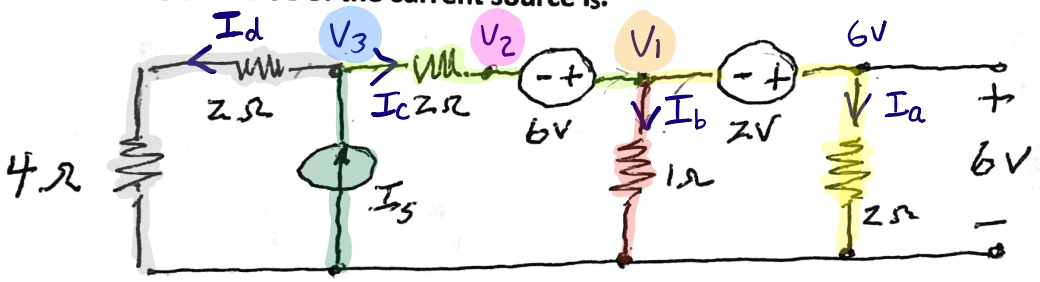
Elec 2110-Exam 1-Spr'18

Test Review

Name

1. Determine the value of the current source Is.



① $I_a = \frac{6V}{2\Omega} = 3A$

② $6V - V_1 = 2V$

$V_1 = 4V$

③ $I_b = \frac{V_1}{1\Omega} = 4A$

④ $V_1 - V_2 = 6V$

$4 - V_2 = 6V$

$V_2 = -2V$

⑤ $I_c = I_b + I_a$

$= 4 + 3$

$= 7A$

⑥ $V_3 - V_2 = I_c \cdot 2\Omega$

$V_3 = 14 - 2$

$= 12V$

⑦ $I_d = \frac{V_3}{4\Omega + 2\Omega}$

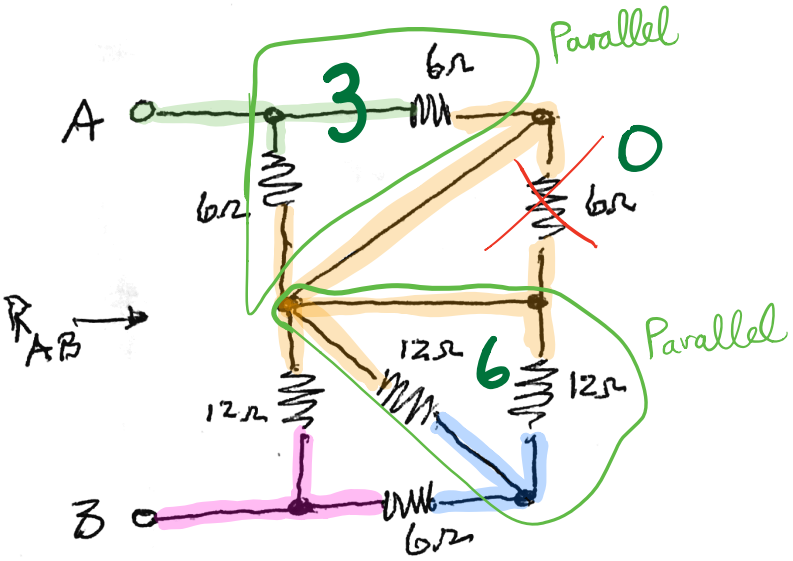
$= \frac{12}{6} = 2A$

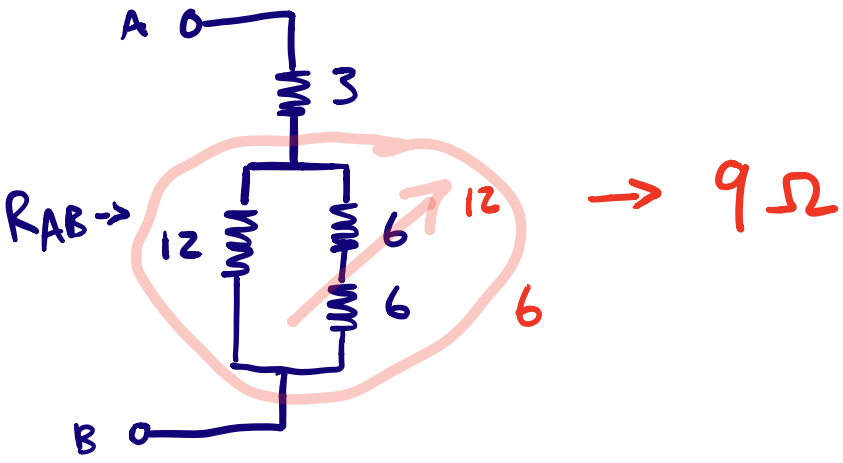
⑧ $I_s = I_d + I_c$

$= 2A + 7A$

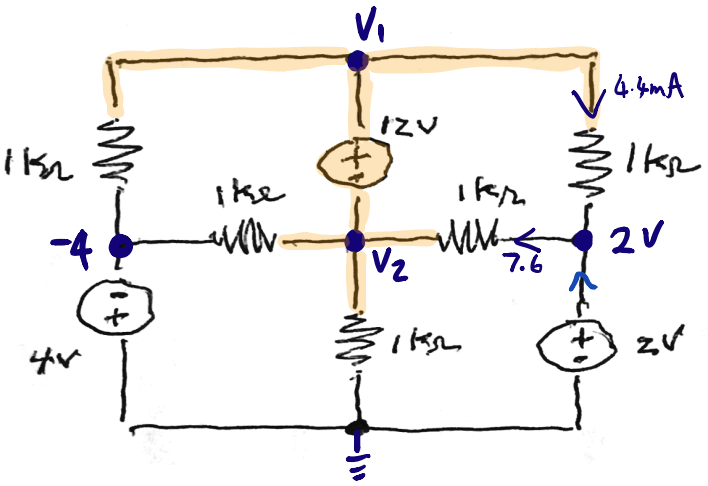
$= 9A$

2. Find the resistance at the terminals A-B





