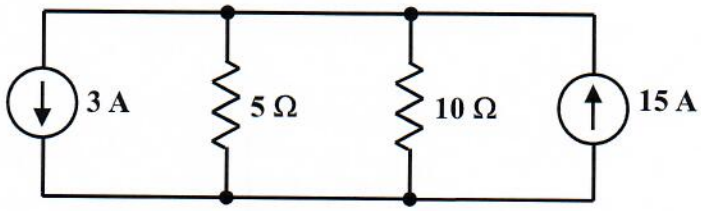
EE/EET 2240

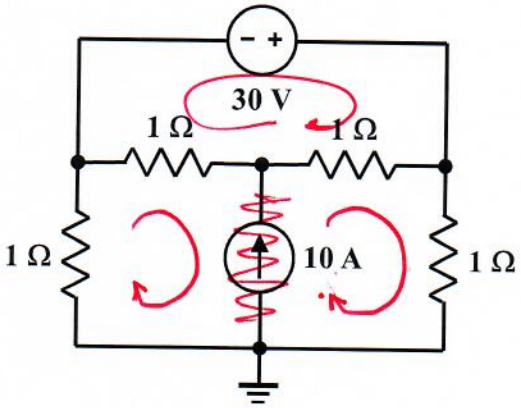
Homework Problem #017

Express mesh equations in the matrix form discussed in class.



EE/EET 2240

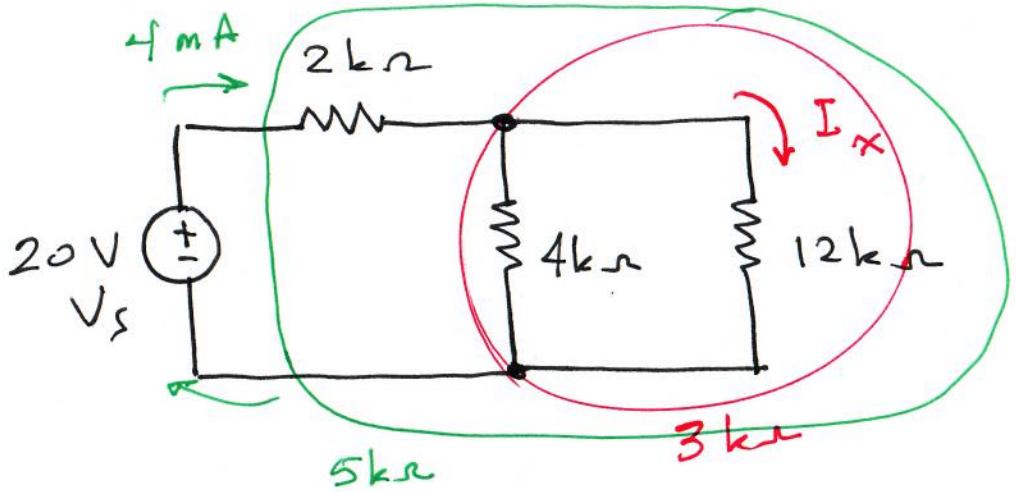
Homework Problem #018



a. Express mesh equations in the matrix form discussed in class.

b. Solve the equations.

c. Is the 30 V source *delivering power* or *absorbing* power? How much?



