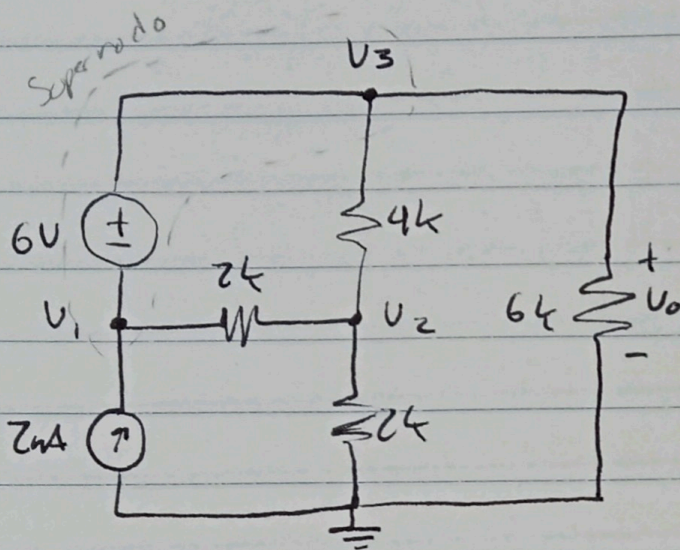


1. Analiza el siguiente circuito mediante el método de nodos y encuentra V_o .



$$\text{Supernodo } V_1 - V_3: -2\text{mA} + \frac{V_1 - V_2}{2k} + \frac{V_3 - V_2}{4k} + \frac{V_3}{6k} = 0$$

$$-24 + 6V_1 - 6V_2 + 3V_3 - 3V_2 + 2V_3 = 0$$

$$6V_1 - 9V_2 + 5V_3 = 24$$

$$\text{Nodo } (2): \frac{V_2}{2k} + \frac{V_2 - V_1}{2k} + \frac{V_2 - V_3}{4k} = 0$$

$$2V_2 + 2V_2 - 2V_1 + V_2 - V_3 = 0$$

$$-2V_1 + 5V_2 - V_3 = 0$$

$$V_3 = V_o$$

$$V_3 - V_1 = 6$$

$$V_o - V_1 = 6$$

$$6V_1 - 9V_2 + 5V_o = 24$$

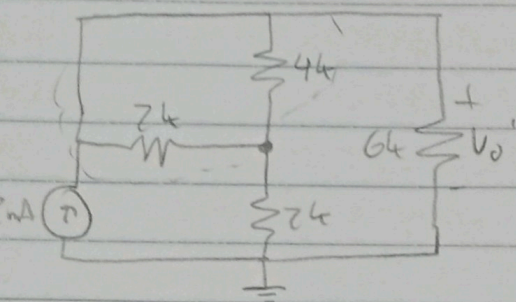
$$V_o = 6.86\text{V}$$

$$-2V_1 + 5V_2 - V_o = 0$$

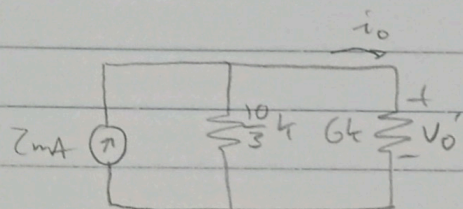
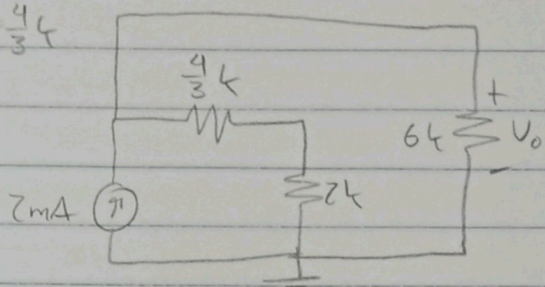
$$-V_1 \quad V_o = 6$$

2. Compruebe por superposición

Quitando la fuente de 6V



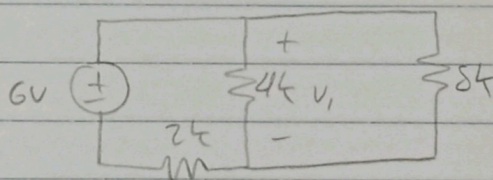
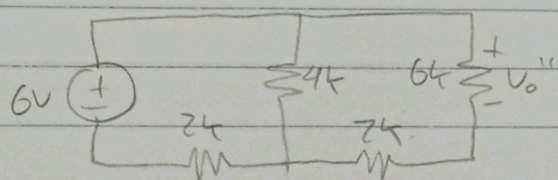
$$2k // 4k = \frac{4}{3}k$$



