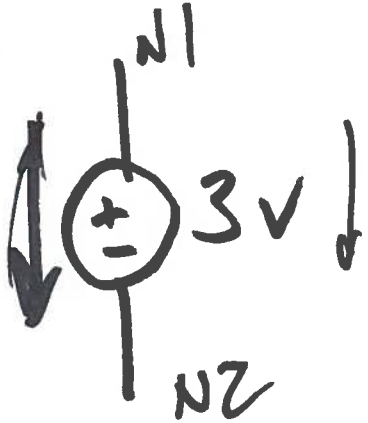
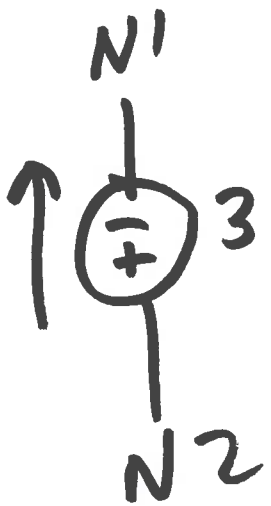
# EE 220

# Circuits I

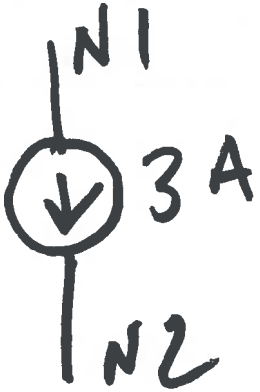
## Lecture 3



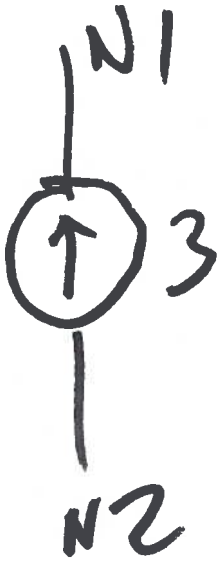

V1 N1 N2 DC 3




V1 N2 N1 DC 3



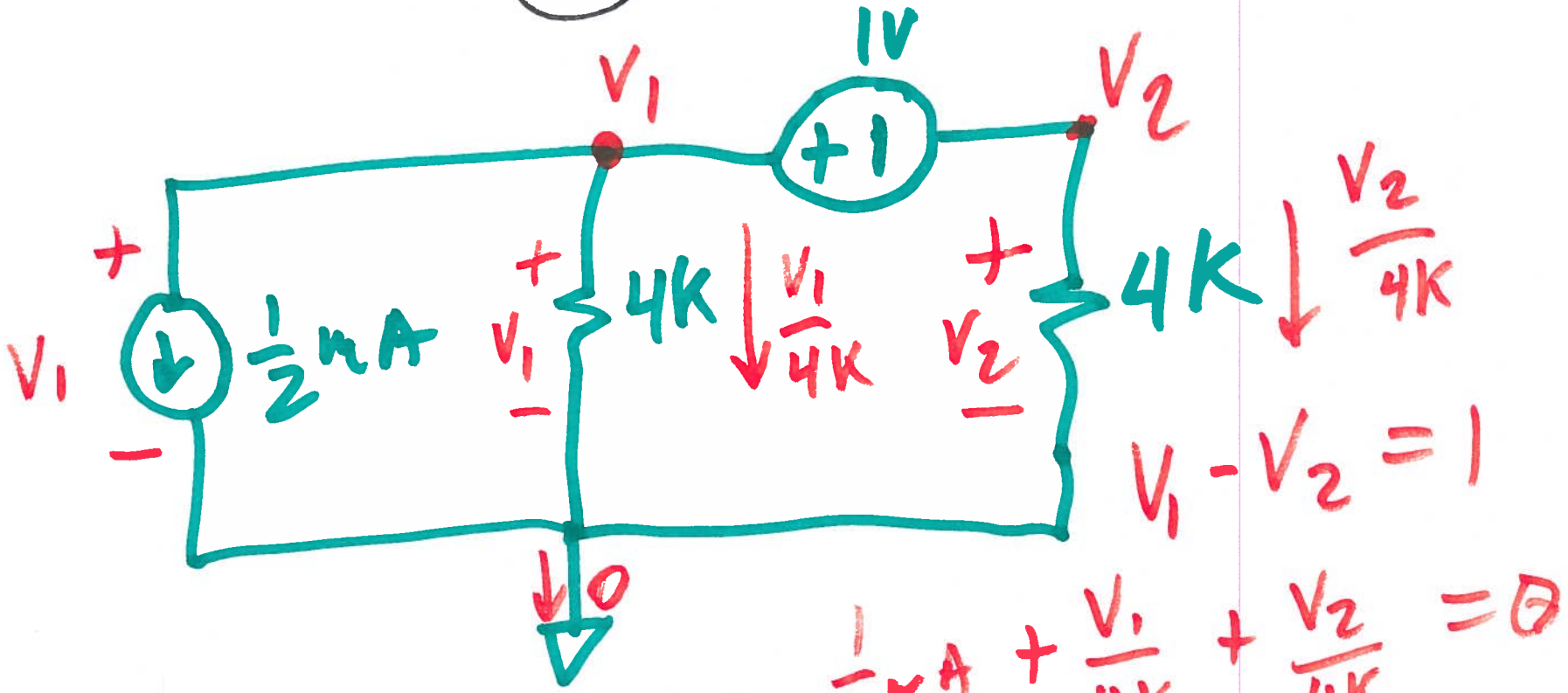

IX N1 N2 DC 3




IY N2 N1 DC 3


R7 N1 N2 1K

R7 N2 N1 1K




$V_1 - V_2 = 1$