$$I_x = \frac{4k\Omega}{4k\Omega + 12k\Omega} \cdot 4mA$$

$$= \frac{16}{16k} = 1mA$$

$$P_{2k\Omega} = I_x^2 (12k\Omega)$$

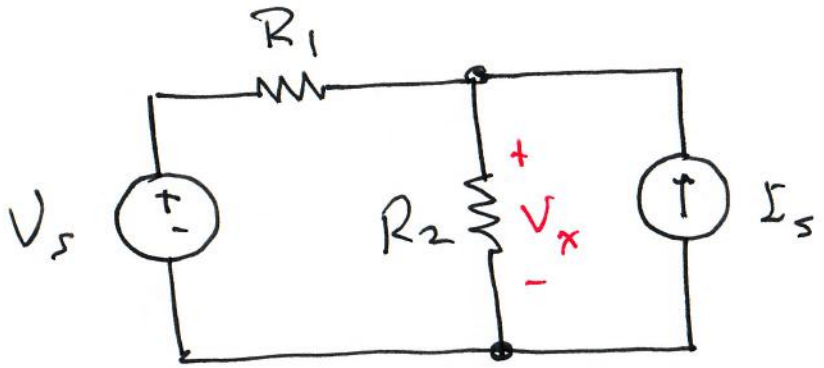
$$= 12\,mW$$

$$I_x = C \cdot V_s$$

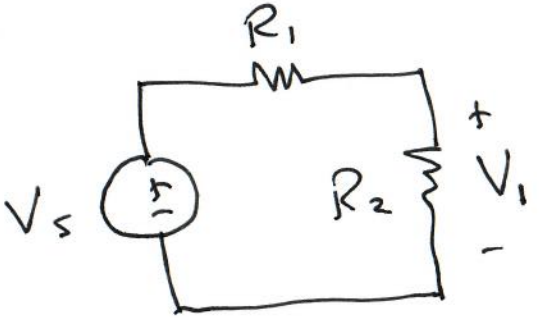
$$= \frac{4k\Omega}{4k\Omega + 12k\Omega} \cdot \frac{V_s}{5k\Omega}$$

$$= \frac{4k\Omega}{16k\Omega \cdot 5k\Omega} \cdot V_s \qquad 2k\Omega + (4k\Omega \| 12k\Omega)$$

$$= \frac{1}{20} \times 10^{-3} V_s$$



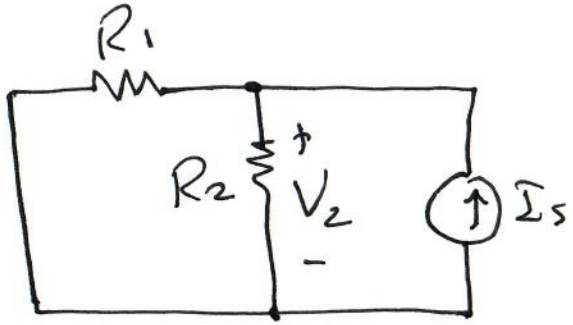
Superposition:



open circuit

Contribution to V_x from the V_s source.

$$V_1 = \frac{R_2}{R_1+R_2} V_s$$



short circuit

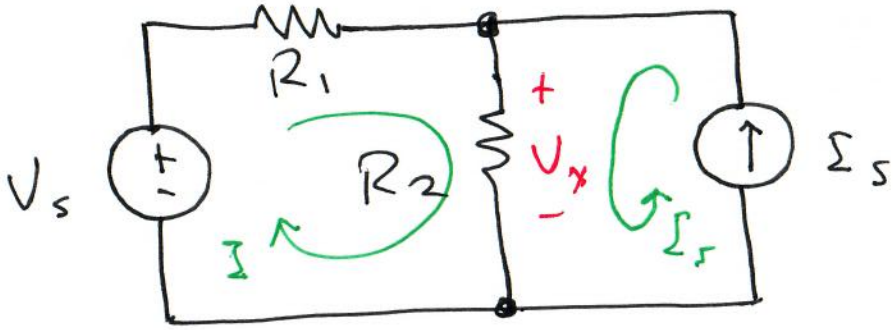
Contribution to V_x from the I_s source.

$$V_2 = \frac{R_1 R_2}{R_1+R_2} I_s$$

$$V_x = V_1 + V_2$$

$$= \frac{R_2}{R_1 + R_2} V_s + \frac{R_1 R_2}{R_1 + R_2} I_s$$

Is this true?