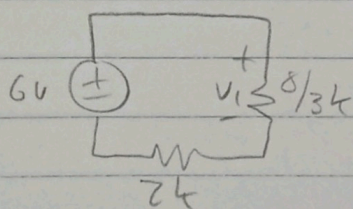
$$i_o = \frac{(2mA)(\frac{10}{3}k)}{\frac{16}{3}k} = \frac{5}{7}mA$$

$$V_o' = (\frac{5}{7}mA)(6k) = \frac{30}{7}V$$

Quitando la fuente de 2mA



$$4k // 8k = \frac{8}{3}k$$

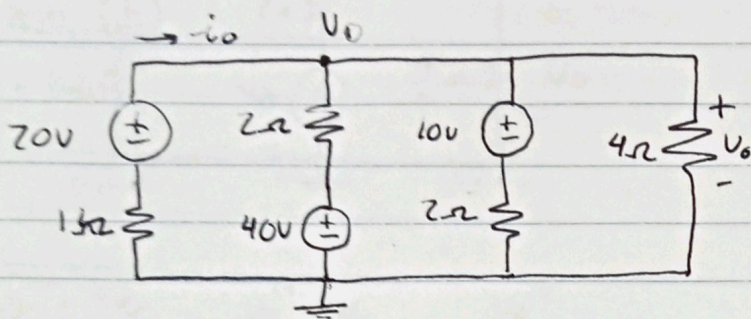


$$V_o'' = \frac{464}{8k} = \frac{(\frac{24}{7}V)(6k)}{8k} = \frac{18}{7}V$$

$$V_1 = \frac{(\frac{8}{3}k)(6)}{\frac{14}{3}k} = \frac{24}{7}V$$

$$V_o = V_o' + V_o'' = \frac{30}{7} + \frac{18}{7} = \frac{48}{7} = 6.86V$$

3. Encuentra V_o e i_o mediante el método de nodos y comprueba tus resultados por medio de superposición



$$V_1 = V_o$$

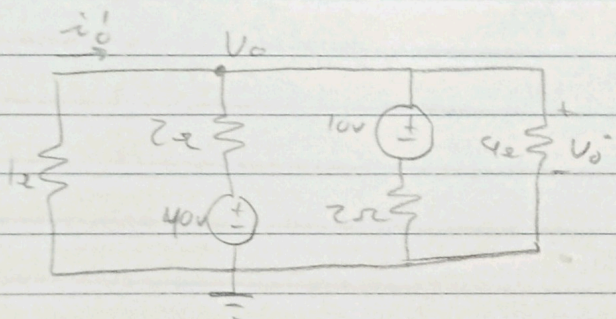
$$\frac{V_o - 20}{1} + \frac{V_o - 40}{2} + \frac{V_o - 10}{2} + \frac{V_o}{4} = 0$$

$$V_o - 20 + \frac{V_o}{2} - 20 + \frac{V_o}{2} - 5 + \frac{V_o}{4} = 0$$

$$\frac{9}{4} V_o = 45 \quad \boxed{V_o = 20V}$$

$$i_o = \frac{20 - V_o}{1} = 0A$$

Quitando la fuente de 20V



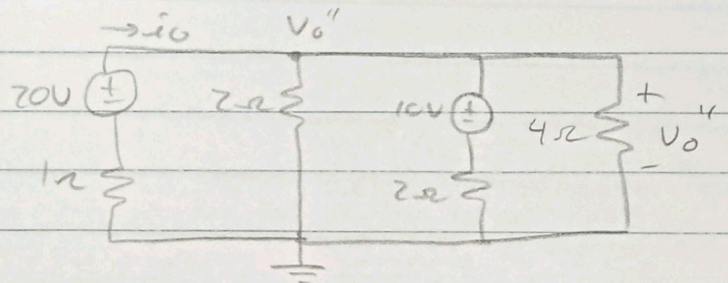
$$\frac{V_o'}{1} + \frac{V_o' - 40}{2} + \frac{V_o' - 10}{2} + \frac{V_o'}{4} = 0$$