KCL $\frac{1}{2}mA + \frac{V_1}{4K} + \frac{V_2}{4K} = 0$

$\frac{3mA}{4} = \frac{3}{4}mA$

$= \frac{3}{4} \cdot 10^{-3}$

$\frac{1}{10^3} = 10^{-3}$

$V_1 = 1 + V_2$

$\frac{2V}{4K} + \frac{2V}{4K} + \frac{1+V_2}{4K} + \frac{1+V_2}{4K} + \frac{V_2}{4K} = 0$

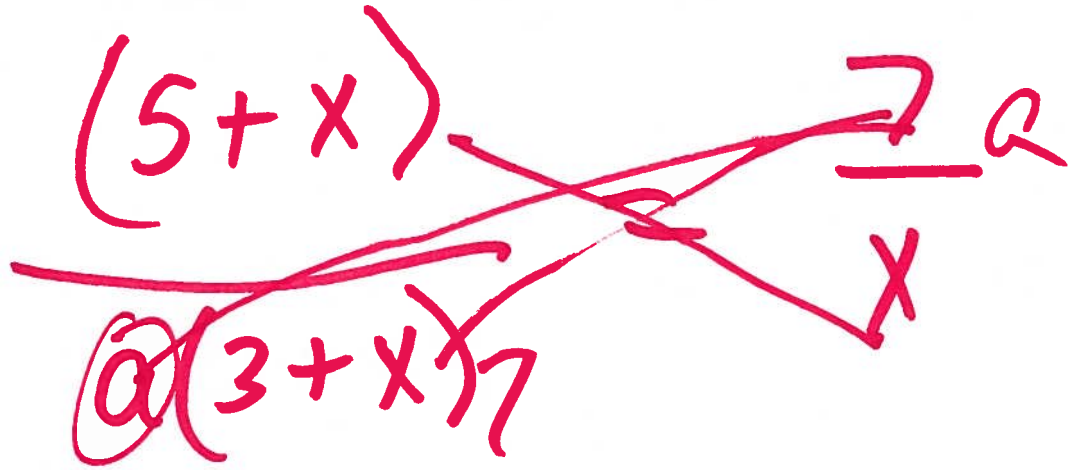
$\frac{1}{2}mA + \frac{1+V_2}{4K} + \frac{V_2}{4K}$

