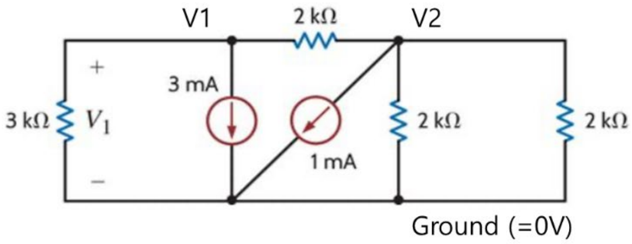
1. **(6 Points) Use nodal analysis to find V_1 in the circuit shown below.**



Without using nodal analysis: 0pts

Step 1

KCL @ node V1

$$\frac{V1}{3k} + \frac{V1 - V2}{2k} + 3m = 0 \qquad [+2]$$

KCL @ node V2

$$\frac{V2}{2k} + \frac{V2}{2k} + \frac{V2 - V1}{2k} + 1m = 0 \qquad [+2]$$

Using different nodes for nodal analysis and if it is correct, you can also get full credit

Step 2

Using two equations above

$$5V1 - 3V2 = -18$$

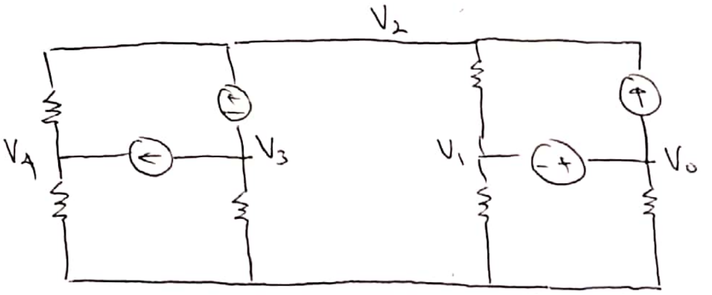
$$3V2 - V1 = -2$$

$$V1 = -5V$$

Answer) -5V [+2]

Wrong units (No unit) [-1]

#2.



1) set five equations. less than three, deduct 1 point per each

$V_2 - V_3 = 6$ ... ①

$V_o - V_1 = 89$ ... ②

~~$-2V_1 +$~~

KCL @ V_2

$$\frac{V_2 - V_4}{2k} + 9m + \frac{V_3}{1k} + \frac{V_2 - V_1}{1k} - 2m = 0 \quad \text{... ③}$$

KCL @ $V_1 \sim V_o$

$$\frac{V_1}{1K} + \frac{V_1 - V_2}{1K} + 2m + \frac{V_o}{1K} = 0 \quad \text{... ④}$$

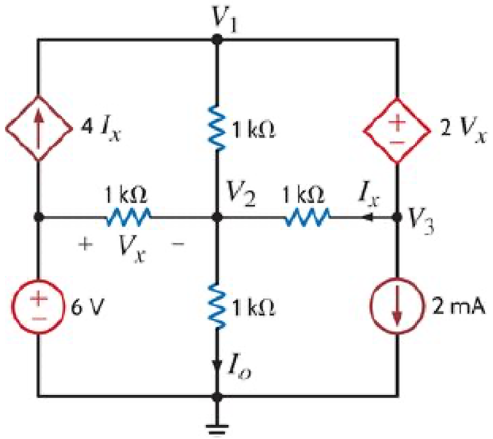
KCL @ V_4

$$9m = \frac{V_4}{2K} + \frac{V_4 - V_2}{2K} \quad \text{... ⑤}$$

2) answer. 3 points. ±1 error allowed.

$V_o = 54\ (V)$

3. **(6 Points) Use nodal analysis to find I_o in the circuit shown below.**



To find V_1, V_2, V_3, V_x and I_x, we have to find out 5 equations.

$$\frac{V_1 - V_2}{1k} + \frac{V_3 - V_2}{1k} - 4I_x = -\frac{2}{1k} \qquad \cdots (1) \qquad 1 \text{ pt}$$

$$I_x = \frac{V_3 - V_2}{1k} \qquad \cdots (2) \qquad 1 \text{ pt}$$

$$V_1 - V_3 = 2V_x \qquad \cdots (3) \qquad 1 \text{ pt}$$

$$V_x = 6 - V_2 \qquad \cdots (4) \qquad 1 \text{ pt}$$

$$\frac{V_2 - 6}{1k} + \frac{V_2 - V_1}{1k} + \frac{V_2 - V_3}{1k} + \frac{V_2}{1k} = 0 \qquad \cdots (5) \qquad 1 \text{ pt}$$

