First, we solve the network with a short circuit:

\[ i_{25} = \frac{25 \text{ V}}{25 \Omega} = 1 \text{ A} \]

\[ R_{eq} = 10 + \frac{1}{\frac{1}{20} + \frac{1}{5}} = 14 \Omega \]

\[ i_{10} = \frac{25}{R_{eq}} = 1.786 \text{ A} \]

\[ i_5 = \frac{20}{20 + 5} = 1.429 \text{ A} \]

\[ i_{sc} = i_{25} + i_5 = 2.429 \text{ A} \]

Zeroing the source, we have:

Combining resistances in series and parallel we find \( R_s = 5.198 \Omega \).

Then the Thevenin voltage is \( V_s = i_{sc} R_s = 12.63 \text{ V} \).

P2.54 With open-circuit conditions:

Solving, we find \( v_{ab} = -5 \text{ V} \).

With the source zeroed:
The equivalent circuits are:

Notice the source polarity relative to terminals a and b.

**P2.55** The Thévenin voltage is equal to the open-circuit voltage which is 20 V. The circuit with the load attached is:

We have \( i_L = \frac{5}{1000} = 5 \text{ mA} \) and \( v_x = V_t - 5 = 15 \text{ V} \). Thus the Thévenin resistance is \( R_t = \frac{15 \text{ V}}{5 \text{ mA}} = 3 \text{ k}\Omega \).

**P2.59** As in Problem P2.54, we find the Thevenin equivalent:

Then maximum power is obtained for a load resistance equal to the Thevenin resistance.

\[
p_{\text{max}} = \frac{(v_r/2)^2}{R_t} = 1.667 \text{ W}
\]
a. Rearranging Equation 2.80, we have
\[ R_3 = \frac{R_2}{R_2} R_x = \frac{10 \text{k}\Omega}{10 \text{k}\Omega} \times 5932 = 5932 \text{\Omega} \]

(b) The circuit is:

\[ \mathcal{V}_s = 10 \text{V} \]

The Thevenin resistance is
\[ R_t = \frac{1}{\frac{1}{R_3} + \frac{1}{R_x}} = 7447 \text{\Omega} \]

The Thevenin voltage is
\[ v_t = v_s \frac{R_3}{R_3 + R_x} - v_s \frac{R_x}{R_3 + R_x} = 0.3939 \text{mV} \]

Thus, the equivalent circuit is:

\[ \mathcal{V}_t = 0.3939 \text{mV} \]

\[ i_{\text{detector}} = \frac{v_t}{R_t + R_{\text{detector}}} = 31.65 \times 10^{-9} \text{A} \]

Thus the detector must be sensitive to very small currents if the bridge is to be accurately balanced.