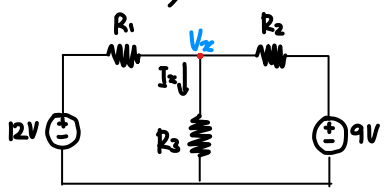
Week 6 HW

3.1 nodal analysis



$R_1 = 4\Omega$, $R_2 = 2\Omega$, $R_3 = 2\Omega$ 이라 할 때,

KCL :

$$\frac{(12 - V_x)}{R_1} + \frac{(9 - V_x)}{R_2} - \frac{V_x}{R_3} = 0$$

$$\left(\frac{1}{4} + \frac{1}{2} + \frac{1}{2}\right)V_x + \left(-3 - \frac{9}{2}\right) = 0$$

$$\frac{5}{4}V_x = \frac{15}{2} \quad V_x = 6$$

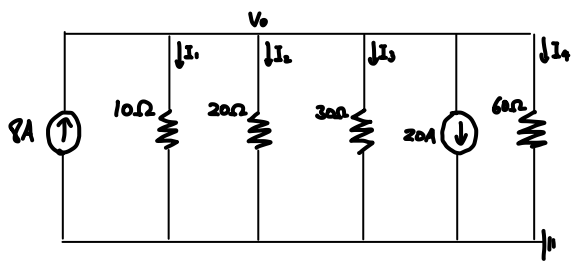
Ohm's Law :

$$V = IR, \; I = \frac{V}{R}$$

$$I_x = \frac{6}{2} = 3$$

KCL과 Ohm's Law를 사용해 $I_x = 3\,A$가 도출된다.

3.3 Find $I_1 \sim I_4$, V_o



KCL:

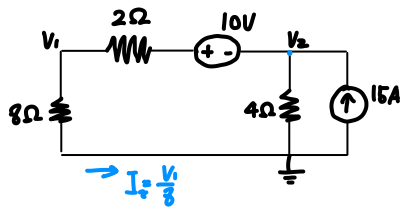
$$-8 + \frac{V_o}{10} + \frac{V_o}{20} + \frac{V_o}{30} + 20 + \frac{V_o}{60} = 0$$

$$\frac{(6+3+2+1)V_o}{60} + 12 = \frac{12}{60}V_o \qquad 12V_o = -720$$

$$V_o = -60\,V$$

$$I_1 = \frac{-60}{10} = -6A, \; I_2 = \frac{-60}{20} = -3A, \; I_3 = \frac{-60}{30} = -2, \; I_4 = \frac{-60}{60} = -1A$$

3.13 Calculate V_1, V_2



$I_x = \frac{V_1}{8}$

KCL :

$$\left(\frac{V_2 + 10}{8+2}\right) + \frac{V_2}{4} - 15 = 0$$

$$\frac{V_2}{10} + 1 + \frac{V_2}{4} - 15$$

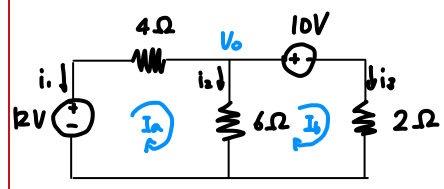
$$= \frac{4V_2 + 10V_2}{40} - 14$$

$$14V_2 = 14 \cdot 40 \quad V_2 = 40V$$

$$I_x = \frac{V_2 + 10}{8+2} = 5A = \frac{V_1}{8}$$

$$V_1 = 40V$$

3.36 i_1, i_2, i_3 ?



KVL :

① $12 = (4+6)I_a - 6I_b \rightarrow 5I_a - 3I_b = 6$

② $-10 = -6I_a + (2+6)I_b \rightarrow 3I_a - 4I_b = 5$

$$\begin{cases} 5I_a - 3I_b = 6 \\ 3I_a - 4I_b = 5 \end{cases} \quad \left[\begin{array}{cc|c} 15 & -9 & 18 \\ 15 & -20 & 25 \end{array}\right] \quad \left[\begin{array}{cc|c} 20 & -12 & 24 \\ 9 & -12 & 15 \end{array}\right]$$

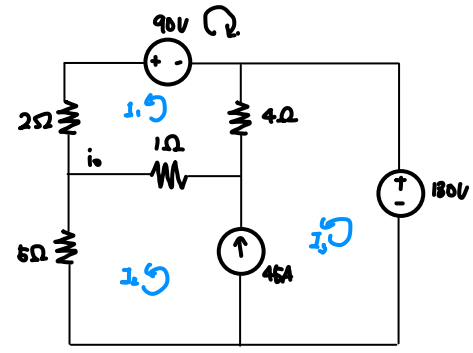
$$[0 \quad +11 \quad -9] \qquad [11 \quad 0 \mid 9]$$

$$\therefore I_b = -\frac{9}{11}, \; I_a = \frac{9}{11}$$

$$i_1 = -I_a, \; i_2 = I_a - I_b, \; i_3 = I_b$$

$$i_1 = -\frac{9}{11}A, \; i_2 = \frac{16}{11}A, \; i_3 = -\frac{9}{11}A$$

3.44 obtain i_o



KVL :

$$90 + (2+1+4)I_1 - 1I_2 - 4I_3 = 0$$

$$180 + 4I_3 + (145)I_2 - (441)I_1 = 0$$

$$\begin{cases} 7I_1 - I_2 - 4I_3 = 90 \\ -53I_1 + 62I_2 + 4I_3 = -180 \\ -I_2 + I_3 = 45 \end{cases}$$

$I_3 = I_2 + 45$

$7I_1 - I_2 - 4I_2 - 180 = -90$

$-53I_1 + 62I_2 + 4I_2 + 180 = -180$

$$\begin{cases} 7I_1 - 5I_2 = -270 \\ -53I_1 + 70I_2 = -360 \end{cases} \qquad -350 + 10I_2 = -360$$

$$143I_1 - 10I_2 = 540 \qquad 20 \quad I_2 = 24$$

$I_1 = -20, \; I_2 = -46$

KCL :

$$45 + (I_1 - I_3) + (I_2 - I_1) = 0$$

$$I_3 - I_2 = 45$$

$$i_o = I_1 - I_2 = -26A$$