$$V_o' + \frac{V_o'}{2} - 20 + \frac{V_o'}{2} - 5 + \frac{V_o'}{4} = 0$$

$$\frac{9}{4} V_o' = 25 \quad \boxed{V_o' = 11.11V}$$

$$i_o' = -\frac{V_o'}{1} = -11.11A$$

Quitando la fuente de 40V



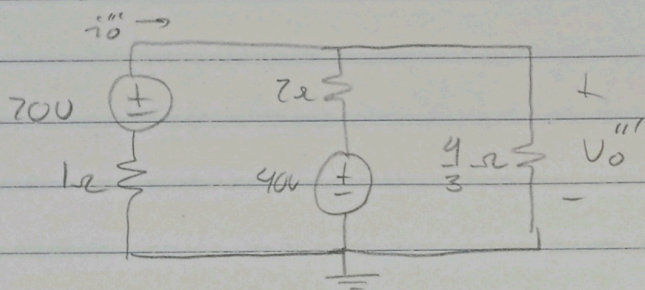
$$\frac{V_o'' - 20}{1} + \frac{V_o''}{2} + \frac{V_o'' - 10}{2} + \frac{V_o''}{4} = 0$$

$$V_o'' - 20 + \frac{V_o''}{2} + \frac{V_o''}{2} - 5 + \frac{V_o''}{4} = 0$$

$$\frac{9}{4} V_o'' = 25 \quad \boxed{V_o'' = 11.11V}$$

$$i_o'' = \frac{20 - V_o''}{1} = 8.89A$$

Quitando la fuente de 10V



$$V_o = V_o' + V_o'' + V_o'''$$

$$V_o = 11.11 + 11.11 + 17.7 = 29.9$$

$$i_o = i_o' + i_o'' + i_o'''$$

$$i_o = -11.11A + 0.8A + 7.3 = -0.01$$

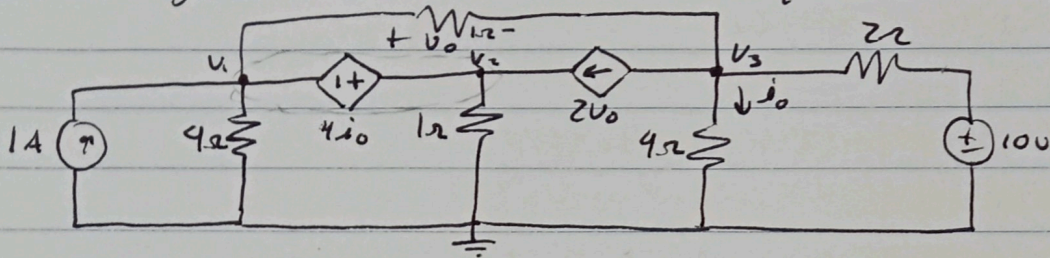
$$\frac{V_o''' - 70}{1} + \frac{V_o''' - 40}{2} + \frac{V_o'''}{\frac{4}{3}} = 0$$

$$V_o''' - 70 + \frac{V_o''' - 40}{2} + \frac{3V_o'''}{4} = 0$$

$$\frac{9}{4} V_o''' = 40 \quad V_o''' = 17.7V$$

$$i_o''' = \frac{70 - V_o'''}{1} = \frac{70 - 17.7}{1} = 52.3A$$

4. Analiza el siguiente circuito con el método de nodos y encuentra V_o e I_o



En el super nodo $-1 + \frac{V_1}{4} + \frac{V_1 - V_3}{1} + \frac{V_2}{1} - 2V_0 = 0$ $V_0 = V_1 - V_3$

