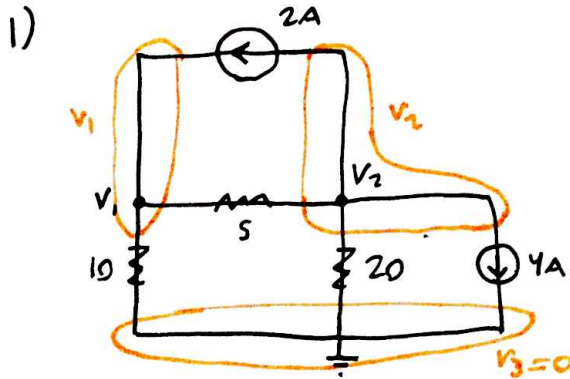


A4

$$V = iR \quad i = \frac{V}{R}$$

$V_1$ : OUT IS POSITIVE

$$V_1: -2 + \frac{V_1 - V_2}{5} + \frac{V_1}{10} = 0$$

$$-20 + 2(V_1 - V_2) + V_1 = 0$$

$$-20 + 2V_1 - 2V_2 + V_1 = 0$$

$$3V_1 - 2V_2 = 20$$

$$V_2: +2 + \frac{V_2}{20} + 4 + \frac{V_2 - V_1}{5} = 0$$

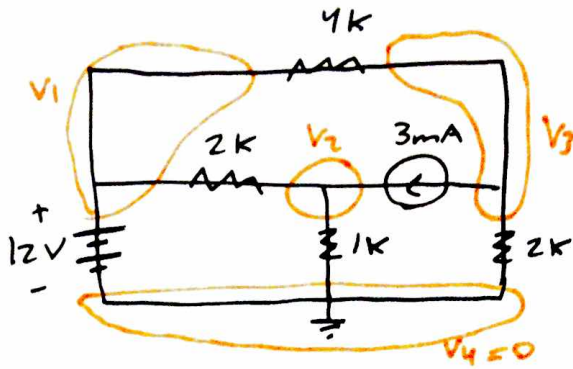
$$120 + V_2 + 4V_2 - 4V_1 = 0$$

$$-4V_1 + 5V_2 = -120$$

$$4V_1 - 5V_2 = 120$$

$$\boxed{V_1 = -20 \quad V_2 = -40}$$

2)



