \quad v_{oc} = \left(\frac{30}{30+R_1}\right) v_s + \left(\frac{30\,R_1}{30+R_1}\right) 0.3$$

Using $v_{oc} = 9$ V and $R_t = 18\ \Omega$ we have

$$18 = 6 + \frac{30\,R_1}{30+R_1} \quad \Rightarrow \quad R_1 = 20\ \Omega$$

$$9 = \left(\frac{30}{30+R_1}\right) v_s + \left(\frac{30\,R_1}{30+R_1}\right) 0.3 = \left(\frac{30}{30+20}\right) v_s + \left(\frac{30 \cdot 20}{30+20}\right) 0.3 = 0.6\,v_s + 3.6 \quad \Rightarrow \quad v_s = 9\ \text{V}$$