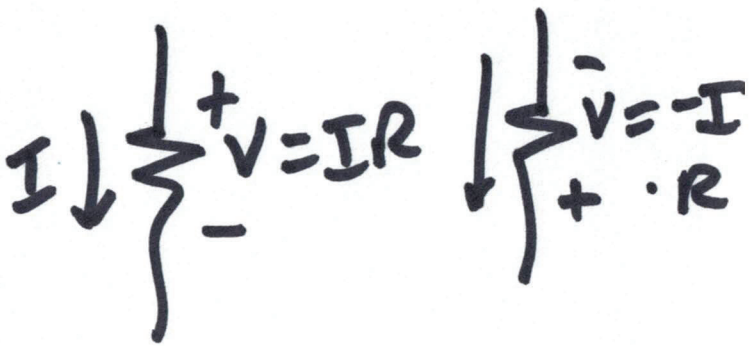
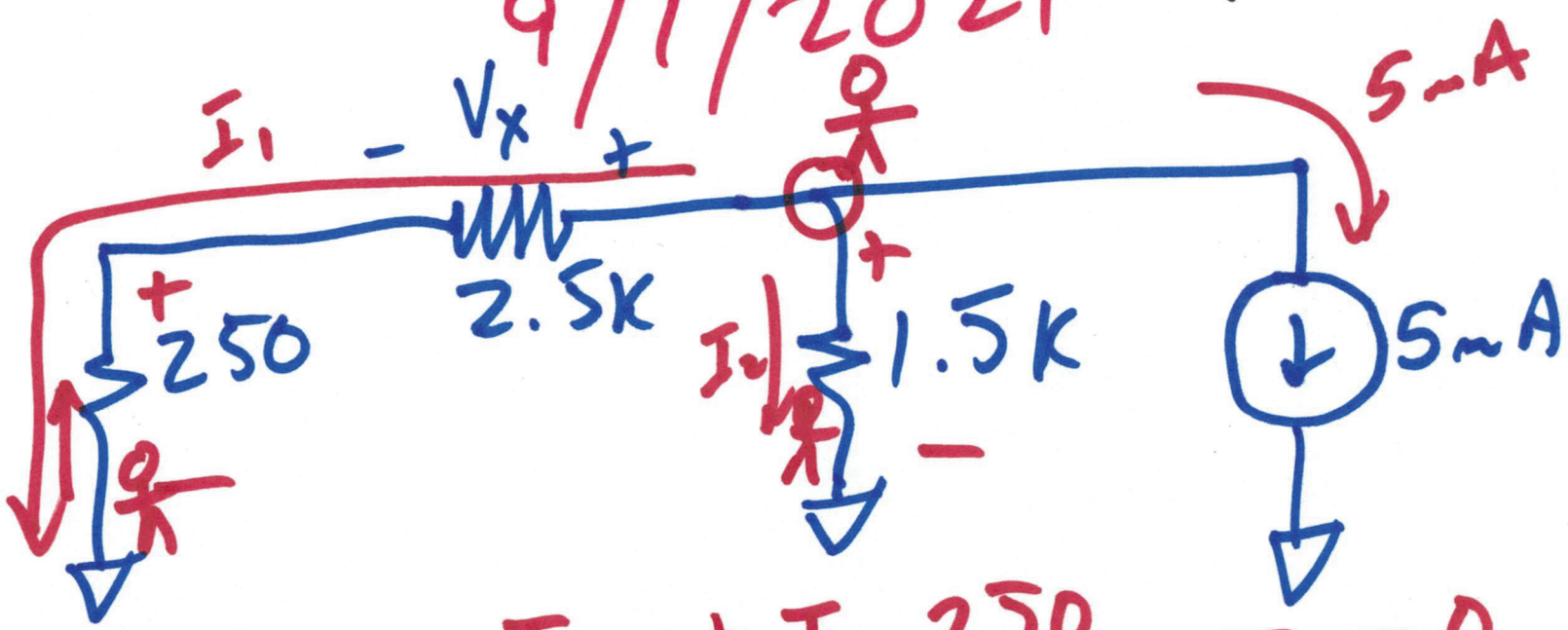
EE 220 Circuits I