3. **Use nodal analysis to determine if power is absorbed or supplied by the 2 V source, and determine the amount**



$$\frac{V_1-(-4)}{1k}+\frac{V_1-2}{1k}+\frac{V_2-2}{1k}+\frac{V_2}{1k}+\frac{V_2-(-4)}{1K}=0$$

SUPPLIED

Direct to matrix:

$$\begin{matrix} & V_1 & V_2 \\ \text{SNE} & 2 & 3 \\ \text{SNI} & 1 & -1 \end{matrix}\begin{bmatrix}2 & 3\\ 1 & -1\end{bmatrix}^{-1}\begin{bmatrix}-4\\ 12\end{bmatrix}=\begin{bmatrix}V_1\\ V_2\end{bmatrix}=\begin{bmatrix}6.4\\ -5.6\end{bmatrix}$$

(1) OR

Substitution Method

SNE $2V_1 + 3V_2 = -4$

SNI $V_1 - V_2 = 12$

$V_1 = 12 + V_2$

$2(12+V_2) + 3V_2 = -4$

$24 + 2V_2 + 3V_2 = -4$

$5V_2 = -28$

$V_2 = \frac{-28}{5} = -5.6$

$V_1 = 12 - 5.6 = 6.4$

(2) Find Currents in/out of 2V node:

