

setting all the independent sources to zero and then turning each one on individually. Total $v_{a-a'}$ is the sum of the individual components. With I_1 set to zero (open circuit), it follows that

$$v_{a-a'} = \frac{R_1 + R_2}{R_1 + R_2 + R_3} V_1$$

Note that R_4 does not affect $v_{a-a'}$, because it appears directly in parallel with V_1 .

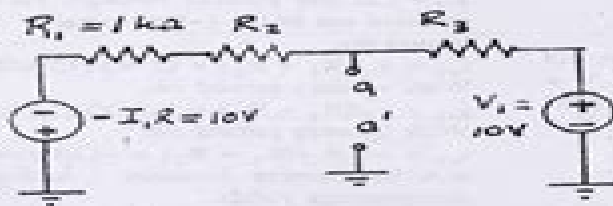
With V_1 set to zero (short circuit), current division yields the current through R_3 , so that

$$v_{a-a'} = -I_1 \frac{R_1}{R_1 + (R_2 + R_3)} R_3$$

Combining $v_{a-a'}$ and $v_{a-a'}$ yields

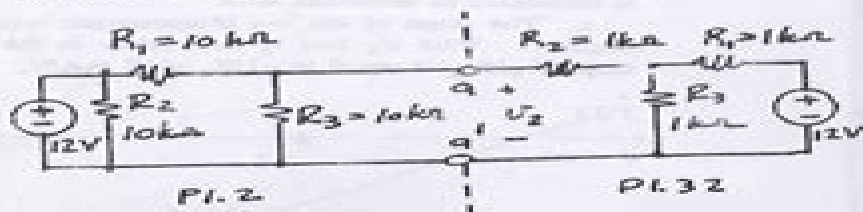
$$v_{a-a'} = v_{a-a'} + v_{a-a'} = \frac{(R_1 + R_2)V_1}{R_1 + R_2 + R_3} - \frac{(R_1 R_3)I_1}{R_1 + R_2 + R_3}$$

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 $v_{Th} = v_{OC}$, 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 $R_1 + R_2 = R_3 \Rightarrow R_3 - R_1 = 1$ kΩ. Choice of R_4 is arbitrary.

1.32 Shown below is the entire circuit with both parts connected. The objective is to find v_2 .



As a first step, the Thévenin equivalent of each half of the circuit is taken, as shown below.



Now, using superposition, the value of v_2 can easily be computed:

$$v_2 = \frac{R_{Th2}}{R_{Th1} + R_{Th2}} v_{Th1} + \frac{R_{Th1}}{R_{Th1} + R_{Th2}} v_{Th2} = \frac{1.5 \text{ k}\Omega}{6.5 \text{ k}\Omega} (6 \text{ V}) + \frac{5 \text{ k}\Omega}{6.5 \text{ k}\Omega} (6 \text{ V}) = 6 \text{ V}$$

This result should be evident by inspection anyway, since a Thévenin source of value 6 V is connected on both sides of the circuit.

1.33 Shown below is the entire circuit with both parts connected. The objective is to find v_2 .



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David Buchla



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