Lecture 4



9/1/2021



KVL $-1.5K \cdot I_2 + I_1 \cdot 250 + 0 = 0$

KCL $I_1 + I_2 + 5\text{-}A = 0$ $\quad I_1 \cdot 2{,}500$

$$-1.5k I_2 + I_1 \cdot 250 + 2.5k I_1 = 0$$

$$I_1 + I_2 + 5mA = 0 \rightarrow I_1 = -I_2 - 5mA$$

$$-6I_2 + I_1 + 10 I_1 = 0$$

$$-6I_2 + 11 I_1 = 0$$

$$-6I_2 + 11 I_2 - 55mA = 0$$

$$-17 I_2 = 55mA$$

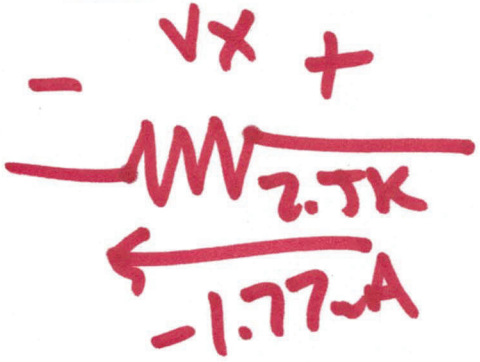
$$I_2 = \frac{-55mA}{7}$$

