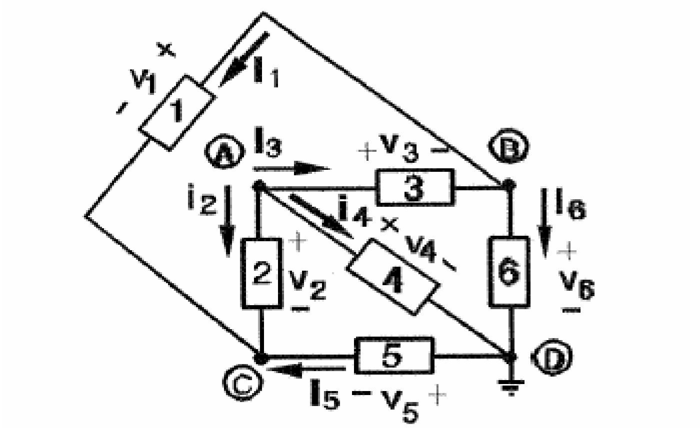
<u>**Homework Solutions 2**</u>

(2-14) In figure P2-13, v1 = -8V, v4 = 8V, and v6 = 6V. Find the other element voltages.



To solve this problem the basic concept of the KVL loop must be used, consider each loop of devices add together to equal zero as KVL states then,

Consider passive sign convention

Loop 3,6,4 = 0; v3 + v6 – v4 = 0
Loop 2,4,5 = 0; v4 – v2 + v5 = 0
Loop 1,3,2 = 0; v1 + v3 – v2 = 0

Now all the KVL equations are stated, substitute in the voltage values given and solve for the unknown element voltages.

2-14 By KVL: Given Loop 1,2,3 $-v_1 + v_2 - v_3 = 0$ and Loop 2,4,5 $-v_2 + v_4 + v_5 = 0$ and Loop 3,6,4 $v_3 + v_6 - v_4 = 0$. Hence if $v_1 := 8$, $v_4 := 8$ and $v_6 := 6$ then from Loop 3,6,4 $v_3 := v_4 - v_6$ or $v_3 = 2$. From Loop 1,3,2 $v_2 := v_1 + v_3$ or $v_2 = -6$ and finally From Loop 2,4,5 $v_5 := v_2 - v_4$ or $v_5 = -14$

In summary
$v_1 = -8$ $v_2 = -6$ $v_3 = 2$ $v_4 = 8$ $v_5 = -14$ $v_6 = 6$ all in V

(2-16) In figure P2-16, v1 = 5V, v3 = -10V, and v4 = 10V. Find v2 and v5.

To solve this problem consider the KVL equations. Find each loop and solve for unknown voltages v2 and v5. Consider the previous problem as an example.

Loops are listed by KVL

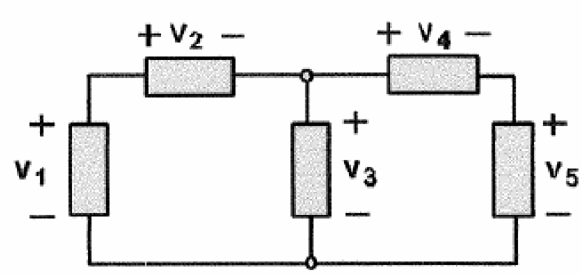
2-16 $v_1 := 5$ $v_3 := -10$ $v_4 := 10$

By KVL $-v_1 + v_2 + v_3 = 0$

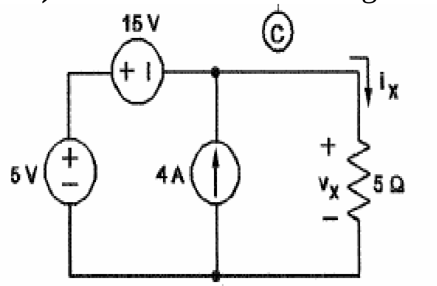
$-v_3 + v_4 + v_5 = 0$

hence $v_2 := v_1 - v_3$ $v_2 = 15$

$v_5 := v_3 - v_4$ $v_5 = -20$



(2-21) Find vx and ix in the figure P2-21.