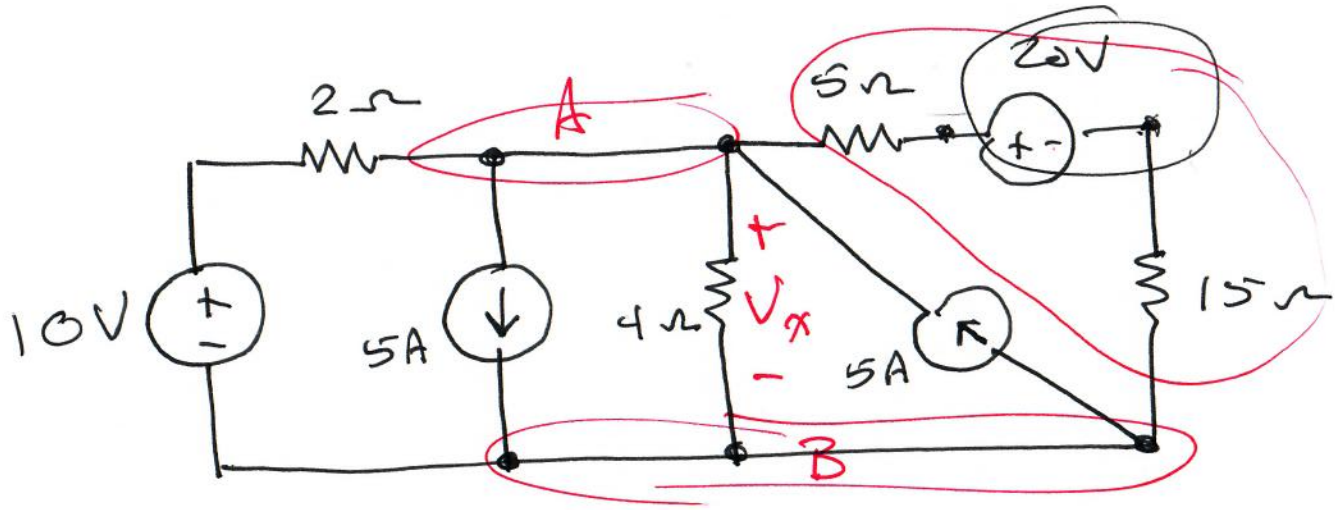
$$-V_s + R_1 I + R_2 (I + I_s) = 0$$

$$I = \frac{V_s - R_2 I_s}{R_1 + R_2}$$

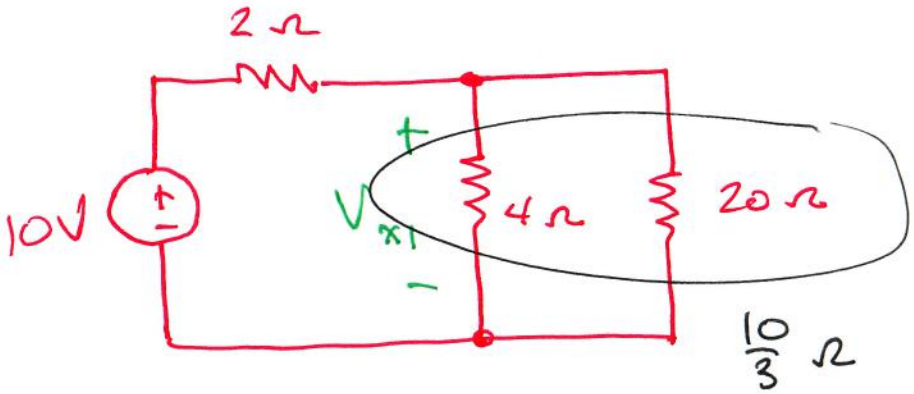
$$V_x = R_2 (I + I_s) = \frac{R_2 V_s - R_2^2 I_s}{R_1 + R_2} + R_2 I_s$$