$$\boxed{I_2 = 3.23mA}$$

$$I_1 + I_2 + 5\text{m}A = 0$$

$$I_2 = -3.23\text{m}A$$

$$\boxed{I_1 = -1.77\text{m}A}$$

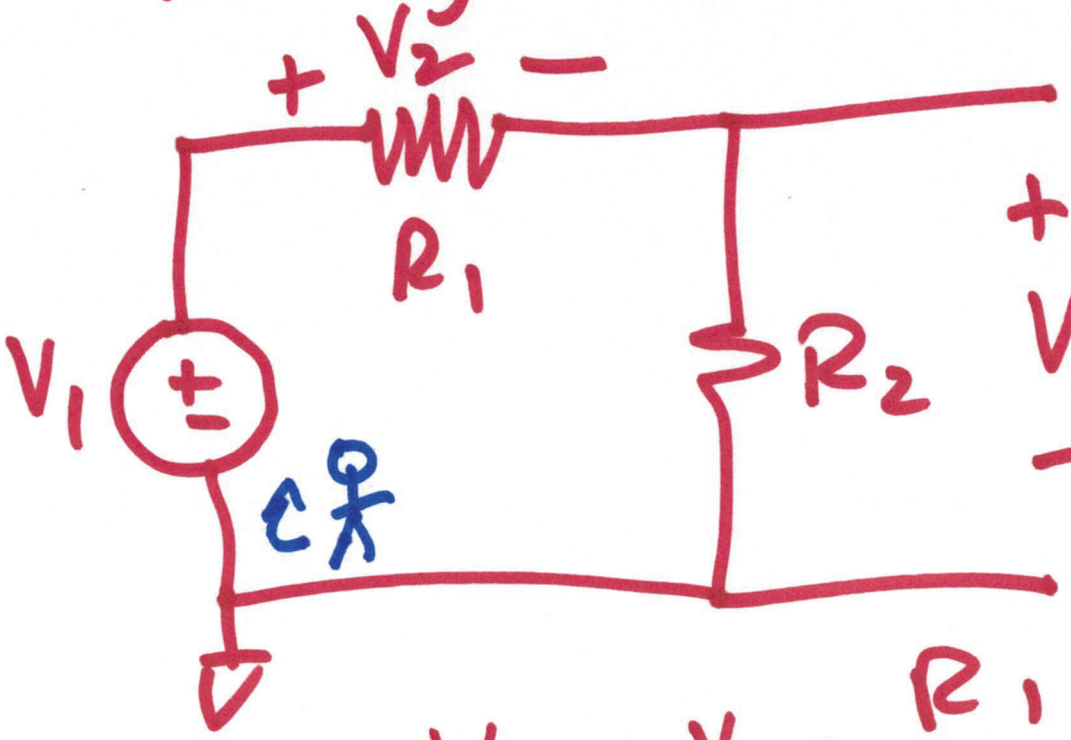


$$V_x = I \cdot 2.5\text{K}$$

$$V_x = -1.77\text{m}A \cdot 2.5\text{K}$$

$$\boxed{V_x = -4.425\text{V}}$$

Voltage Divider



$$V_3 = V_1 \cdot \frac{R_2}{R_1 + R_2}$$

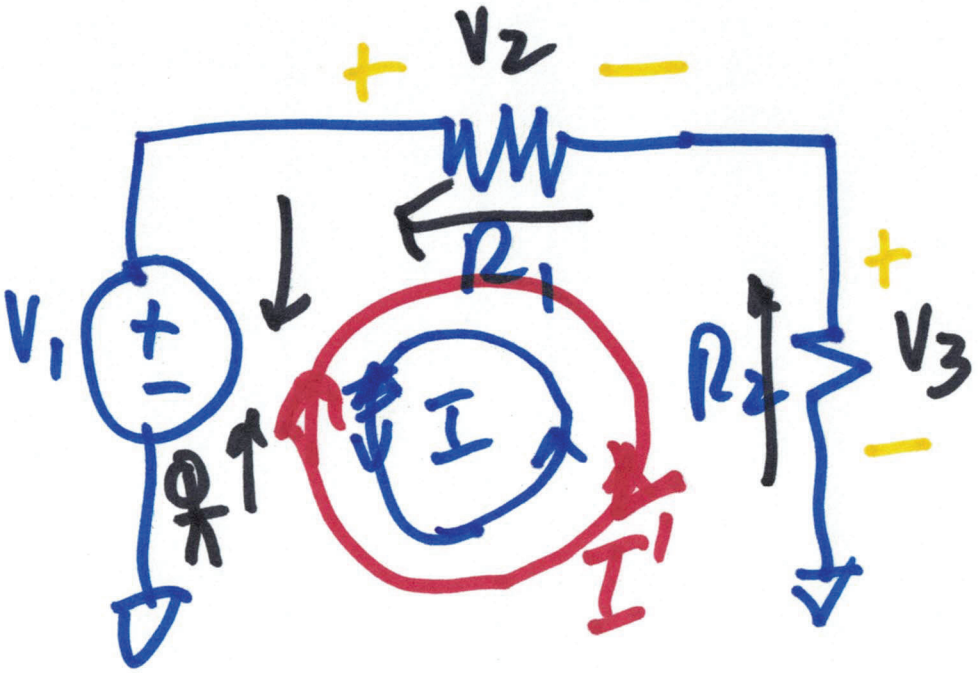
$$V_2 = V_1 \cdot \frac{R_1}{R_1 + R_2}$$