$\frac{V_2}{2K} = -3mA = \frac{3mA}{4}$

$\frac{1}{2}mA + \frac{1}{4}mA + \frac{V_2}{4K} + \frac{V_2}{4K} = 0$

$4V_2 = -2K \cdot 3mA \cdot \frac{1}{2}$

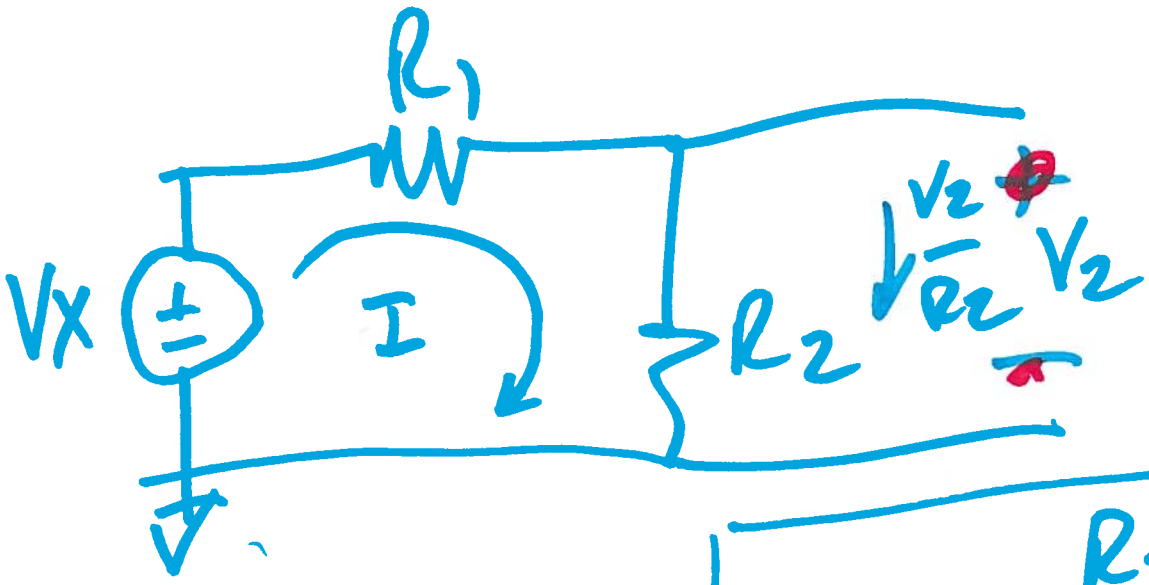
$\frac{3}{4}mA + \frac{V_2}{2K} = 0$



$$\frac{x(5+x)}{(3+x)7} = a$$

# Voltage divider

Attenuator

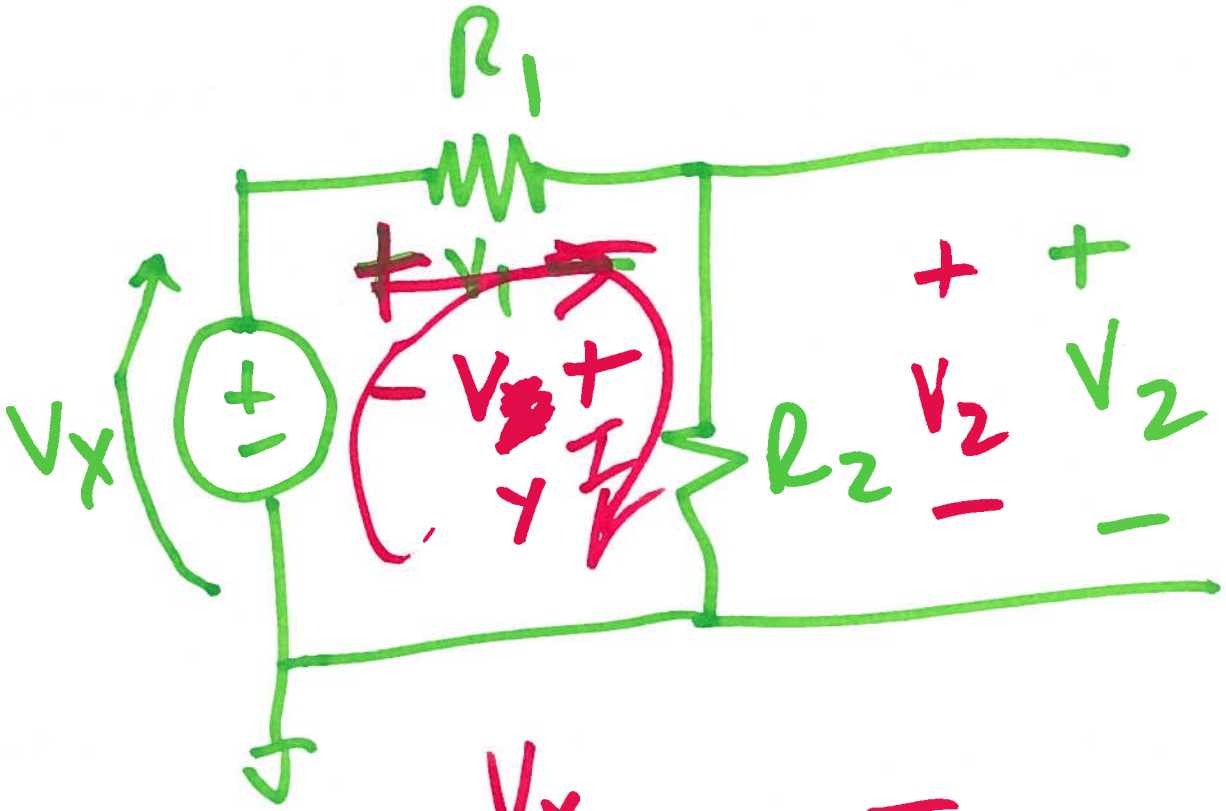



