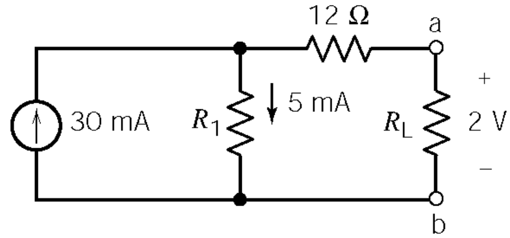
P1

$$R_L = \frac{2}{0.025} = 80\ \Omega$$

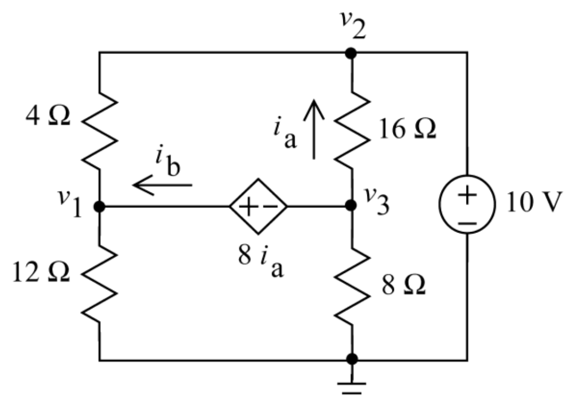


$$5\times10^{-3} = \frac{12+R_L}{R_1+(12+R_L)}(30\times10^{-3})$$

so

R_1 = 460 ohms

P2



Label the node voltages.

First, v_2 = 10 V due to the independent voltage source. Next, express the controlling current of the dependent source in terms of the node voltages:

$$i_a = \frac{v_3 - v_2}{16} = \frac{v_3 - 10}{16}$$

Now the controlled voltage of the dependent source can be expressed as

$$v_1 - v_3 = 8\ i_a = 8\left(\frac{v_3-10}{16}\right) \quad \Rightarrow \quad v_1 = \frac{3}{2}v_3 - 5$$

Apply KCL to the supernode corresponding to the dependent source to get

$$\frac{v_1 - v_2}{4} + \frac{v_1}{12} + \frac{v_3 - v_2}{16} + \frac{v_3}{8} = 0$$

Multiplying by 48 and using v_2 = 10 V gives

$$16v_1 + 9v_3 = 150$$

Substituting the earlier expression for v_1

$$16\left(\frac{3}{2}v_3 - 5\right) + 9v_3 = 150 \quad \Rightarrow \quad v_3 = 6.970\ \text{V}$$

Then v_1 = 5.455 V and i_a = -0.1894 A. Applying KCL at node 2 gives

$$\frac{v_1}{12} = i_b + \frac{10 - v_1}{4} \quad \Rightarrow \quad 12\, i_b = -3 + 4\, v_1 = -30 + 4(5.455)$$

So

$$i_b = -0.6817 \text{ A.}$$

Finally, the power supplied by the dependent source is

$$p = (8\, i_a) i_b = 8(-0.1894)(-0.6817) = 1.033 \text{ W}$$

P3

(a)

$$50(i_3 - i_2) + R_3 i_3 + 32 = 0 \quad \Rightarrow \quad 50(0.0770 - 0.7787) + R_3(0.0770) + 32 = 0$$

$$\Rightarrow \quad R_3 = 40\ \Omega$$

$$i_1 R_1 + 20 i_2 + 50(i_2 - i_3) - 24 = 0 \quad \Rightarrow \quad R_1(-2.2213) + 20(0.7787) + 50(0.7787 - 0.0770) = 24$$

$$\Rightarrow \quad R_1 = 12\ \Omega$$

(b)

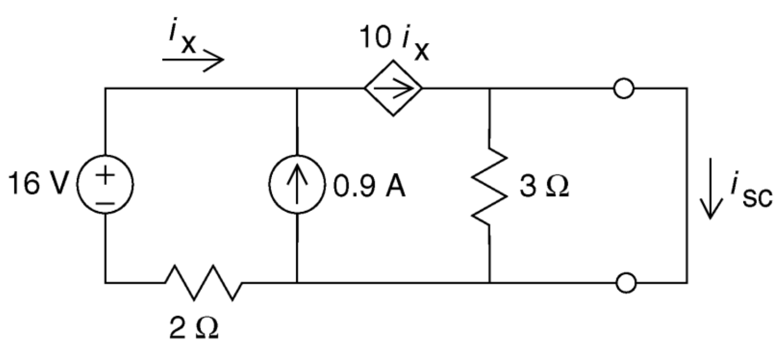
$$I_s = i_2 - i_1 = 0.7787 - (-2.2213) = 3 \text{ A}$$

The power supplied by the current source is

$$p = I_s(24 - R_1 i_1) = 3(24 - 12(-2.2213)) = 152 \text{ W}$$

P4

Find R_t by finding i_{sc} and v_{oc}:



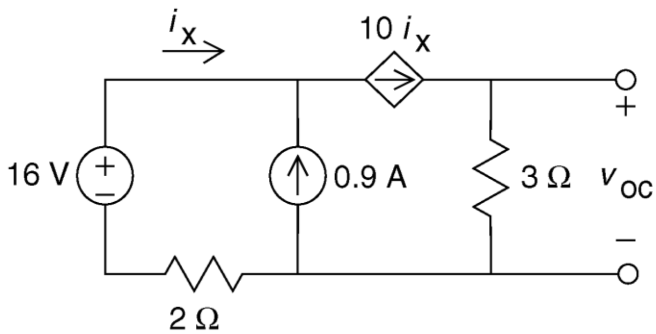
The current in the 3 Ω resistor is zero because of the short circuit. Consequently, $i_{sc} = 10\, i_x$. Apply KCL at the top-left node to get

$$i_x + 0.9 = 10\, i_x \quad \Rightarrow \quad i_x = \frac{0.9}{9} = 0.1 \text{ A}$$

so

$$i_{sc} = 10\, i_x = 1\text{A}$$

Next



Apply KCL at the top-left node to get

$$i_x + 0.9 = 10\, i_x \quad \Rightarrow \quad i_x = \frac{0.9}{9} = 0.1 \text{ A}$$

Apply Ohm's law to the 3 Ω resistor to get

$$v_{oc} = 3(10\, i_x) = 30(0.1) = 3 \text{ V}$$

For maximum power transfer to R_L:

$$R_L = R_t = \frac{v_{oc}}{i_{sc}} = \frac{3}{1} = 3\,\Omega$$

The maximum power delivered to R_L is given by

$$p_{\max} = \frac{{v_{oc}}^2}{4\, R_t} = \frac{3^2}{4(3)} = \frac{3}{4} \text{ W}$$