$$V_1 - V_2 - V_3 = 0$$

$$V_1 = V_2 + V_3$$

$$\frac{V_1 \cdot R_1}{R_1 + R_2} + \frac{V_1 \cdot R_2}{R_1 + R_2}$$

$$\frac{V_1 (R_1 + R_2)}{R_1 + R_2}$$



$I \uparrow \gtrless \overset{+}{V}_{-} = -I \cdot R$

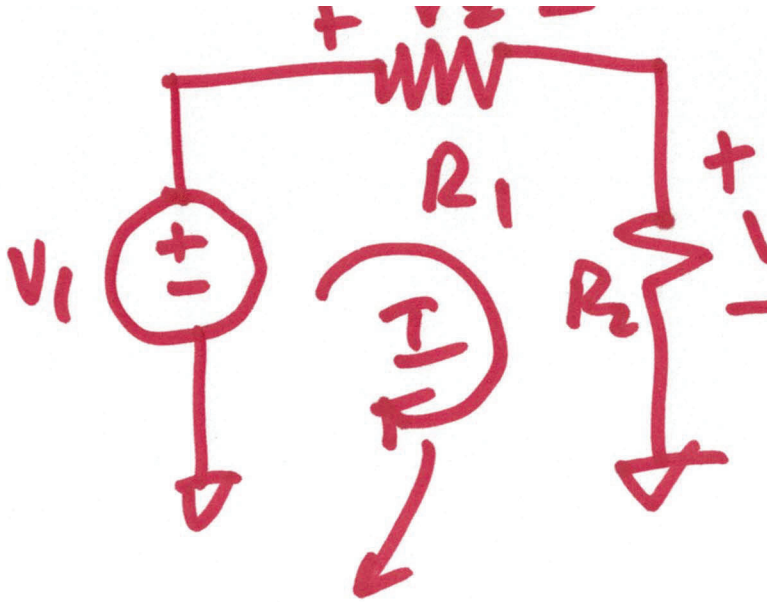
$$I' = \frac{V_1}{R_1 + R_2}$$

$$V_1 = V_2 + V_3$$

$$V_1 - V_2 - V_3 = 0$$

$$V_1 - (-I \cdot R_1) - (-I \cdot R_2) = 0$$

$$I = \frac{-V_1}{R_1 + R_2}$$



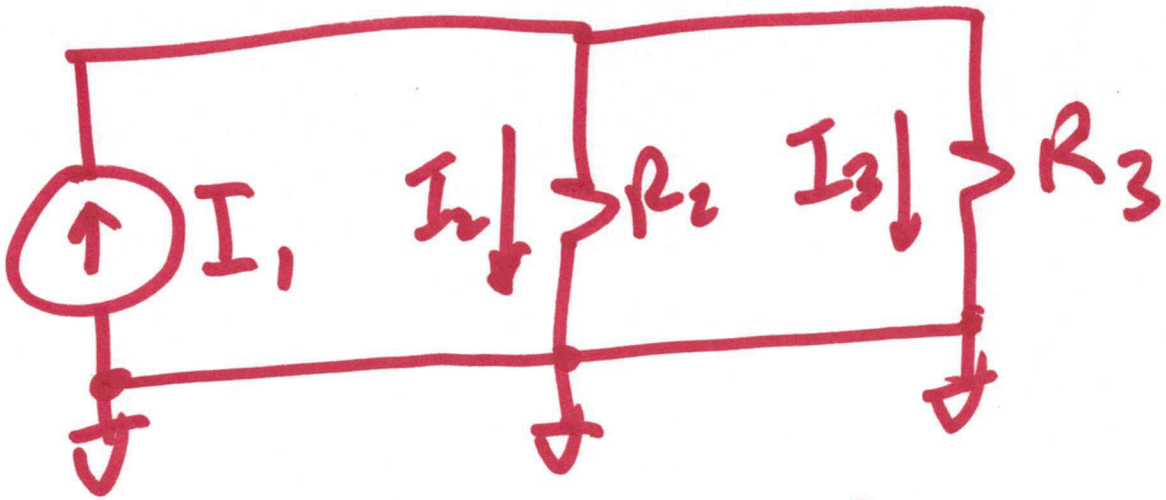
$$V_3 = I \cdot R_2 = V_1 \cdot \frac{R_2}{R_1 + R_2}$$

