P2.70 Writing KVL equations around each mesh, we have

$$10i_1 + 15(i_1 - i_3) - 75 = 0$$

$$25(i_2 - i_3) + i_2 + 75 = 0$$

$$5i_3 + 25(i_3 - i_2) + 15(i_3 - i_2) = 0$$

Putting the equations into standard from, we have

$$25i_1 - 15i_3 = 75$$

$$26i_2 - 25i_3 = -75$$

$$-15i_1 - 25i_2 + 45i_3 = 0$$

Using Matlab to solve, we have

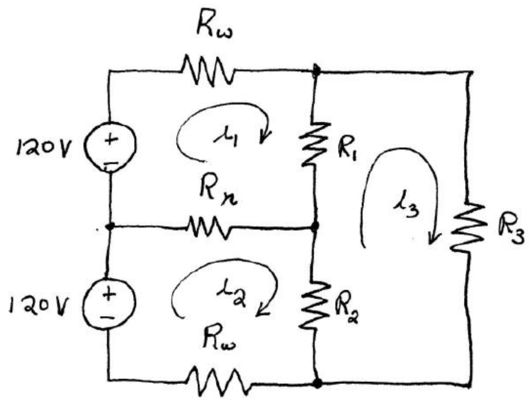
```
R = [25 0 -15; 0 26 -25; -15 -25 45];
V = [75; -75; 0];

I = R\V
I =

   1.6399
  -5.0643
  -2.2669
```

Then, the power delivered by the source is $P = 75(i_1 - i_2) =$ 502.815 W.

P2.77 (a) First, we select mesh-current variables as shown.



Then, we can write

$$(R_w + R_n + R_1)i_1 - R_n i_2 - R_1 i_3 = 120$$

$$-R_n i_1 + (R_w + R_n + R_2)i_2 - R_2 i_3 = 120$$
$$-R_1 i_1 - R_2 i_2 + (R_1 + R_2 + R_3)i_3 = 0$$

Alternatively, because the network consists of independent voltage sources and resistances, and all of the mesh currents flow clockwise, we can enter the matrices directly into MATLAB.

```
Rw = 0.1; Rn=0.1; R1 = 20; R2 = 10; R3 = 16;
R = [Rw+Rn+R1 -Rn -R1; -Rn Rw+Rn+R2 -R2; -R1 -R2 R1+R2+R3];
V = [120; 120; 0];
I = R\V;
% Finally, we compute the voltages across the loads.
Vr1 = R1*(I(1) - I(3)), Vr2 = R2*(I(2) - I(3)), Vr3 = R3*I(3)...
% which results in:

 Vr1 =
   118.5121
 Vr2 =
   116.7862
 Vr3 =
   235.2983
```

These values are within the normal range for nearly all devices.

(b) Next, we change Rn to a very high value such as 10^9 which for practical calculations is equivalent to an open circuit, and again compute the voltages resulting in:

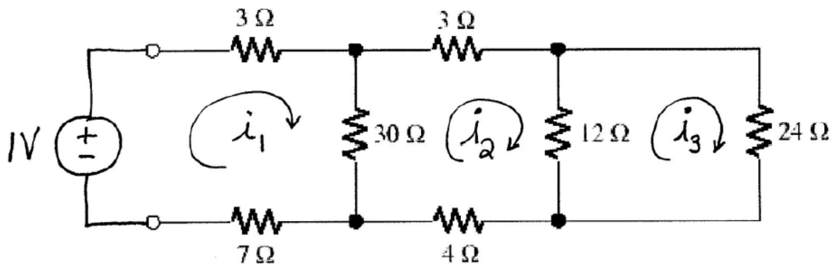
```
 Vr1 =
   156.9910
 Vr2 =
    78.4955
 Vr3 =
   235.4865
```

The voltage across R_1 is certainly high enough to damage most loads designed to operate at 110 to 120 V.

P2.80 Mesh 1: $3i_1 + 7i_1 + 30(i_1 - i_2) = 1$

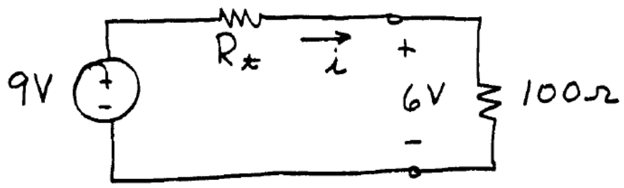
Mesh 2: $3i_2 + 12(i_2 - i_3) + 4i_2 + 30(i_2 - i_1) = 0$

Mesh 3: $24i_3 + 12(i_3 - i_2) = 0$



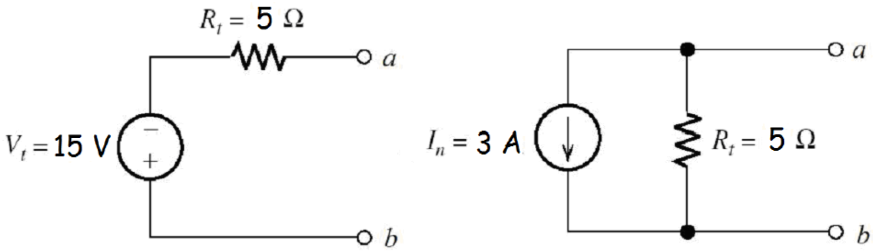
Solving, we find $i_1 = 0.05$ A. Then $R_{eq} = 1/i_1 = 20\ \Omega$.