$$I = \frac{V_x}{R_1+R_2} = \frac{V_2}{R_2}$$

$$\boxed{V_2 = \frac{R_2}{R_1+R_2} \cdot V_x}$$

Memorize

$$V_2 = I \cdot R_2$$




KVL

$V_x - V_1 - V_2 = 0$

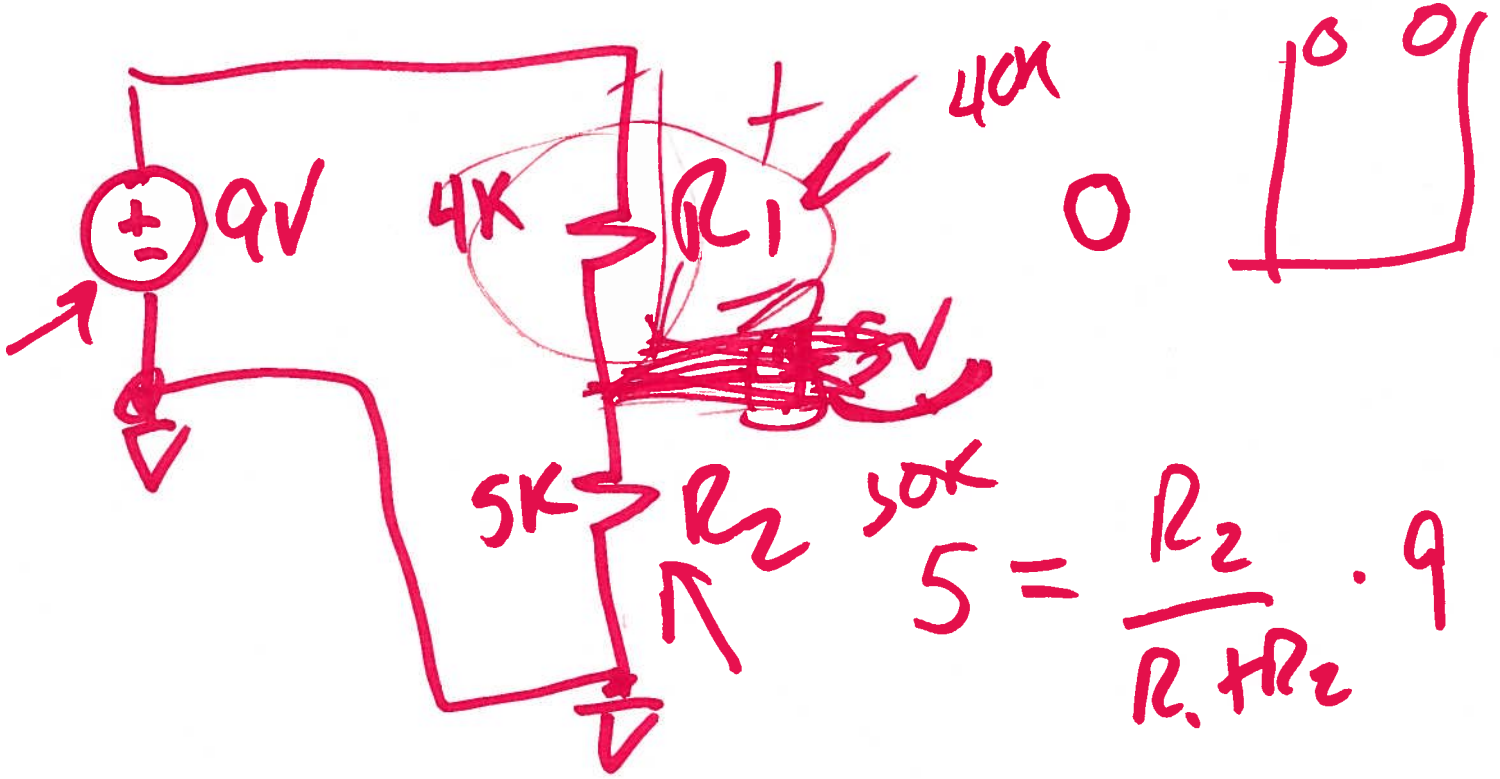
$V_x + V_y - V_2 = 0$

$V_1 = -V_y$

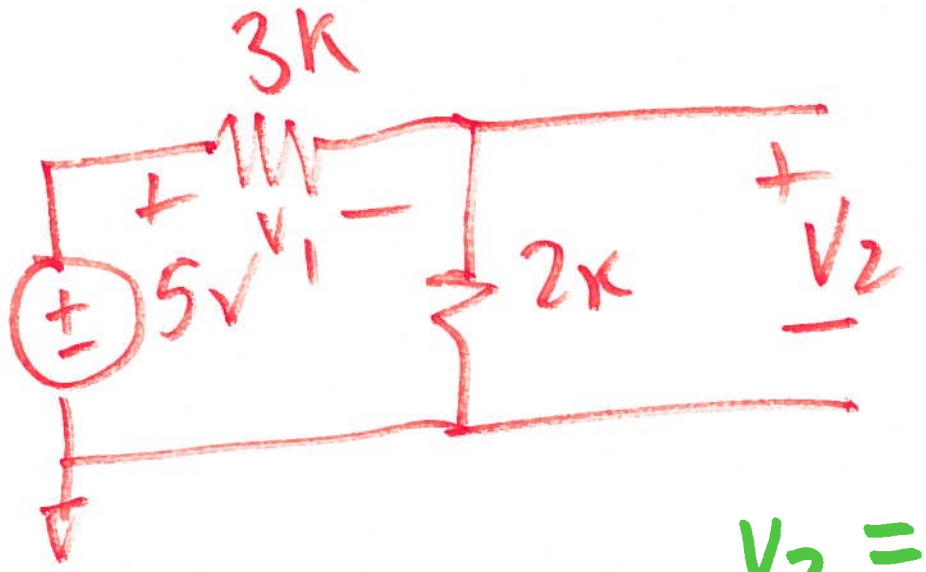
$$\frac{V_x}{R_1 + R_2} = I \rightarrow V_1 = I \cdot R_1$$