$$V_2 = I \cdot R_1 = V_1 \cdot \frac{R_1}{R_1 + R_2}$$

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

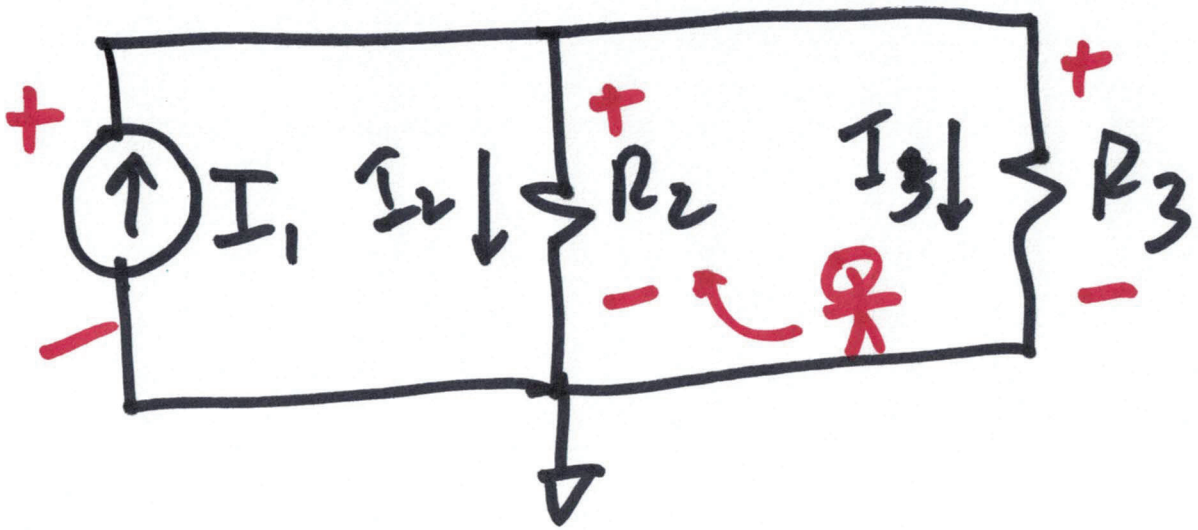
current divider

$$I_1 = I_2 + I_3$$



$$I_2 = I_1 \cdot \frac{R_3}{R_2 + R_3}$$

$$I_3 = I_1 \cdot \frac{R_2}{R_2 + R_3}$$



$$I_2 = I_1 \cdot \frac{R_3}{R_1 + R_2}$$

$$I_2 \cdot R_2 - I_3 \cdot R_3 = 0$$

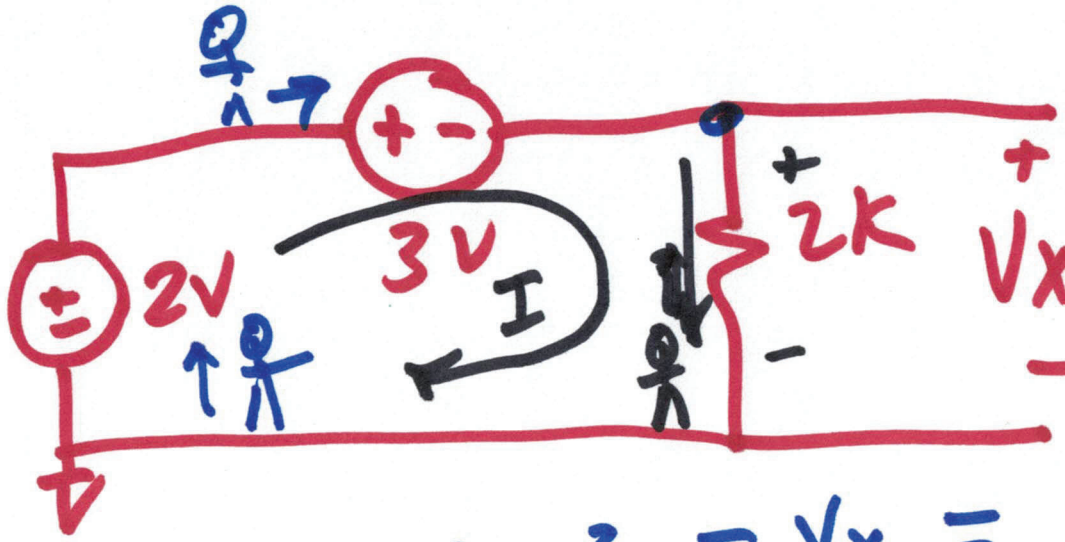
$$I_1 = I_2 + I_3$$

$$I_3 = I_1 \cdot \frac{R_2}{R_2 + R_3}$$

$$I_2 = -I_3 + I_1$$