$$V_x = \frac{R_2 V_s - R_2^2 I_s + R_2 R_1 I_s + R_2^2 I_s}{R_1 + R_2}$$

$$= \frac{R_2}{R_1 + R_2} V_s + \frac{R_2 R_1}{R_1 + R_2} I_s$$



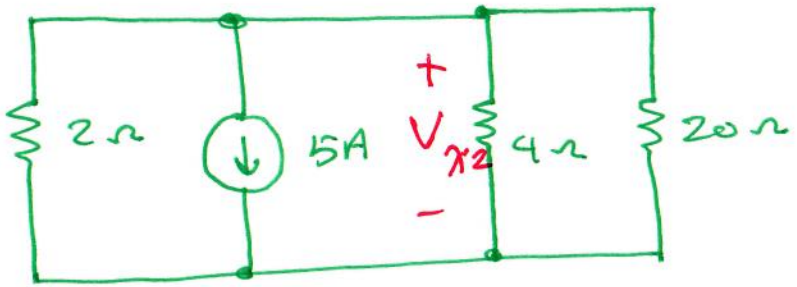
For the 10V source:



$$V_{x1} = \frac{\frac{10}{3}}{2 + \frac{10}{3}} \cdot 10V$$

$$= \frac{5}{8} \cdot 10V = \frac{25}{4} V$$

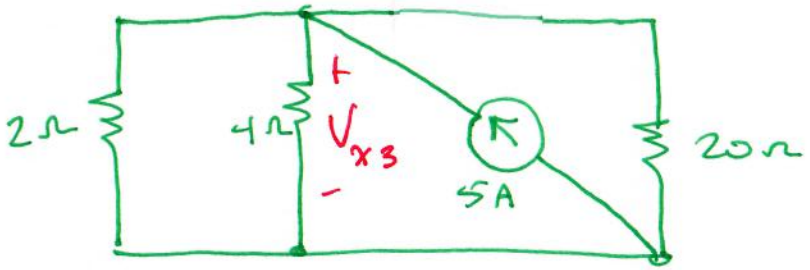
For the left 5A source:



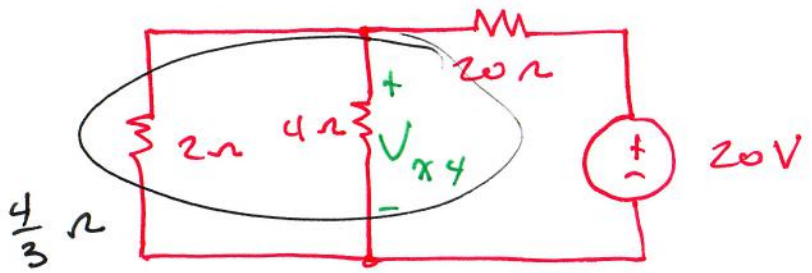
$$R_{eq} = \frac{\frac{10}{3} \times 2}{\frac{10}{3} + 2} = \frac{5}{4} \Omega$$

$$V_{x2} = -\frac{5}{4}\Omega \cdot 5A = -\frac{25}{4} V$$

For the right 5A source:



For the 20V source:



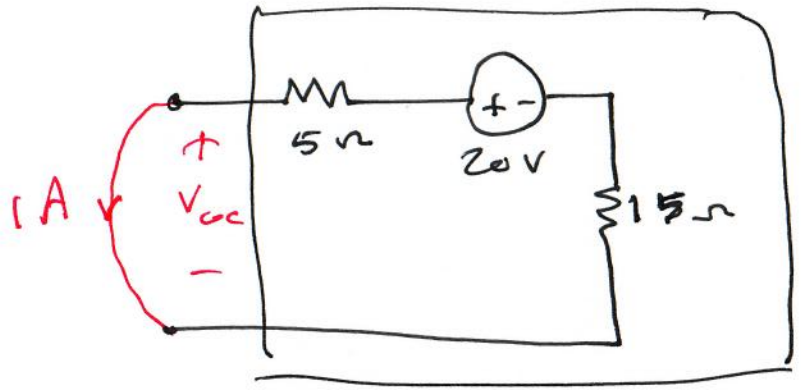
$$V_x = V_{x1} + V_{x2} + V_{x3} + V_{x4} \quad ?$$

