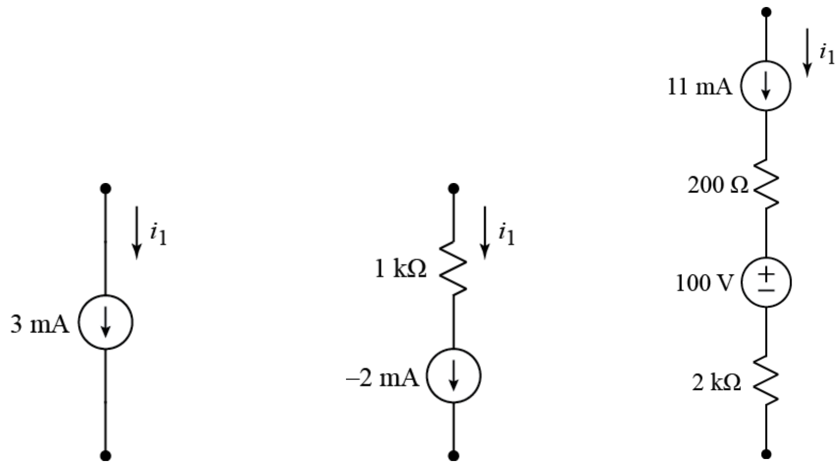
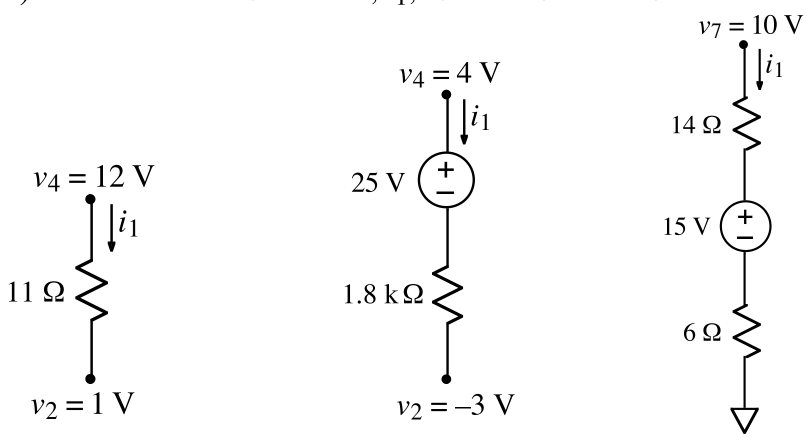
HOMEWORK #4 prob 4 solution

Ex:



a) Find the value of current, i_1, for each of the above branches taken from circuits.



b) Find the value of current, i_1, for each of the above branches taken from circuits.

SOL'N: a) When there is a current source in a branch, the current for that branch must be the value of the current source. So our answers for part (a) are just the values of the current sources.

$$i_1 = 3 \text{ mA}$$

$$i_1 = -2 \text{ mA}$$

$$i_1 = 11 \text{ mA}$$

b) For the first branch, we use Ohm's law. The v-drop across the resistor is the difference between the node voltages. The + sign goes with the node that the current measurement arrow points away from, and the – sign goes with the node toward which the arrow points. This is consistent with the passive sign convention.

$$i_1 = \frac{12\,\text{V} - 1\,\text{V}}{11\,\Omega} = \frac{11\,\text{V}}{11\,\Omega} = 1\,\text{A}$$

For the second branch, we calculate the voltage at a point below the 25 V source. That voltage will be:

$$v = 4\,\text{V} - 25\,\text{V} = -21\,\text{V}$$

Now we take the voltage drop across the resistor and divide by the resistance (Ohm's law):

$$i_1 = \frac{-21\,\text{V} - (-3\,\text{V})}{1.8\,\text{k}\Omega} = \frac{-18\,\text{V}}{1.8\,\text{k}\Omega} = -10\,\text{mA}$$

For the third branch, we want to find the total voltage drop across the total resistance in the branch. We can imagine sliding a voltage source in a branch through a resistor without changing the calculation of the current. (Be careful not to flip the polarity of the voltage source, however.) We can group all the voltage sources together at one end or the other. Here, if we put the voltage source at the bottom, the voltage on top of the source will be:

$$v = 15\,\text{V}$$

The current, as always, is the voltage drop across the total resistance divided by the total resistance:

$$i_1 = \frac{10\,\text{V} - 15\,\text{V}}{6\,\Omega + 14\,\Omega} = -\frac{5\,\text{V}}{20\,\Omega} = -0.25\,\text{A}$$