$$R_2(-I_3 + I_1) - I_3 \cdot R_3 = 0$$

$$I_1 \cdot R_2 = I_3(R_2 + R_3)$$



$V_x = I \cdot 2K = -\frac{1}{2}mA \cdot 2K$

$= -1V$

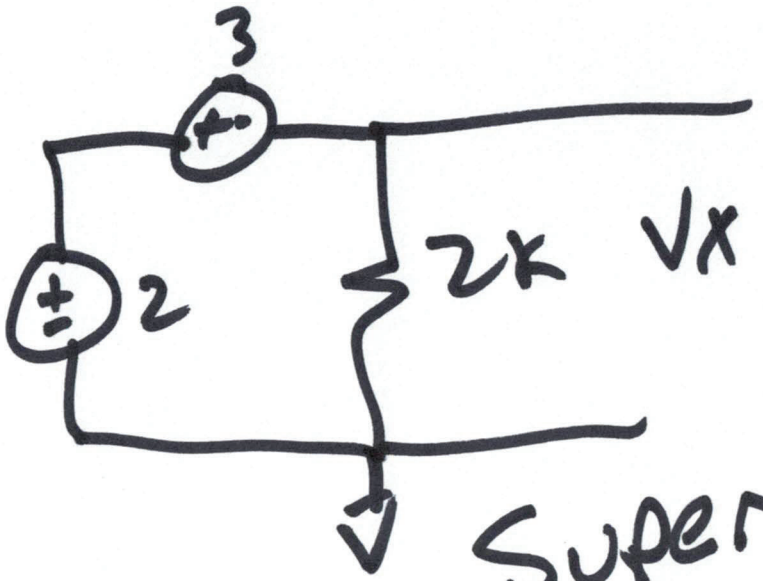
$+2 - 3 = V_x = -1V$

$V_x + 3 - 2 = 0$

$+I \cdot 2K + 3 - 2 = 0$

$I \cdot 2K + 1 = 0$

$I = \frac{-1}{2K} = -\frac{1}{2}mA$

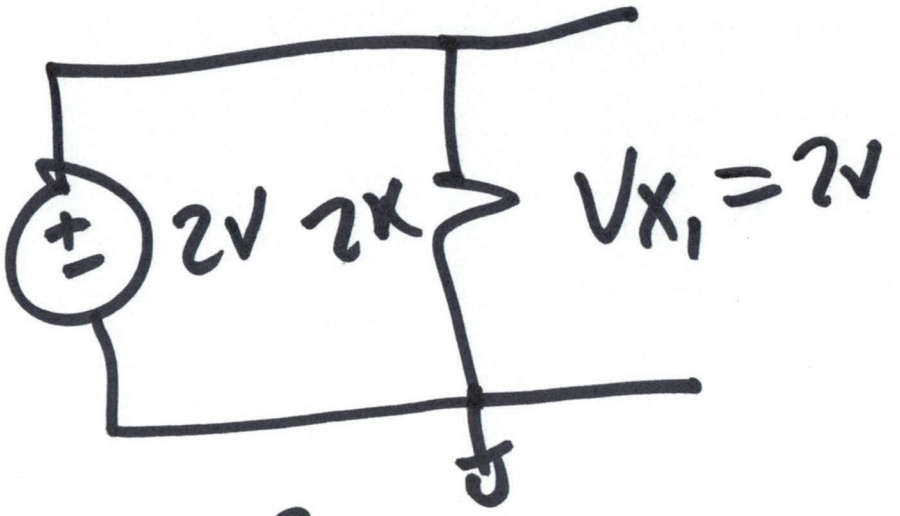


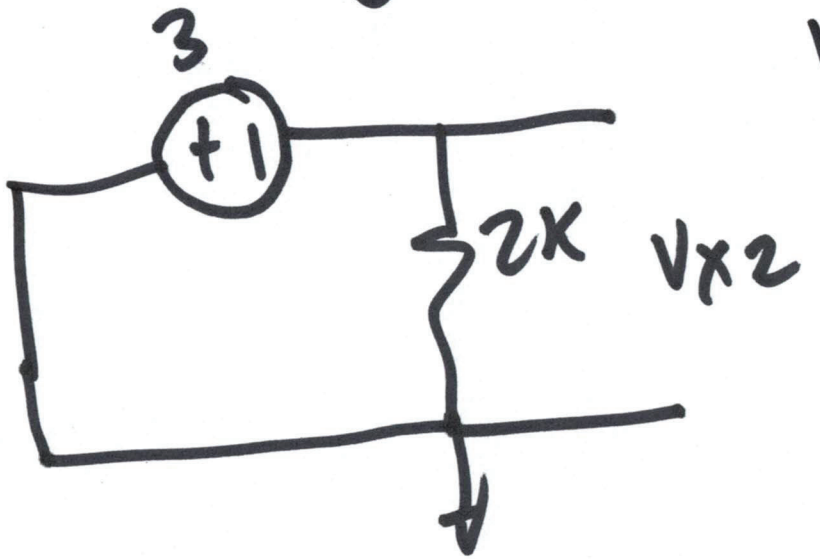
Superposition

Look At one source at a time

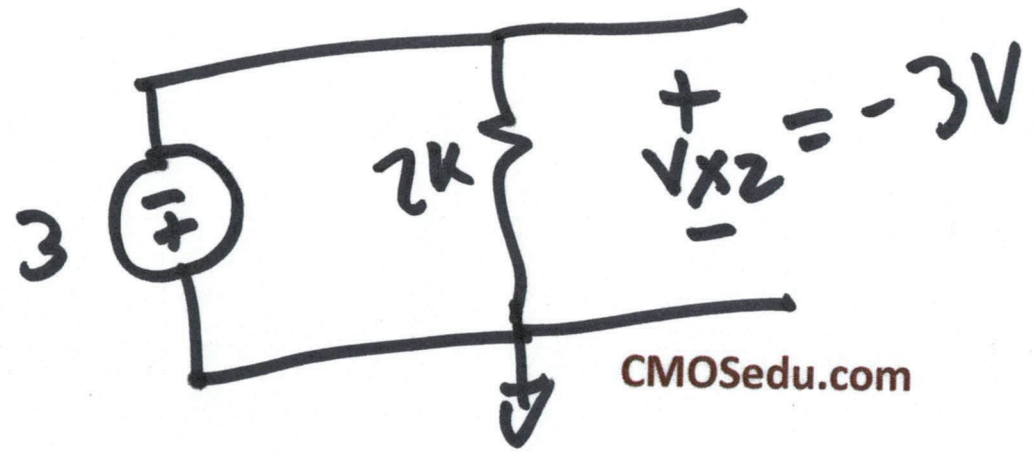
Voltage → wire (short)