$$V_1: \frac{V_1 - V_3}{4} + \frac{V_1 - V_2}{2} \dots V_1 = 12V$$

$$V_2: \frac{V_2 - 12}{2} - 3 + \frac{V_2}{1} = 0$$

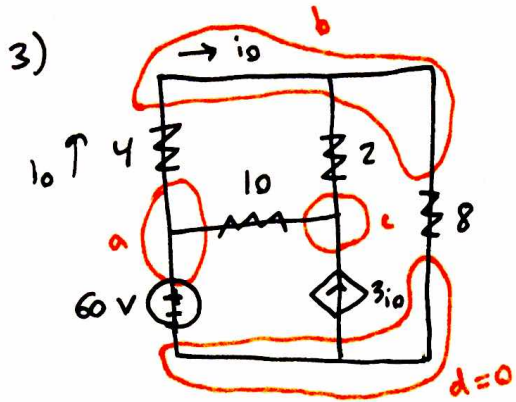
$$V_2 - 12 - 6 + 2V_2 = 0$$

$$3V_2 = 18 \quad \boxed{V_2 = 6V}$$

$$V_3: \frac{V_3}{2} + 3 + \frac{V_3 - 12}{4} = 0$$

$$2V_3 + 12 + V_3 - 12 = 0$$

$$\boxed{V_3 = 0V}$$



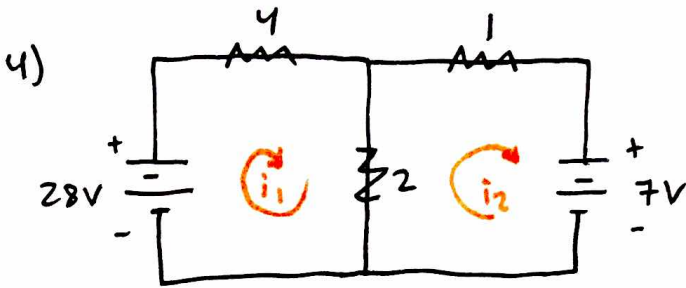
$$V_a = 60V$$

$$V_b: 7V_b - 4V_c + 0i_o = 120$$

$$V_c: -5V_b + 6V_c - 30i_o = 60$$

$$\text{constraint: } V_b + 0V_c + 4i_o = 60$$

$$V_b = 53.08 \quad V_c = 62.88 \quad i_o = 1.73A$$



$$i_1: -28 + 4i_1 + 2(i_1 - i_2) = 0$$

$$i_2: 2(i_2 - i_1) + i_2 + 7 = 0$$

$$4i_1 + 2i_1 - 2i_2 = 28$$

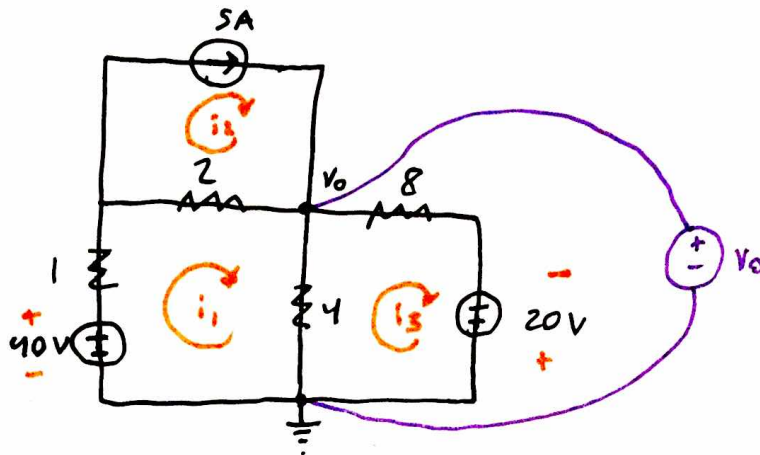
$$6i_1 - 2i_2 = 28$$

$$2i_2 - 2i_1 + i_2 = -7$$

$$-2i_1 + 3i_2 = -7$$

$$i_1 = 5A \quad i_2 = 1A$$

5)



$$i_1: -40 + i_1 + 2(i_1 - i_2) + 4(i_1 - i_3) = 0$$

$$-40 + i_1 + 2i_1 - 2i_2 + 4i_1 - 4i_3 = 0$$

$$i_2: 5A$$

$$i_1: -40 + i_1 + 2i_1 - 10 + 4i_1 - 4i_3 = 0$$

$$7i_1 - 4i_3 = 60$$

$$i_3: 4(i_3 - i_1) + 8i_3 - 20 = 0$$

$$4i_3 - 4i_1 + 8i_3 - 20 = 0$$

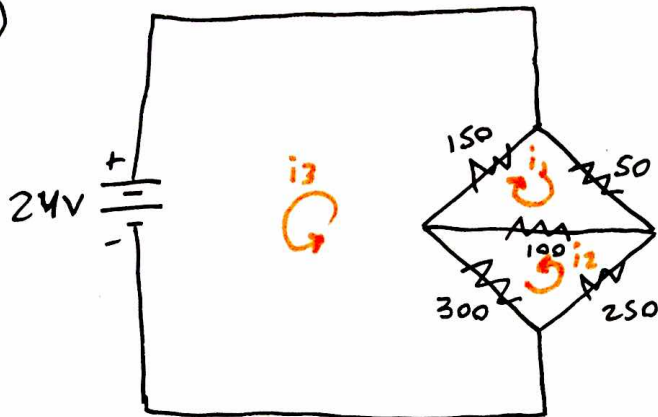
$$-4i_1 + 12i_3 = 20$$

$$i_1 = 10A \quad i_3 = 5A$$

$$\text{KVL: } 4(i_3 - i_1) + V_0 = 0 \rightarrow -20 + V_0 = 0$$

$$\boxed{V_0 = 20V}$$

6)

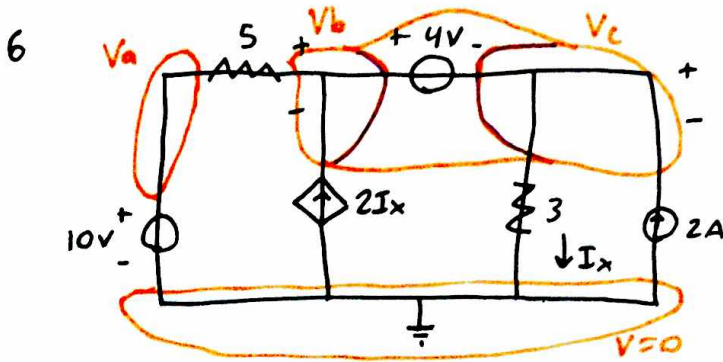


$$\begin{aligned}
 i_3: \quad & 300(i_3 - i_2) + 150(i_3 + i_1) + 24 = 0 \\
 & 300i_3 - 300i_2 + 150i_3 + 150i_1 = -24 \\
 & 150i_1 - 300i_2 + 450i_3 = -24
 \end{aligned}$$

$$\begin{aligned}
 i_2: \quad & 250i_2 + 100(i_2 + i_1) + 300(i_2 - i_3) = 0 \\
 & 250i_2 + 100i_2 + 100i_1 + 300i_2 - 300i_3 = 0 \\
 & 100i_1 + 650i_2 - 300i_3 = 0
 \end{aligned}$$