$$-4 + V_1 + 4V_1 - 4V_3 + 4V_2 - 8V_0 = 0$$

$$V_2 - V_1 = 4i_0$$

$$5V_1 - 4V_3 + 4V_2 - 8(V_1 - V_3) = 4$$

$$V_2 = 4i_0 + V_1$$

$$-3V_1 + 4V_2 + 4V_3 = 4 \rightarrow E_c (1)$$

$$i_0 = \frac{V_3}{4}$$

Nodo (V_3) $2V_0 + \frac{V_3 - V_1}{1} + \frac{V_3}{4} + \frac{V_3 - 10}{2} = 0$

$$V_2 = V_3 + V_1$$

$$8V_0 + 4V_3 - 4V_1 + V_3 + 2V_3 - 20 = 0$$

$$V_1 + V_2 - V_2 = 0 \rightarrow E_c (2)$$

$$-4V_1 + 7V_3 + 8(V_1 - V_3) = 20$$

$$4V_1 - V_3 = 20 \rightarrow E_c (2)$$

$$V_0 = V_1 - V_3$$

$$-3V_1 + 4V_2 + 4V_3 = 4$$

$$V_1 = 4.9V$$

$$= 4.9 + 0.12$$

$$4V_1 - V_3 = 20$$

$$V_2 = 4.8V$$

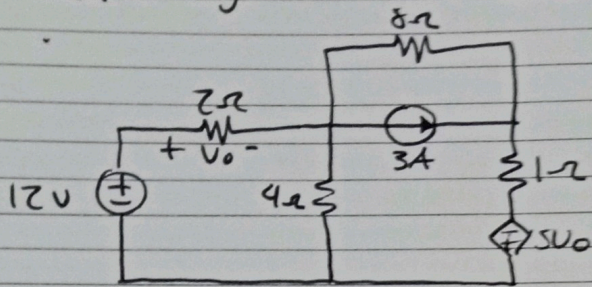
$$V_0 = 5.02$$

$$V_1 - V_2 + V_3 = 0$$

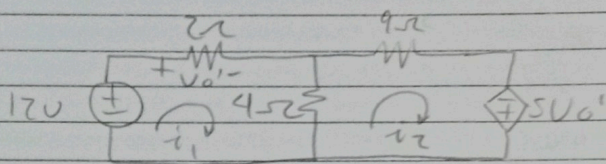
$$V_3 = -0.12V$$

$$i_0 = \frac{V_3}{4} = \frac{-0.12V}{4} = -30mA$$

5. Analiza el siguiente circuito con el método de superposición y encuentra V_o .



Quitando la fuente de 3A



$$\text{Malla (1): } -12 + 2i_1 + 4(i_1 - i_2) = 0$$

$$6i_1 - 4i_2 = 12$$

$$\text{Malla (2): } -5V_o' + 4(i_2 - i_1) + 9i_2 = 0 \quad V_o' = 2i_1$$

$$-16i_1 + 4i_2 - 4i_1 + 9i_2 = 0$$

$$-14i_1 + 13i_2 = 0$$

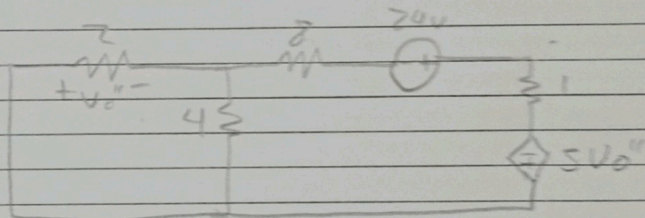
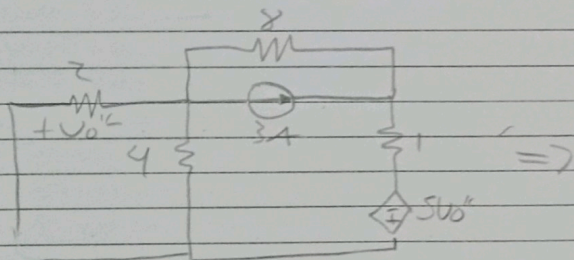
$$6i_1 - 4i_2 = 12$$

$$-14i_1 + 13i_2 = 0 \Rightarrow i_1 = 7.09$$

$$i_2 = 7.69$$

$$V_o' = 2(7.09) = 14.18\text{V}$$

Quitando la fuente de 12V



$$\text{Malla (1): } 2i_1 + 4(i_1 - i_2) = 0$$

$$6i_1 - 4i_2 = 0$$

$$\text{Malla (2): } -4i_2 + 13i_2 - 5V_o'' - 24 = 0 \quad V_o'' = 2i_1$$

$$-4i_1 + 13i_2 - 10i_1 = 24$$

$$-14i_1 + 13i_2 = 24$$

$$6i_1 - 4i_2 = 0 \Rightarrow i_1 = 4.36$$

$$-14i_1 + 13i_2 = 24 \Rightarrow i_2 = 6.55$$

$$V_o'' = 2(4.36) = 8.72$$

$$V_o = V_o' + V_o'' = 14.18 + 8.72 = 22.9$$