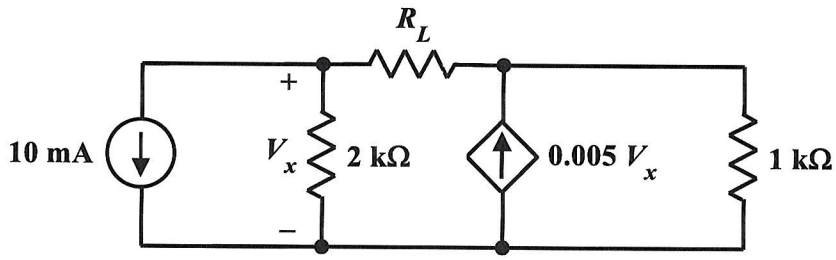
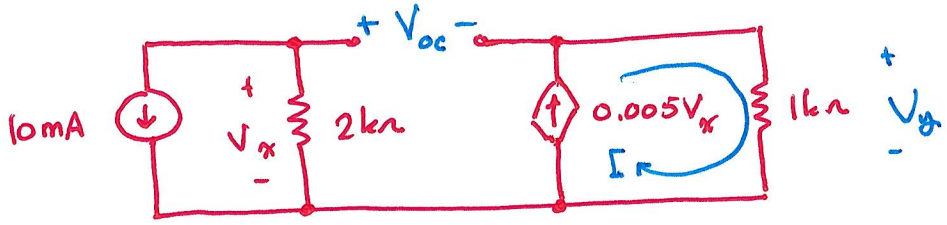
EE 2240

Homework Problem #045



What value of R_L will absorb maximum power from the remainder of the circuit?

Under open-circuit conditions:



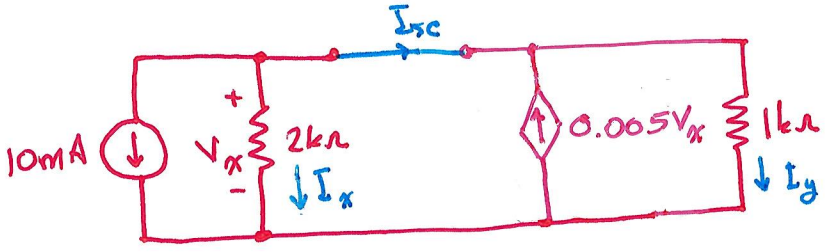
$V_x = -(2k\Omega)(10mA) = -20V$

$I = 0.005\,V_x = 0.005(-20) = -0.1A$

$V_y = (1k\Omega)\,I = -100V$

$V_{oc} = V_x - V_y = -20V - (-100V) = 80V$

Under short-circuit conditions:



$$I_x = \frac{V_x}{2k\Omega}$$

$$I_y = \frac{V_x}{1k\Omega}$$

$$10mA + I_x - 0.005\,V_x + I_y = 0 \qquad \text{(KCL)}$$

or $$10mA + \frac{V_x}{2k\Omega} - 0.005V_x + \frac{V_x}{1k\Omega} = 0$$

$$\Rightarrow \left(\frac{1}{2000} - \frac{5}{1000} + \frac{1}{1000}\right) V_x = -10mA$$

or $$-\frac{7}{2000} V_x = -10mA$$

$$\Rightarrow V_x = \frac{2000}{7}(10\times10^{-3}) = \frac{20}{7}\,V$$

Then $$I_{sc} = -10mA - I_x$$

$$= -10mA - \frac{20/7}{2k\Omega}$$

$$= -\frac{80}{7}\,mA$$

$$R_T = \frac{V_{oc}}{I_{sc}} = \frac{80}{-\frac{80}{7}\times10^{-3}} = -\frac{1000}{7}\,\Omega$$

Controlled sources can make a circuit behave as if it includes a negative resistance!

Since resistors absorb power only if they satisfy the P.S.C., we must choose $R_L = 0$ so that it absorbs 0 watts.