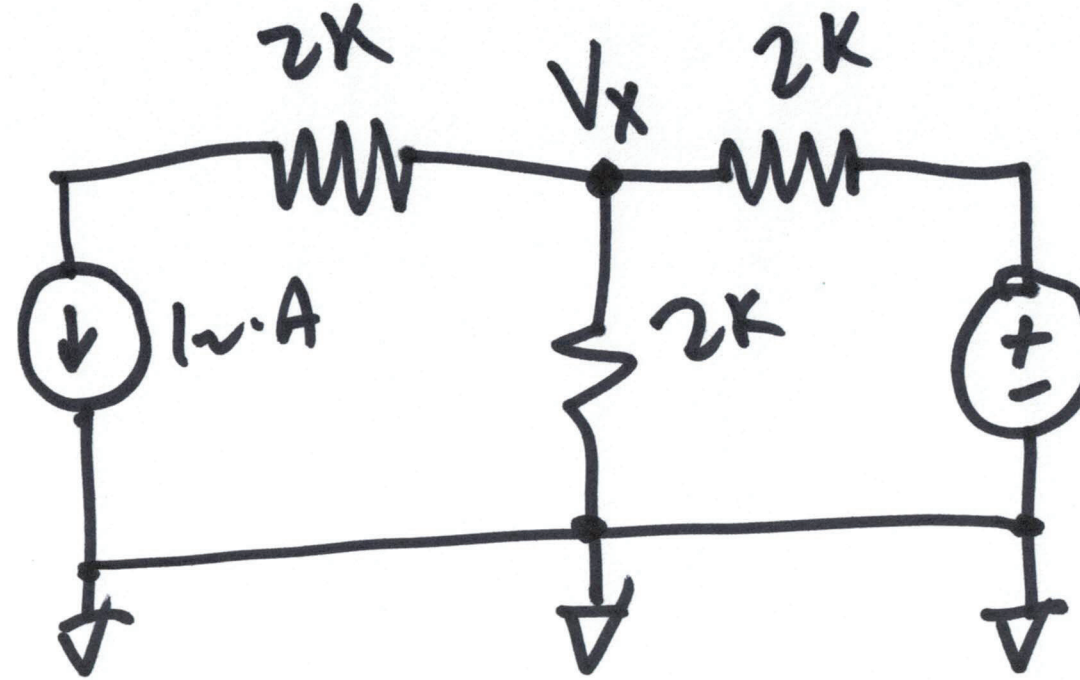
current sources → open



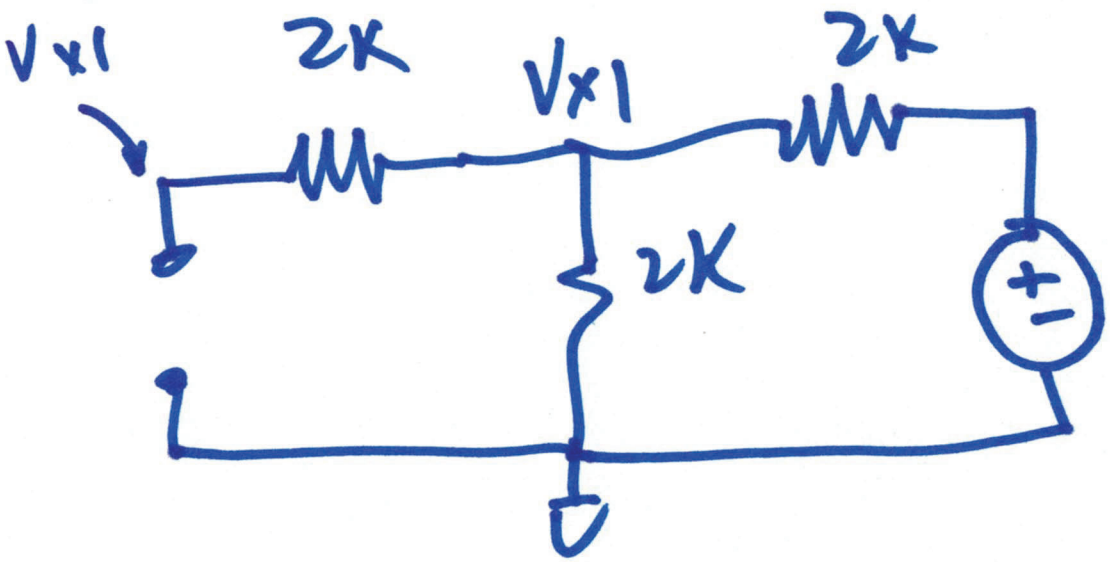


$$V_X = V_{X1} + V_{X2}$$
$$= 2 - 3 = -1V$$



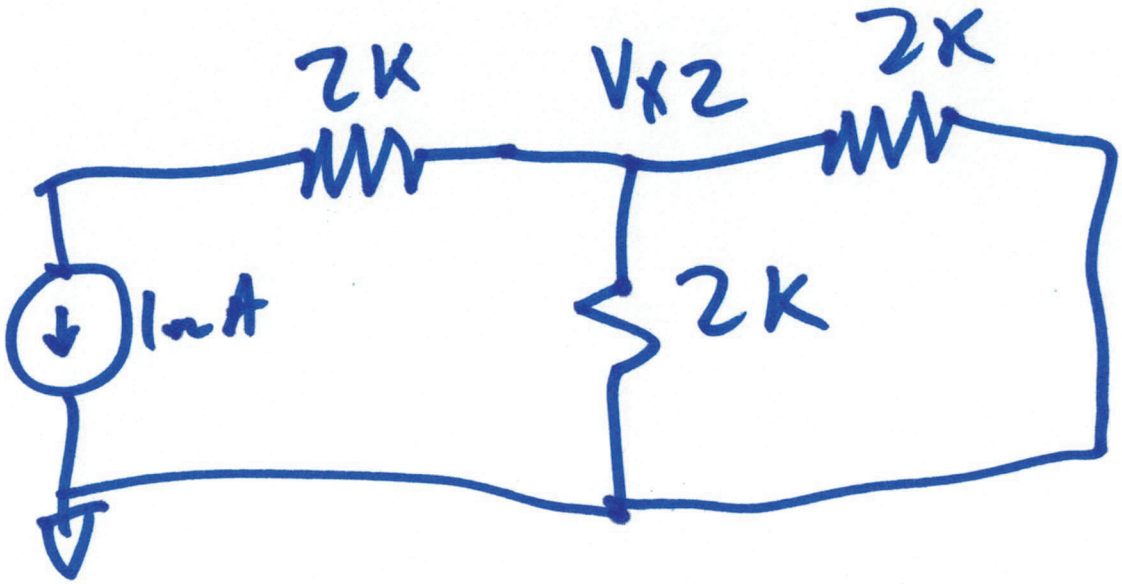


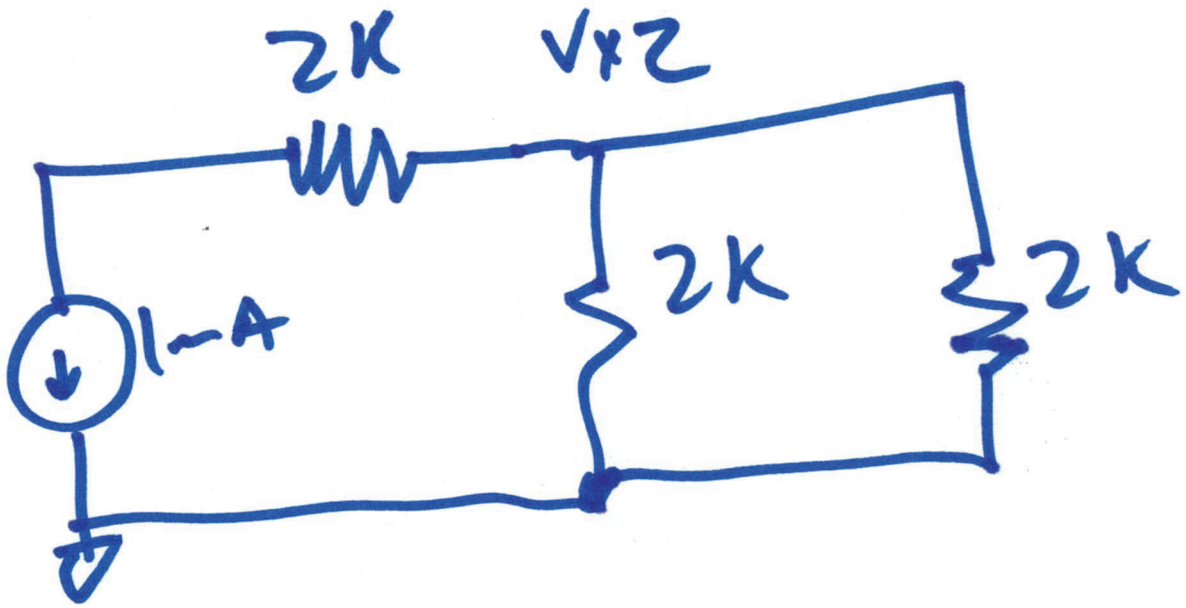
find V_x using superposition