2-21 By KVL around the perimeter

$-5 + 15 + v_X = 0 \quad v_X := 5 - 15 \quad v_X = -10$

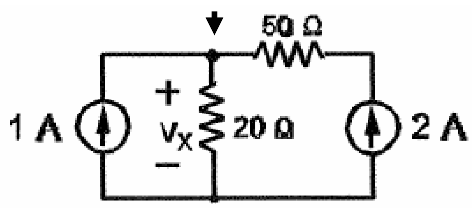
by Ohm's law $\quad i_X := \dfrac{v_X}{5} \quad i_X = -2$

By using the KVL approach for this problem by inspection the 15V voltage source is clearly larger than the 5V voltage source, therefore, the current is flowing in the opposite direction for which is drawn, giving a negative current.

(2-23) Find Vx in figure P2-23.

NODE A

2-23



KCL: $-i_1 + 2 = 0$ hence $i_1 := 2$

$-i_X + i_1 + 1 = 0$ hence $i_X := 3$

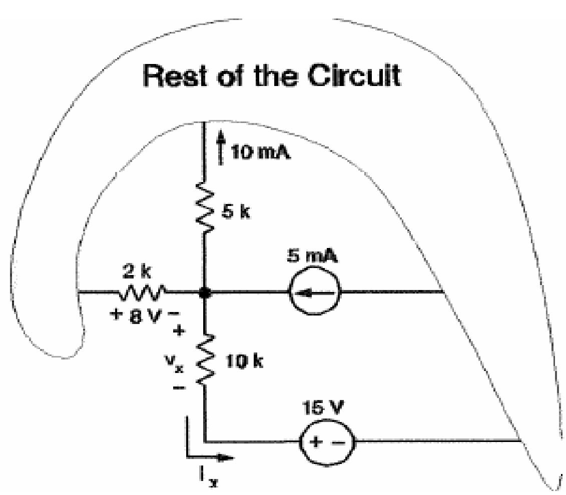
Element: $v_X := 20 \cdot i_X$ hence $v_X = 60$

Using KCL this problem can be easily done, consider at Node A the current is nothing more than the addition of the two incoming currents, therefore the current through the 20Ω resistor must be 1A + 2A (or 3A). Now use Vx = RIx which gives the voltage drop across the 20Ω resistor.

(2-24) Figure P2-24 shows a sub-circuit connected to the rest of the circuit at four points.

(a) Use the element and connection constraints to find Vx and Ix
(b) Show that the sum of the currents into the rest of the circuit is zero.

2-24



(a) $i_1 := \dfrac{8}{2000} \quad i_1 = 4 \times 10^{-3}$

$i_X := i_1 + 0.005 - 0.01 \quad i_X = -10 \times 10^{-}$

$v_X := 10^4 \cdot i_X \quad v_X = -10$

(b) $i_{sum} := -i_1 + 0.01 - 0.005 + i_X$

$i_{sum} = 0$ QED

Finding the current Ix can be done if you consider that all four currents are flow through the single node located in the center of the circuit. Using KCL, then:

$$-10mA + 5mA + 8V/(2k\Omega) - Ix = 0$$

Therefore, **<u>Ix = -1mA</u>**, and considering the *passive sign convention* solving for voltage across the 10kΩ resistor is simply, -1mA × 10kΩ = -10V;   **<u>Vx = -10V</u>**
Notice that the 15V voltage source is not even considered in these equations, this is because the rest is not shown, therefore, it is not known what the "voltage drops" are across all devices in the circuit. Remember, the power balance check.

(2-26) Figure P2-26 shows a resistor with one terminal connected to ground and the other connected to an arrow. The arrow symbol is used to indicate a connection to one terminal of a voltage source whose other terminal is connected to ground. The label next to the arrow indicates the source voltage at the ungrounded terminal. Find the voltage across, current through, and the power dissipated in the resistor.

This problem is relatively simple use your basic equations; V = RI and P = VI.

2-26 $v_X := -12$ $\quad i_X := \dfrac{v_X}{20 \cdot 10^3}$ $\quad p_X := v_X \cdot i_X$

$v_X = -12$ $\quad i_X = -6 \times 10^{-4}$ $\quad p_X = 7.2 \times 10^{-3}$