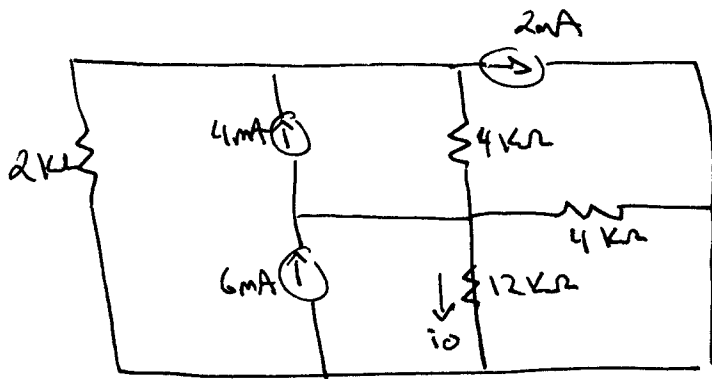
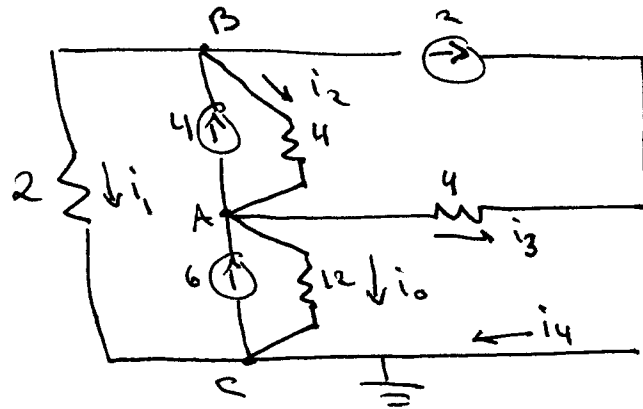


Chapter 3.

11.



Re-draw:



KCL

$$\left. \begin{aligned} \text{A) } 6 + i_2 &= 4 + i_3 + i_o \\ \text{B) } 4 &= i_2 + 2 + i_1 \\ \text{C) } i_o + i_1 + 2 + i_3 &= 6 \\ &= i_4 \end{aligned} \right\} \text{ 3 equations of 4 unknowns}$$

Write in terms of node voltages:

$$\left. \begin{aligned} \text{A) } 6 + \frac{V_B - V_A}{4k\Omega} &= 4 + \frac{V_A}{4k\Omega} + \frac{V_A}{12k\Omega} \\ \text{B) } 4 \text{ mA} &= \frac{V_B - V_A}{4k} + 2 \text{ mA} + \frac{V_B}{2k} \\ \text{C) } \frac{V_A}{12k} + \frac{V_B}{2k} + 2 \text{ mA} + \frac{V_A}{4k\Omega} &= 6 \text{ mA} \end{aligned} \right\} \text{ need 2 unknowns}$$

∴ $V_C = 0$
and $i_o = \frac{V_A}{12k\Omega}$

$$\begin{aligned} \rightarrow \text{A) } 72 + 3V_B - 3V_A &= 48 + 5V_A + V_A \\ 24 &= 7V_A - 3V_B \\ \text{B) } 16 &= V_B - V_A + 8 + 2V_B \\ 8 &= 3V_B - V_A \end{aligned}$$

$$\begin{aligned} \rightarrow \text{A+B} \Rightarrow 32 &= 6V_A \rightarrow V_A = \frac{16}{3} \text{ V} \\ i_o &= \frac{V_A}{12k\Omega} = \frac{4}{9} \text{ mA} \end{aligned}$$