$$V_{x3} = \frac{25}{4}\,V$$

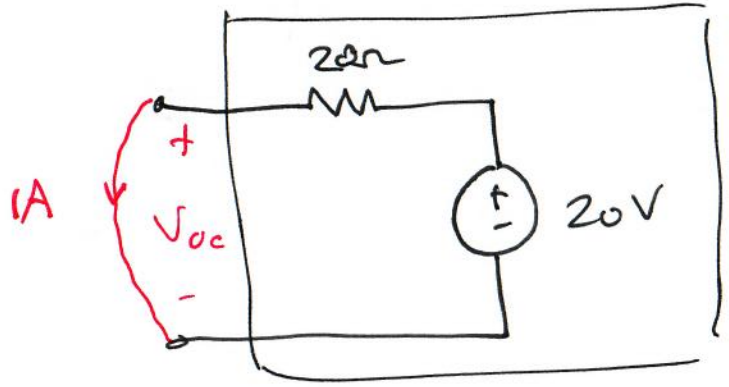
$$V_{x4} = \frac{\frac{4}{3}}{\frac{4}{3}+20}\,20V$$

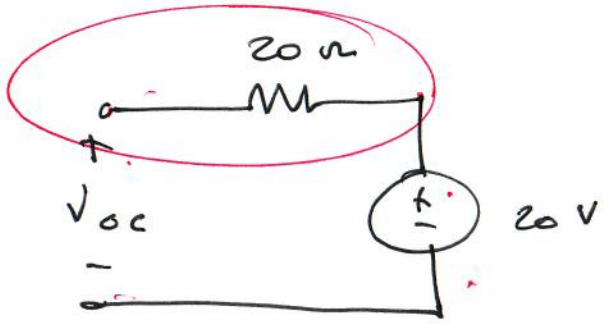
$$= \frac{5}{4}\,V$$

$$V_x = \frac{25}{4} - \frac{25}{4} + \frac{25}{4} + \frac{5}{4} = \frac{15}{2}\,V$$