$$\frac{V_2-2}{1K}=\frac{-5.6-2}{1K}=-7.6\text{ mA}$$

$$\frac{V_1-2}{1k}=\frac{6.4-2}{1K}=4.4\text{ mA}$$

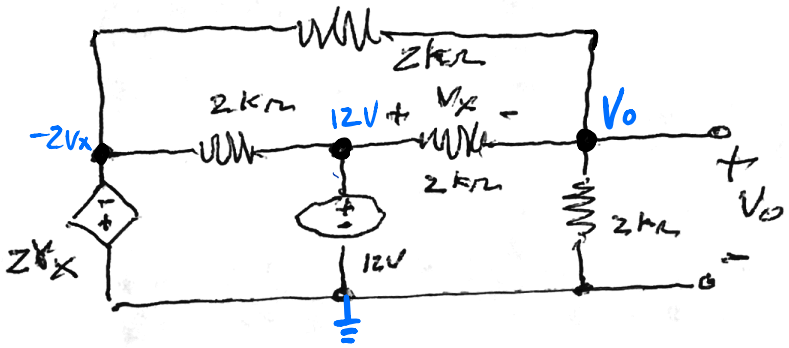
V_2 supply $= 7.6 - 4.4$

$= 3.2\text{ mA}$

$P_{2\text{ supply}} = 2 \cdot 3.2$

$= 6.4\text{ mW}$

4. Use nodal analysis to find V_o



Direct to Matrix Method

$$\begin{bmatrix} \frac{3}{2} & 1 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} V_o \\ V_x \end{bmatrix} = \begin{bmatrix} 6 \\ 12 \end{bmatrix} = \begin{bmatrix} -12 \\ 24 \end{bmatrix} V$$

Substitution Method

$$12 - V_o = V_x$$

$$\frac{V_o}{2K} + \frac{V_o - 12}{2K} + \frac{V_o - (-2V_x)}{2K} = 0$$

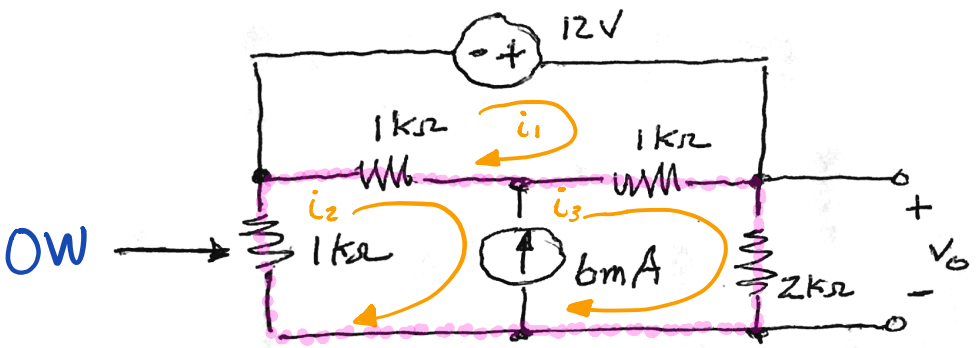
$$\frac{3}{2K} V_o + \frac{V_x}{K} = \frac{6}{K}$$

$$\frac{3}{2} V_o + (12 - V_o) = 6$$

$$3V_o + 24 - 2V_o = 12$$

$$V_o = -12\,V$$

5. **Find V_o and the amount of power absorbed by the resistor identified by the arrow.**



i_1 loop constraint eqn. lower two windows

$$\begin{bmatrix} i_1 & i_2 & i_3 \\ 2k & -1k & -1k \\ 0 & -1 & 1 \\ -2k & 2k & 3k \end{bmatrix}^{-1} \begin{bmatrix} 12 \\ 6\,mA \\ 0 \end{bmatrix} = \begin{bmatrix} 9 \\ 0 \\ 6 \end{bmatrix} mA$$

i_1 loop:

$$-12 + 1k(i_1 - i_3) + 1k(i_1 - i_2) = 0$$

Constraint Eqn:

$$i_3 - i_2 = 6mA$$

Lower Two Windows:

$$1k(i_2) + 1k(i_2 - i_1) + 1k(i_3 - i_1) + 2k(i_3) = 0$$

$$V_o = i_3(2k)$$
$$= 6mA(2k)$$
$$= 12\,V$$