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

CMOSedu.com

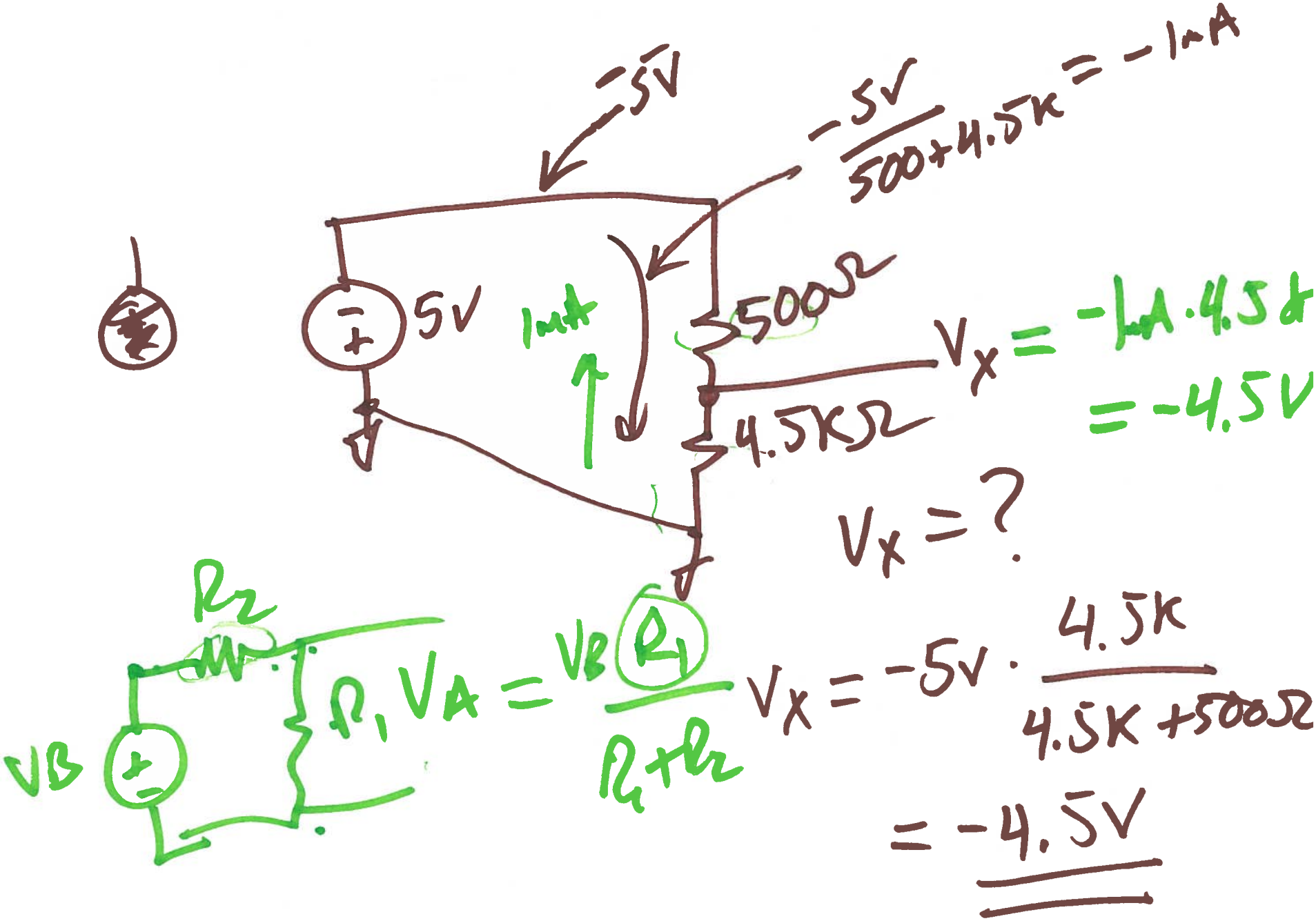


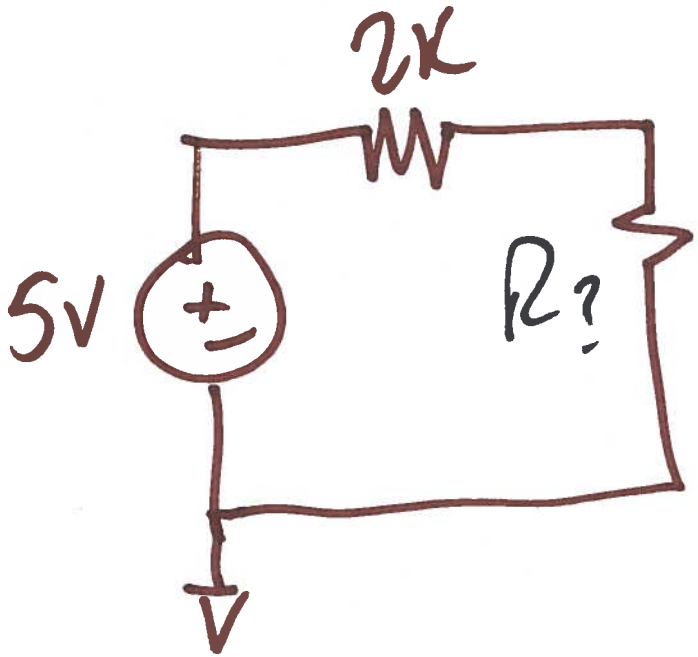

$$5 = \frac{R_2}{R_1 + R_2} \cdot 9$$




$$V_2 = \frac{2K}{2K+3K} \cdot 5V = 2V$$

$$V_1 = \frac{3K}{2K+3K} \cdot 5V = 3V$$


-5V
$\frac{-5V}{500+4.5K} = -1mA$
5V
1mA
500Ω
4.5KΩ
$V_X = -1mA \cdot 4.5k$
$= -4.5V$
$V_X = ?$
$R_2$
$R_1$
$V_B$
$R_1 V_A = V_B \frac{R_1}{R_1+R_2}$
$V_X = -5V \cdot \frac{4.5K}{4.5K+500\Omega}$
$= -4.5V$