$$\begin{aligned}
 i_1: \quad & 150(i_1 + i_3) + 50i_1 + 100(i_1 + i_2) = 0 \\
 & 150i_1 + 150i_3 + 50i_1 + 100i_1 + 100i_2 = 0 \\
 & 300i_1 + 100i_2 + 150i_3 = 0
 \end{aligned}$$

$$i_1 = 93.8 \text{ mA} \quad i_2 = -77.2 \text{ mA} \quad i_3 = -136.1 \text{ mA}$$



$$V_a = 10V$$

$$V = iR \quad i = \frac{V}{R}$$

$$\text{SN: } \frac{V_b - 10}{5} + I_x - 2I_x - 2 = 0$$

$$\text{KVL: } -V_b + 4 + V_c = 0$$

$$\text{cons. } \frac{V_c}{3} = I_x$$

$$\text{SN: } V_b - 10 - 5I_x - 2 = 0$$

$$V_b + 0V_c - 5I_x = 12$$

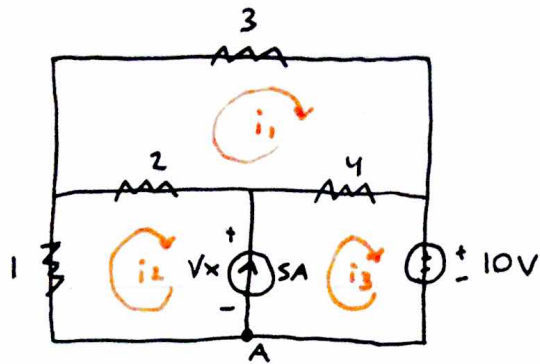
$$V_b + 0V_c - 5I_x = 12$$

$$-V_b + V_c + 0I_x = -4$$

$$0V_b + V_c - 3I_x = 0$$

$$\boxed{I_x = -8A}$$

7.



$$V = iR$$

$$i_1: 2(i_1 - i_2) + 3i_1 + 4(i_1 - i_3) = 0$$

$$i_2: i_2 + 2(i_2 - i_1) + 4(i_3 - i_1) + 10 = 0$$

$$\text{COMS @ A: } 5 - i_3 + i_2 = 0$$

$$\text{ALGEBRA: } 2i_1 - 2i_2 + 3i_1 + 4i_1 - 4i_3 = 0$$

$$\underline{9i_1 - 2i_2 - 4i_3 = 0}$$

$$i_2 + 2i_2 - 2i_1 + 4i_3 - 4i_1 + 10 = 0$$

$$\underline{-6i_1 + 3i_2 + 4i_3 = -10}$$

$$\underline{0i_1 + i_2 - i_3 = -5}$$

$$i_1 = -1.48 \quad i_2 = -5.56 \quad i_3 = -0.56$$

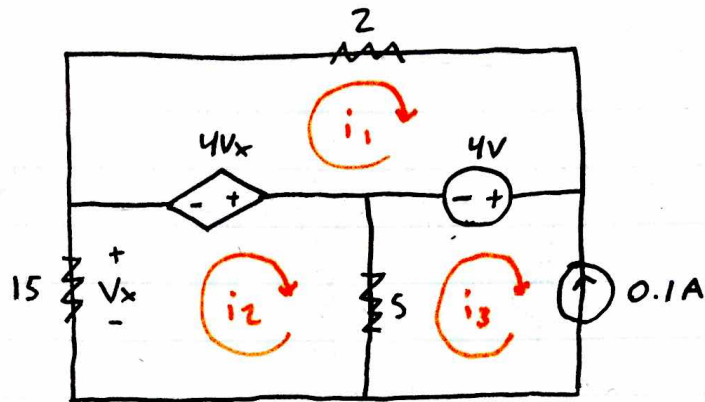
$$\text{KVL } i_3 \text{ LOOP: } -V_x + 4(i_3 - i_1) + 10 = 0$$

$$V_x = 4(i_3 - i_1) + 10$$

$$\boxed{V_x = 13.70V}$$



8)

USE MC TO AVOID SUPERNODE  $V=i.R$ 

$$i_1: 4V_x + 2i_1 + 4 = 0$$

$$i_2: -V_x - 4V_x + 5(i_2 - i_3) = 0$$

$$i_3: i_3 = -0.1A$$

$$\text{CONS. } 15i_2 = -V_x$$

$$i_2: -5V_x + 5i_2 - 5i_3 = 0$$

$$\begin{bmatrix} V_x & i_1 & i_2 & i_3 & C \\ 4 & 2 & 0 & 0 & -4 \\ -5 & 0 & 5 & -5 & 0 \\ 0 & 0 & 0 & 1 & -0.1 \\ 1 & 0 & 15 & 0 & 0 \end{bmatrix}$$

$$V_x = 0.0938 \text{ V}$$