1.4 By KVL: \( v_{R1} = V_1 - v_{R3} \), where \( v_{R3} = v_{R2} + v_{R4} \). By KCL, \( i_{R1} = i_{R3} + i_{R2} \) and \( i_{R2} = i_{R4} \). Using Ohm's law for \( R_1 \)\( \Rightarrow \)
\[
v_{R1} = R_1 i_{R1} = R_1 (i_{R3} + i_{R2}) = R_1 (v_{R2}/R_3 + (v_{R2} + v_{R4})/(R_2 + R_4)) = R_1 (v_{R2}/R_3 + v_{R4}/(R_2 + R_4)).
\]
Solving this latter equation for \( v_{R3} \) results in
\[
v_{R3} = v_{R1}/(R_1/R_3 + R_1/(R_2 + R_4)).
\]
Substituting this expression for \( v_{R3} \) into the first equation results in
\[
v_{R1} = V_1/(1 + [R_1/R_3 + R_1/(R_2 + R_4)]^{-1}) = (6 V)/(1 + 0.8) = 3.33 \text{ V}.
\]

1.14 a. Voltage of terminal a to ground given by \( V_1 R_2/(R_1 + R_2) = (12 \text{ V})(10 \text{ k}\Omega)/(10 \text{ k}\Omega + 10 \text{ k}\Omega) = 6 \text{ V} \). Voltage of terminal a' to ground given by \( V_2 R_4/(R_3 + R_4) = (5 \text{ V})(10 \text{ k}\Omega)/(10 \text{ k}\Omega + 10 \text{ k}\Omega) = 2.5 \text{ V} \). Value of \( V_A \) is equal to \( V_a - V_a' = 6 \text{ V} - 2.5 \text{ V} = 3.5 \text{ V} \).

b. Make a Thévenin equivalent of each side:
\[
V_A = 6 \text{ V}; \quad R_A = R_1 || R_2 = 5 \text{ k}\Omega
\]
\[
V_{A'} = 2.5 \text{ V}; \quad R_B = R_3 || R_4 = 5 \text{ k}\Omega
\]
c. From the equivalent model of part (b), the short-circuit current will be \( (V_A - V_{A'})/(R_A + R_B) = (6 \text{ V} - 2.5 \text{ V})/(10 \text{ k}\Omega) = 0.35 \text{ mA} \). Note that this same value can be obtained from \( (V_1 - V_2)/(R_1 + R_3) \).
1.31 First find the Thévenin equivalent of everything to the left and to the right of terminals a–a'. Looking to the left yields $v_{Th} = I_1 R_1 = 10$ V and $R_{Th} = R_1 + R_2$. ($R_2$ does not contribute to $v_{Th} = v_{DC}$, since no current flows through it when $I_1$, $R_1$, and $R_2$ are disconnected as a unit from the circuit). Similarly, looking to the right yields $v_{Th} = V_1 = 10$ V and $R_{Th} = R_3$. Note that $R_4$, which appears directly in parallel with a voltage source, has no effect on $v_{Th}$ or $R_{Th}$. Here is a diagram of the equivalent circuit as seen at terminals a–a':

Clearly, given the balanced nature of the circuit, $v_{a–a'}$ can be made zero if we choose $R_2$ and $R_3$ such that $R_1 + R_2 = R_3 \Rightarrow R_3 - R_2 = 1 \, \text{k}\Omega$. Choice of $R_4$ is arbitrary.

1.36 Here is a picture of the circuit with the voltage and current sources connected. Note that $V_{AB}$, the voltage that must be computed, is equal to $v_A - v_B$, where $v_A$ and $v_B$ are measured relative to ground.

Now invoke superposition. In this case, setting $I_2$ to zero (open circuit) leaves the bottom part of the circuit disconnected from ground, so that $v_A = V_B = V_1 = 11$ V. With $V_1$ set to zero (short circuit), apply current division:

$$i_A = I_2 \frac{R_3 + R_4}{R_3 + R_4 + R_1 + R_2} = 4.49 \, \text{mA}$$

and

$$i_B = I_2 \frac{R_1 + R_2}{R_1 + R_2 + R_3 + R_4} = 1.51 \, \text{mA}$$

so that $v_A = -i_A R_1 = -44.9$ V and $v_B = -i_B R_3 = -49.8$ V. Adding together the components of $v_A$ and $v_B$ and subtracting yields $V_{AB} = v_A - v_B$

$$= [11 \, \text{V} + (-44.9 \, \text{V})] - [11 \, \text{V} + (-49.8 \, \text{V})] = 4.9 \, \text{V}.$$