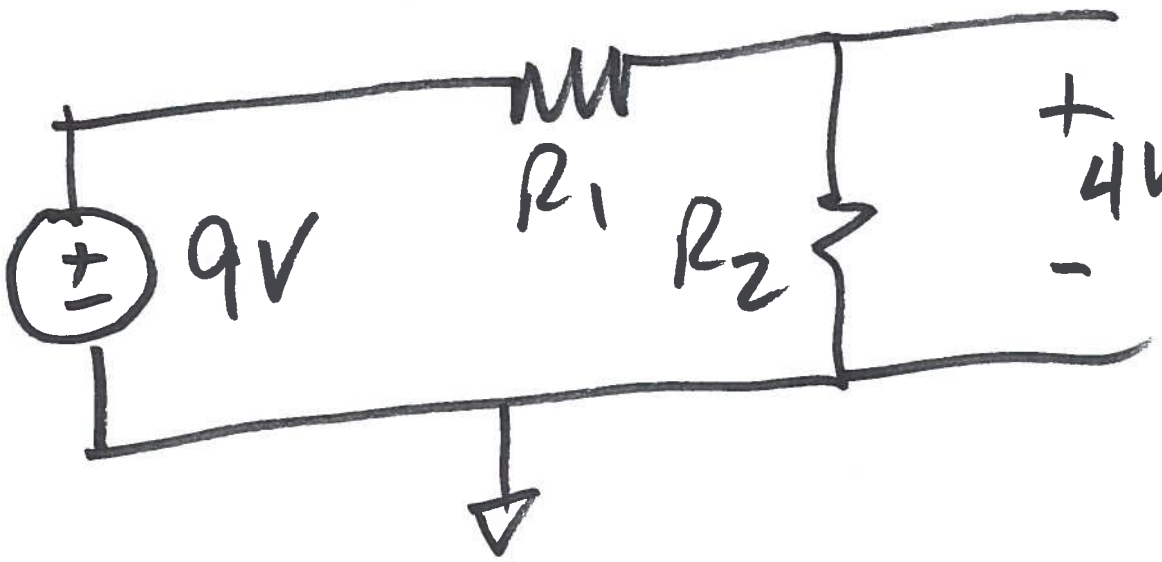

$$2V = 5V \cdot \frac{R_?}{R_1 + R_?}$$

Design

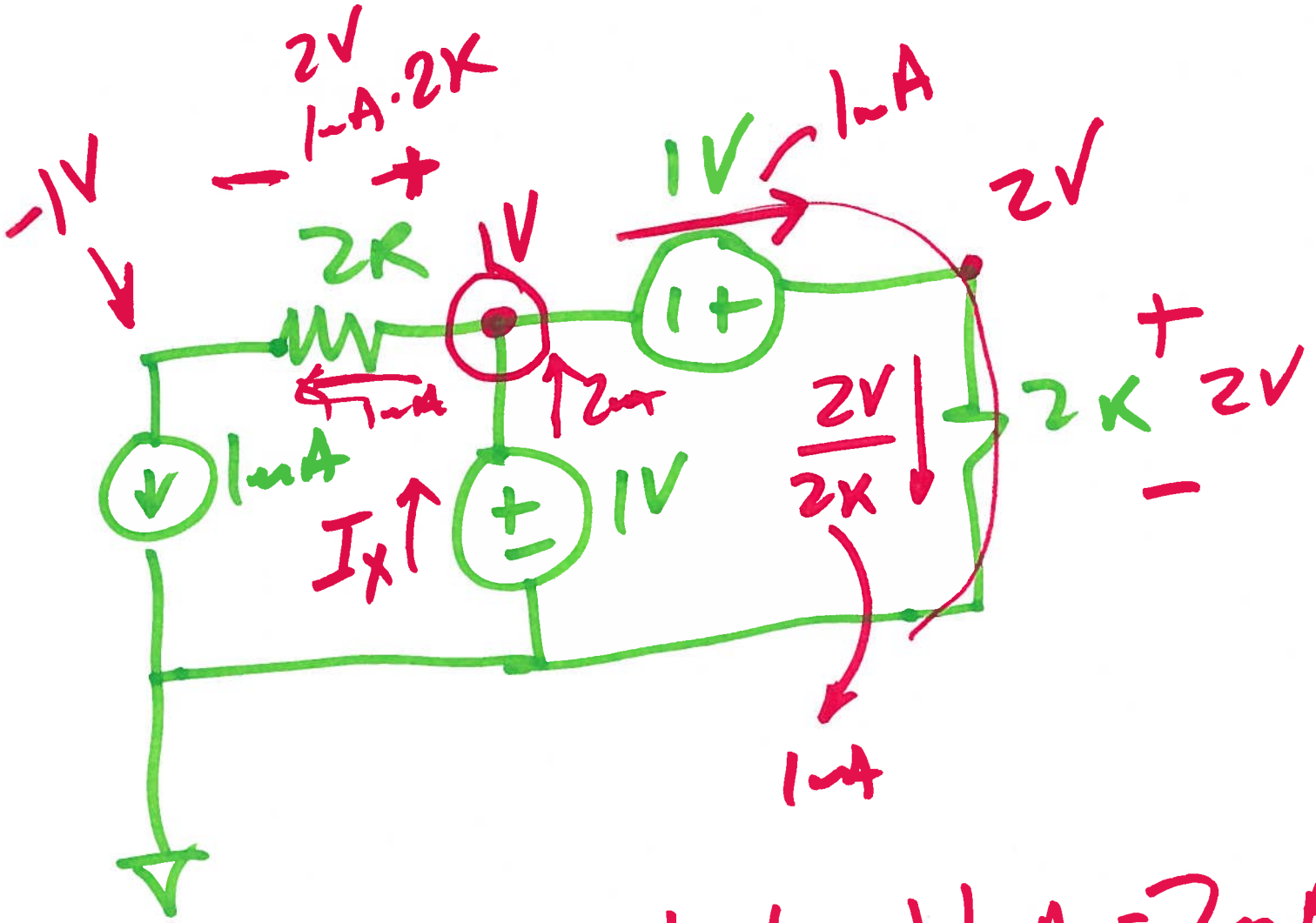
The battery must supply $< 1mA$ ←

design A circuit to generate 4V.

