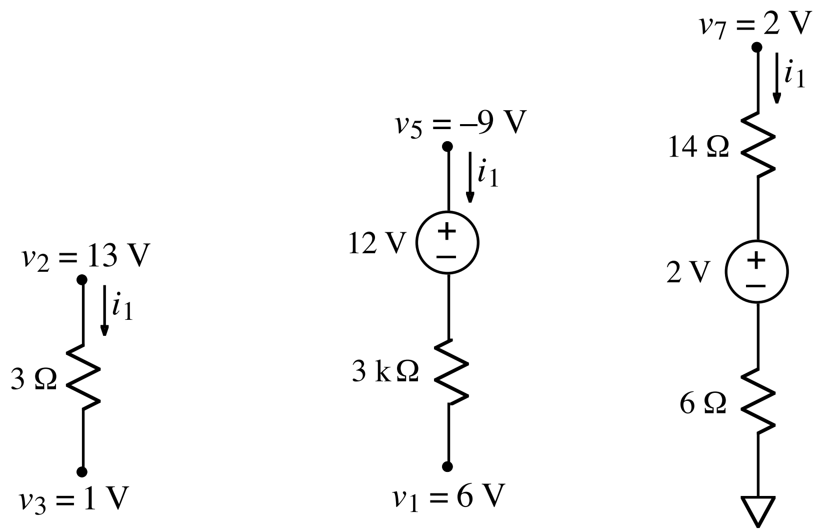
HOMEWORK #5 solution

Ex:



Find the value of current, i_1, for each of the above circuits.

SOL'N: a) We use Ohm's law and the node voltages to find i_1.

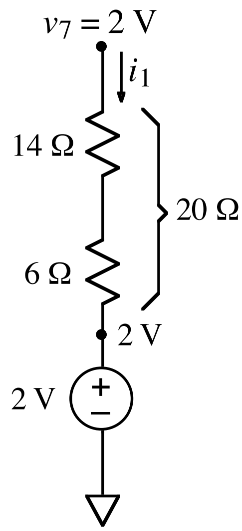
$$i_1 = \frac{v_2 - v_3}{3\ \Omega} = \frac{13\text{ V} - 1\text{ V}}{3\ \Omega} = \frac{12\text{ V}}{3\Omega} = 4\text{ A}$$

NOTE: To determine the signs, if we were to mark a + and – for a voltage measurement across the 3 Ω resistor that is in the passive sign direction for i_1, then we add v_2 (which is next to the + sign) and subtract v_1 (which is next to the – sign).

b) The voltage immediately below the 12 V source is v_5 – 12 V = –21 V. We use this voltage and v_1 and Ohm's law to find i_1.

$$i_1 = \frac{(v_5 - 12\text{ V}) - v_1}{3\text{ k}\Omega} = \frac{(-9\text{ V} - 12\text{ V}) - 6\text{ V}}{3\text{ k}\Omega} = \frac{-27\text{ V}}{3\text{ k}\Omega} = -9\text{ mA}$$

c) When we have multiple resistors or voltage sources, we may slide the voltage sources through the resistors so that all the sources and all the resistors are adjacent. If we slide the 2 V source through the 6 Ω resistor, we have the following picture:



We combine the resistors into a single 20 Ω resistor, and we observe that we have 2 V below this 20 Ω resistor. The voltage drop across the resistor turns out to be 0 V, and we have no current:

$$i_1 = \frac{v_7 - 2\text{ V}}{20\ \Omega} = \frac{2\text{ V} - 2\text{ V}}{20\ \Omega} = 0\text{ A}$$