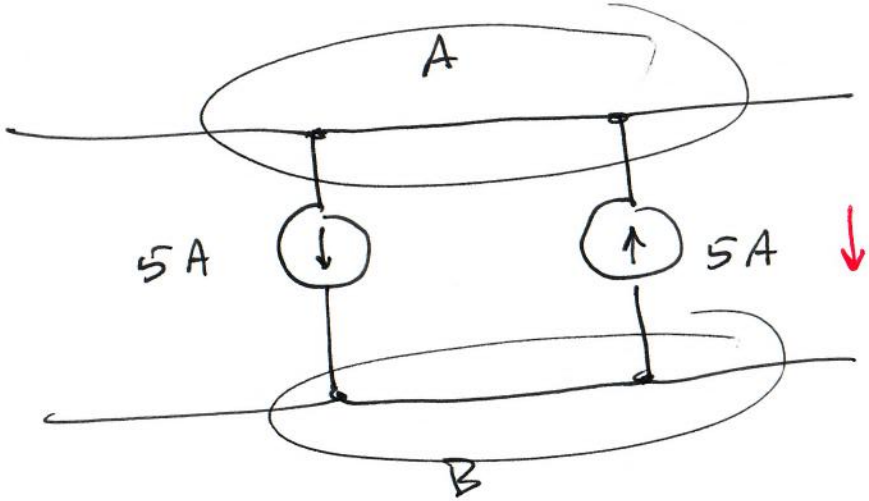
$V_{oc} = 20V$

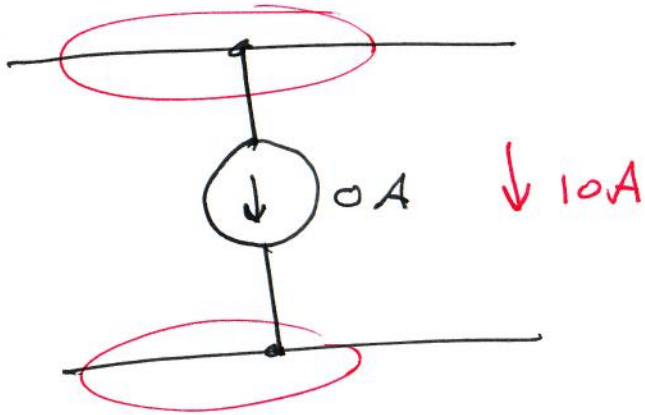


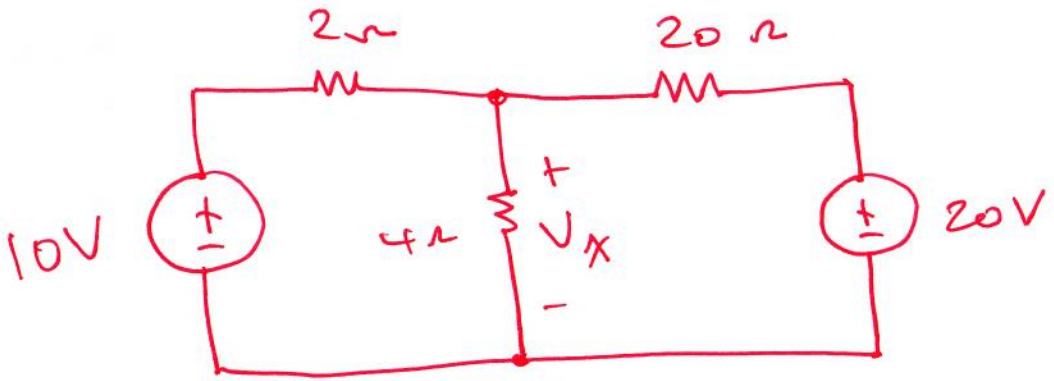


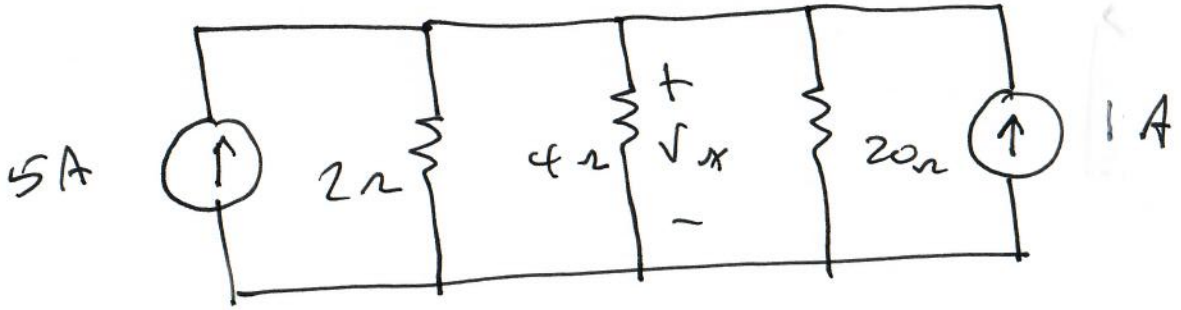
$-V_{oc} + \cancel{R(0)}^{0} + 20 = 0$

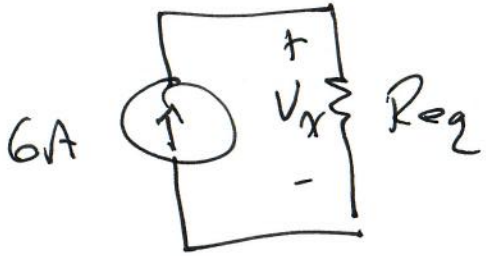
$V_{oc} = 20V$


A
5A
5A
B


0A
10A


2Ω
20Ω
10V
4Ω
+
V_x
-
20V


5A
2Ω
4Ω
+
V_x
-
20Ω
1A


6A
+
V_x
-
R_{eq}