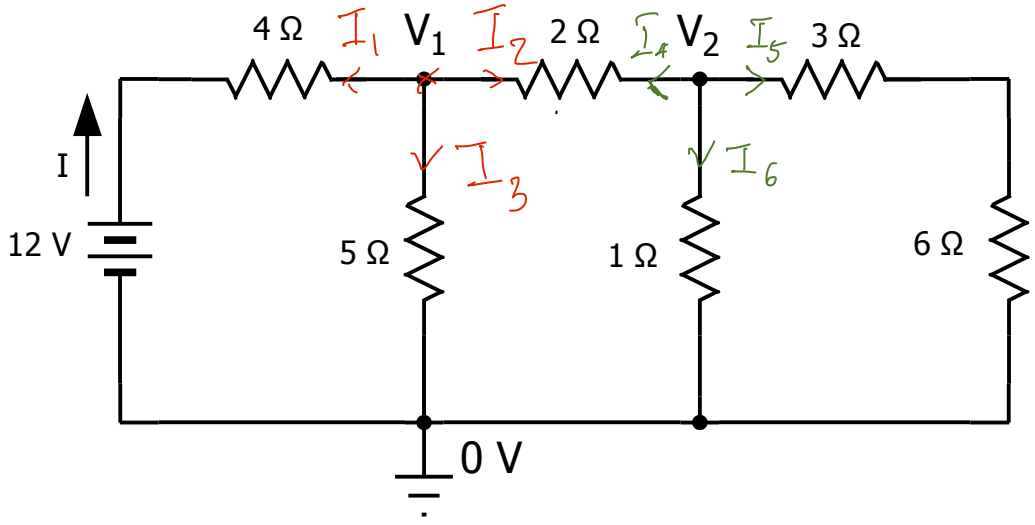
Nhat Ho
105 355 311

EE3 Fall 2018
Practice Problems 2



1.Watch and study the KVL-KCL video as posted under Week 1.
   a. Assuming that all of the currents at Node 1 (where V_1 is) are *leaving* the node, write an Ohm's Law expression for the current going through the 4 Ω resistor.
   b. Under the same assumption, write an Ohm's Law expression for the current through the 5 Ω resistor.
   c. Continuing, write an expression for the current through the 2 Ω resistor.
   d. Now, combine the answers to 1a,b,c into a KCL equation.
   e. Now, following the procedures in a, b, and c, write Ohm's Law expressions for the three currents leaving Node 2.
   f. Combine the three answers to 1e into a second KCL equation.
2. You now have 2 equations in 2 unknowns. Solve them for V_1 and V_2.
3. Now that you know V_1, you can compute I.

a) $\frac{V_1 - 12V}{4\Omega} = I_1$ b) $I_3 = \frac{V_1}{5\Omega}$

c) $I_2 = \frac{V_1 - V_2}{2\Omega}$

d) We have: $I_1 + I_2 + I_3 = 0$

$\Rightarrow \frac{V_1 - 12}{4} + \frac{V_1}{5} + \frac{V_1 - V_2}{2} = 0$

$$\Rightarrow \frac{5(V_1-12)+4V_1+10(V_1-V_2)}{20}=0$$

$$\Leftrightarrow 5V_1-60+4V_1+10V_1-10V_2=0$$

$$\Leftrightarrow \boxed{19V_1-10V_2=60} \quad (1)$$

e) $I_4=\frac{V_2-V_1}{2\Omega}$; $I_5=\frac{V_2}{3\Omega+6\Omega}=\frac{V_2}{9\Omega}$

$I_6=\frac{V_2}{1\Omega}$, Also $I_4+I_5+I_6=0$ (KCL)

$$\Rightarrow \frac{V_2-V_1}{2}+\frac{V_2}{9}+\frac{V_2}{1}=0$$

$$\Leftrightarrow \frac{9(V_2-V_1)+2V_2+18V_2}{18}=0$$

$$\Leftrightarrow 9V_2-9V_1+2V_2+18V_2=0$$

$$\Leftrightarrow -9V_1+29V_2=0 \Leftrightarrow \boxed{9V_1-29V_2=0} \quad (2)$$

f) Combine with (1), we have:

$$\begin{cases} 19V_1-10V_2=60 & (1) \\ 9V_1-29V_2=0 & (2) \end{cases}$$

2) Solve these equations

From (2), $V_1=\frac{29V_2}{9}$, plug it into (1), we have

$$19 \times \frac{29V_2}{9} - 10V_2 = 60$$

$$\Leftrightarrow \frac{461}{9} V_2 = 60 \Rightarrow \boxed{V_2 = 1.17(V)}$$

$$\Rightarrow \boxed{V_1 = \frac{29V_2}{9} = 3.774(V)}$$

3) From 1a, we have:

$$\frac{V_1 - 12V}{4\Omega} = I_1 \Rightarrow I_1 = \frac{3.774 - 12}{4\Omega}$$

$$\Rightarrow I_1 = -2.06(A)$$

Also, following the circuit $I = -I_1$

$$\Rightarrow \boxed{I = 2.06(A)}$$