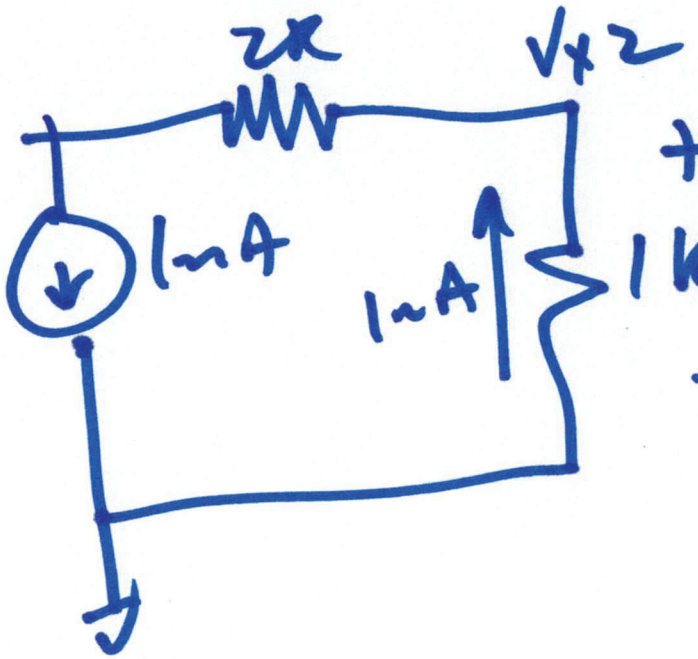


$$V_{x1} = 3 \cdot \frac{2K}{2K+2K}$$

$$\boxed{V_{x1} = 1.5V}$$


2K
Vx2
2K
1mA
2K


2K
Vx2
1mA
2K
2K



$$1K\, V_{X2} = -1mA \cdot 1K$$

$$= -1V$$

$$V_X = V_{X1} + V_{X2} =$$

$$1.5 - 1$$

$$\boxed{V_X = 0.5V}$$