P2.84* The equivalent circuit of the battery with the resistance connected is

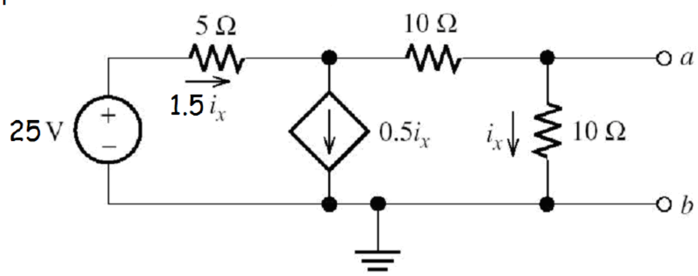


$i = 6/100 = 0.06$ A $\qquad R_t = \dfrac{9-6}{0.06} = 50\ \Omega$

P2.85 The 9-Ω resistor has no effect on the equivalent circuits because the voltage across the 12-V source is independent of the resistor value.

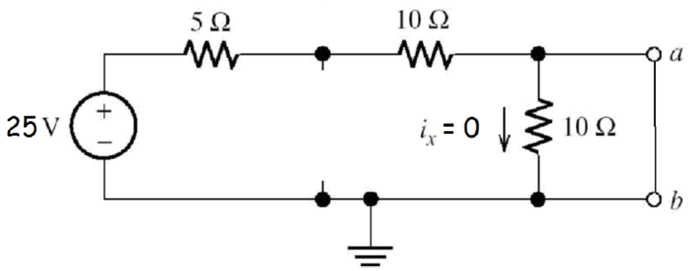


P2.91 Open-circuit conditions:

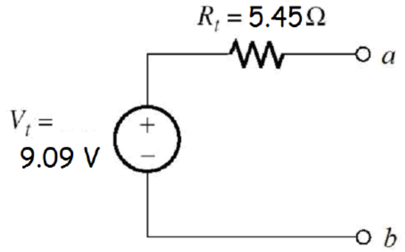


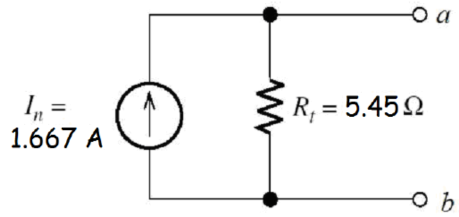
Using KVL, we have $25 = 5(1.5i_x) + 10i_x + 10i_x$ Solving, we find $i_x = 0.90909$ A and then we have $V_t = v_{oc} = 10i_x = 9.0909$ V.

Under short-circuit conditions, we have $i_x = 0$ and the controlled source becomes an open circuit:



$i_{sc} = \dfrac{25}{15} = 1.667$ A. Then, we have $R_t = v_{oc}/i_{sc} = 5.45\ \Omega$. Thus, the equivalents are:

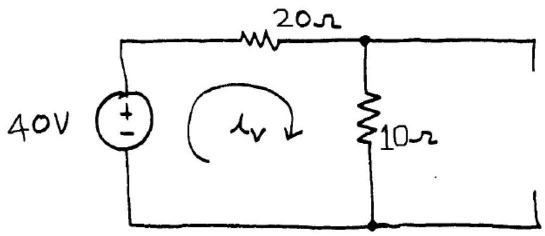




P2.95* To maximize the power to R_L, we must maximize the voltage across it. Thus, we need to have $R_t = 0$. The maximum power is

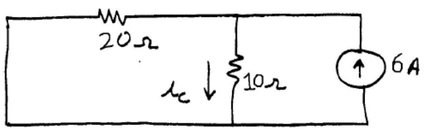
$$P_{max} = \frac{20^2}{5} = 80 \text{ W}$$

P2.97* First, we zero the current source and find the current due to the voltage source.



$$i_v = 40/30 = 1.33\ \Omega$$

Then, we zero the voltage source and use the current-division principle to find the current due to the current source.

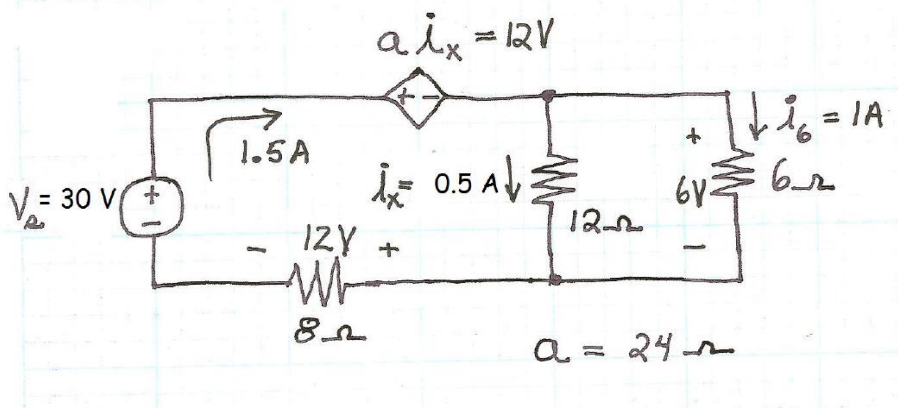


$$i_c = 6\frac{20}{10+20} = 4 \text{ A}$$

Finally, the total current is the sum of the contributions from each source.

$$i = i_v + i_c = 5.33 \text{ A}$$

P2.103 We start by assuming $i_6 = 1$ A and work back through the circuit to determine the value of V_s. This results in V_s = 30 V.



However, the circuit actually has V_s = 10 V, so the actual value of i_6 is $\dfrac{10}{30} \times (1\text{ A}) = 0.3333$ A.

P2.105 From Equation 2.91, we have

(a) $R_x = \dfrac{R_2}{R_1} R_3 = \dfrac{1\,\text{k}\Omega}{1\,\text{k}\Omega} \times 3419 = 3419\ \Omega$

(b) $R_x = \dfrac{R_2}{R_1} R_3 = \dfrac{100\,\text{k}\Omega}{1\ \text{k}\Omega} \times 3419 = 341900\ \Omega$