From (1) and (2),

$$V_1 + 2V_2 - V_3 = 12 \qquad \cdots (6)$$

From (2), (3), and (4)

$$V_1 + 2V_2 - V_3 = 12 \qquad \cdots (7)$$

From (5),

$$-\mathrm{V}_1 + 4\mathrm{V}_2 - \mathrm{V}_3 = 6 \qquad \cdots (8)$$

From (6), (7), and (8)

$$V_2 = \frac{16}{3}\,\mathrm{V}$$

$$I_O = \frac{\mathrm{V}_2}{1\mathrm{k}} = \frac{16}{3}\,\mathrm{mA} \qquad 1 \text{ pt}$$

3.65 Determine each mesh current in the circuit in Fig. P3.65.

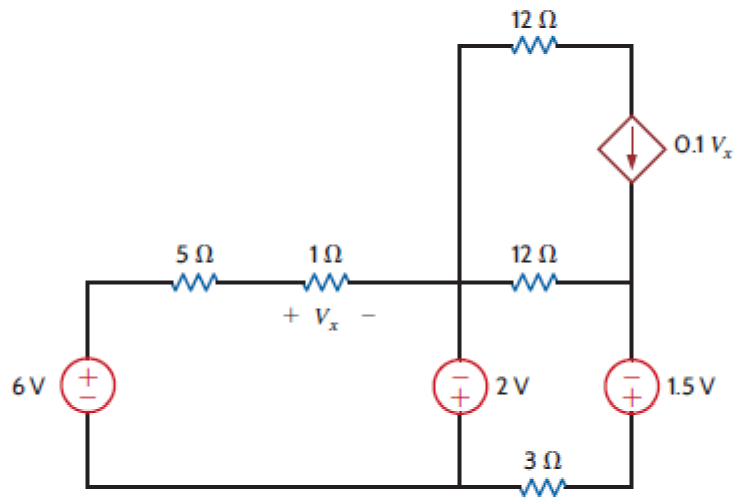


Figure P3.65

SOLUTION:

We define a clockwise mesh current i_3 in the upper right mesh, a clockwise mesh current i_1 in the lower left mesh, and a clockwise mesh current i_2 in the lower right mesh.

MESH 1: $-6 + 6\, i_1 - 2 = 0$ [1]

MESH 2: $2 + 15\, i_2 - 12\, i_3 - 1.5 = 0$ [2]

MESH 3: $i_3 = 0.1\, v_x$ [3]

Eq. [1] may be solved directly to obtain $i_1 = 1.333$ A.

It would help in the solution of Eqs. [2] and [3] if we could express the dependent source controlling variable v_x in terms of mesh currents. Referring to the circuit diagram, we see that $v = (1)(i_1) = i_1$, so Eq. [3] reduces to

$i_3 = 0.1\, v_x = 0.1\, i = 133.3$ mA

As a result, Eq. [1] reduces to

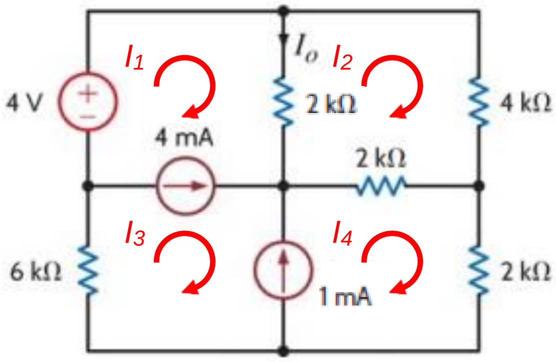
$i_2 = [-0.5 + 12(0.1333)]/ 15 = 73.31$ mA

[채점기준]

- Each expression of mesh 1, 2, 3 is correct : 1 pts for each 3pts
- Each mesh current i_1, i_2, i_3 is correct : 1 pts for each 3pts

Total 6pts

5. (6 points) Find I_o in the circuit shown below using loop analysis.



$$I_3 - I_1 = 4\ mA \cdots\cdots (i) \qquad \text{1pts}$$

$$I_4 - I_3 = 1\ mA \cdots\cdots (ii) \qquad \text{1pts}$$

$$2k(I_2 - I_1) + 4kI_2 + 2k(I_2 - I_4) = 0$$

$$4I_2 - I_1 - I_4 = 0 \cdots\cdots (iii) \qquad \text{1pts}$$

$$4 - 4kI_2 - 2kI_4 - 6kI_3 = 0 \cdots\cdots (iv) \qquad \text{1pts}$$

By *(iii)*, *(iv)*, $-4m + I_1 + 3I_4 + 6I_3 = 0 \cdots\cdots (v)$

By *(i)*, *(ii)*, *(v)*, $-4m + (I_3 - 4m) + 3(I_3 + 1m) + 6I_3 = 0$

$$I_3 = 0.5\ mA$$

$$\therefore I_1 = 0.5\ m - 4m = -3.5\ mA,\ I_4 = 1.5\ mA,\ I_2 = -0.5\ mA$$

$$\therefore I_o = I_1 - I_2 = -3\ mA \qquad \text{2pts}$$