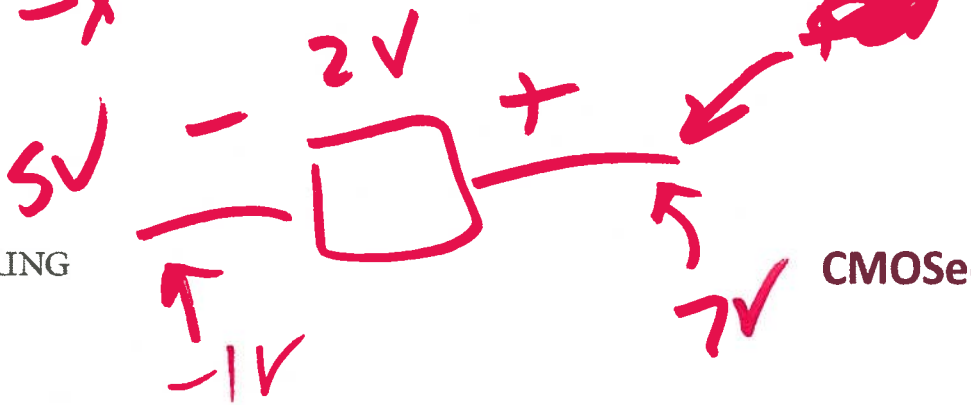
$$4 = 9 \cdot \frac{R_2}{R_1 + R_2}$$



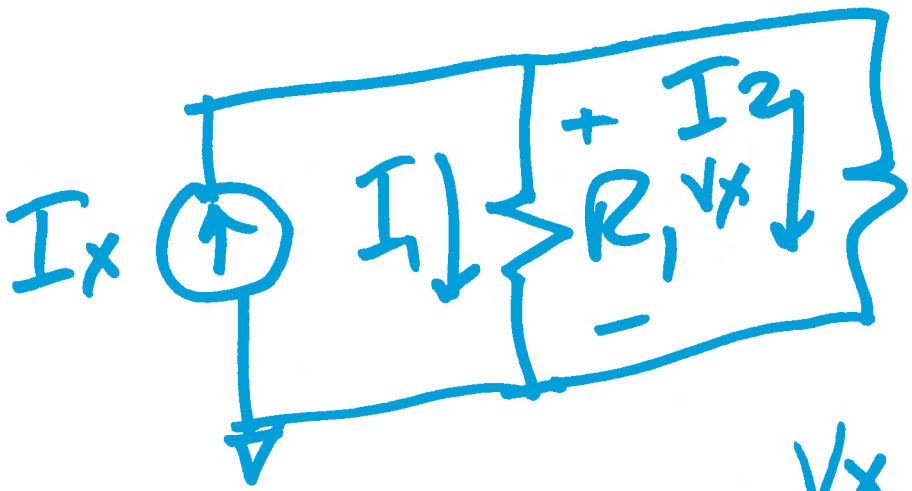

$$\frac{9}{R_1 + R_2} < 1mA$$




$I_x = 1mA + 1mA = 2mA$



# current divider



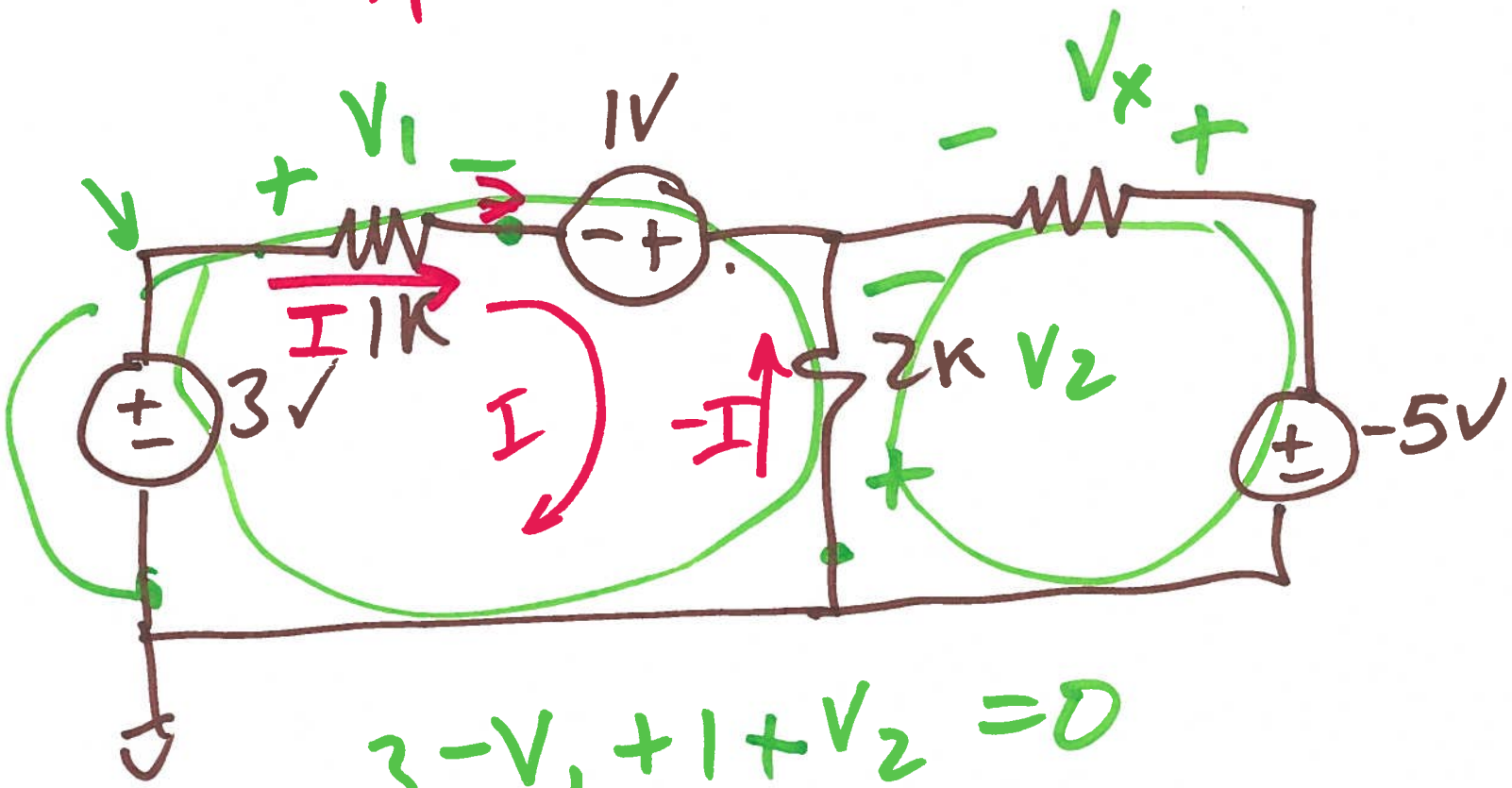

$$V_x = I_x \cdot \frac{R_1 \cdot R_2}{R_1 + R_2}$$

$$I_1 = \frac{V_x}{R_1} = I_x \cdot \frac{R_2}{R_1 + R_2}$$

current through $R_1$

$$I_2 = I_x \cdot \frac{R_1}{R_1 + R_2}$$

$V_1 = I \cdot 1K \qquad V_2 = -I \cdot 2K$




$$3 - V_1 + 1 + V_2 = 0$$

$$-V_2 + V_x - (-5) = 0$$