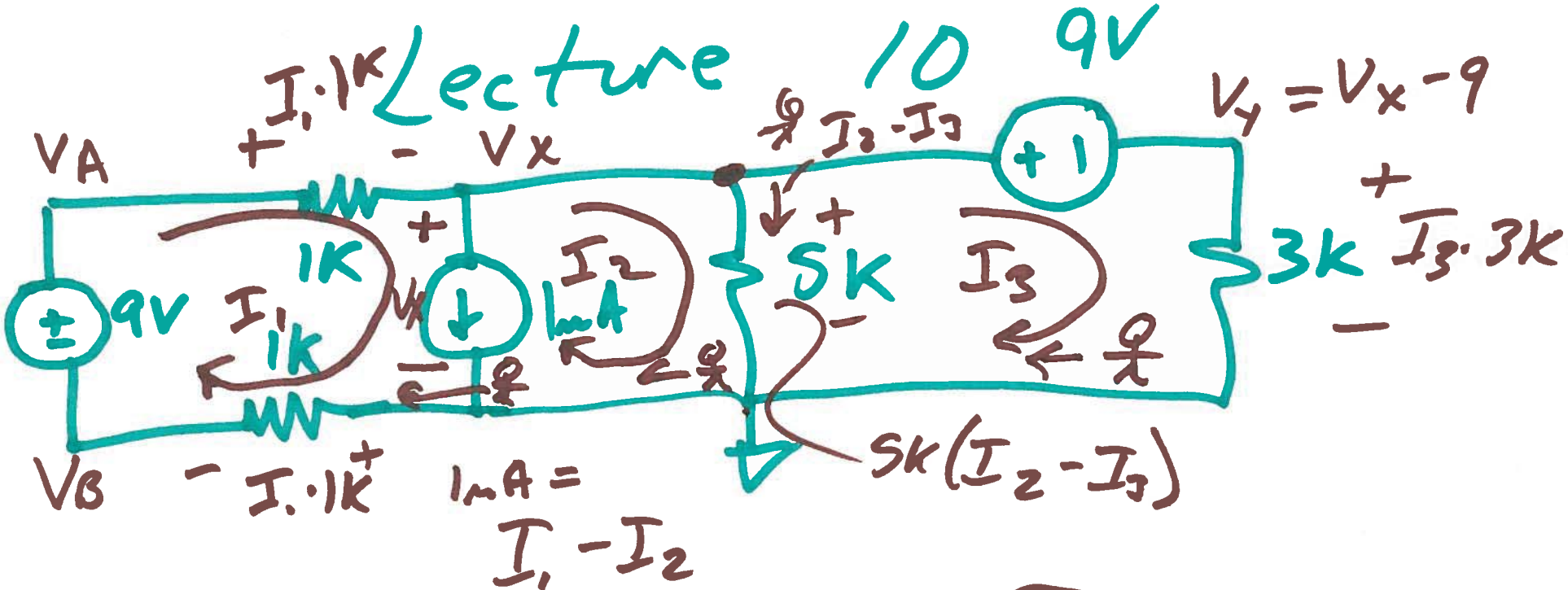
EE 220
Circuits 1
Lecture 10



$$-I_1 \cdot 1K + 9 - I_1 \cdot 1K - V_x = 0$$

$$+V_x - 5K(I_2 - I_3) = 0 \rightarrow V_x = 5K(I_2 - I_3)$$

$$I_3 \cdot 3K = 0$$

$$5K(I_2 - I_3) - 9 =$$

$$I_1 = 1mA + I_2$$

$$-I_1 \cdot 2k + 9 - 5k(I_2 - I_3) = 0$$

$$5k I_2 - 5k I_3 - 9 - 3k I_3 = 0$$

$$I_1 = 1mA + I_2$$

$$I_1(-2k) + I_2(-5k) + I_3(5k) + 9 = 0$$

$$I_2(5k) + I_3(-8k) + 9 = 0$$

$$I_1(-2k) + I_3(-3k) = 0$$

$$-2V + I_2(-2k) + I_3(-3k) = 0$$

$$1mA + I_2 + \frac{3}{5} I_3 = 0$$

$$I_2 = -1mA - 1.5 I_3$$

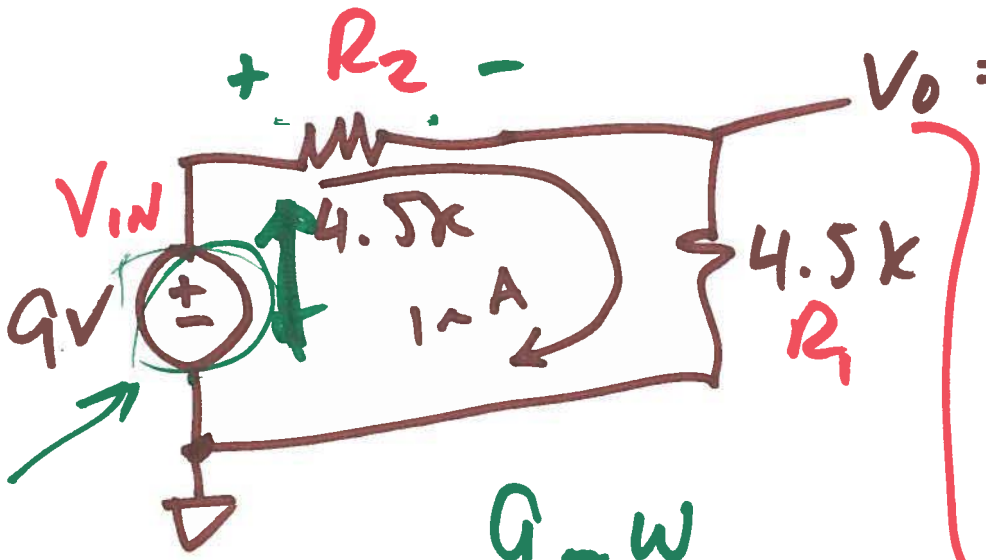
2)

$$5k(-1\text{-}A - 1.5 I_3) + I_3(-8k) - 9 = 0$$

$$-5V - 7.5k I_3 + I_3(-8k) - 9 = 0$$

$$I_3(-15.5) = 14$$

$$I_3 = \frac{-14}{15.5} \simeq \underline{\underline{-0.96}}$$



$V_O = 4.5V$

9 mW

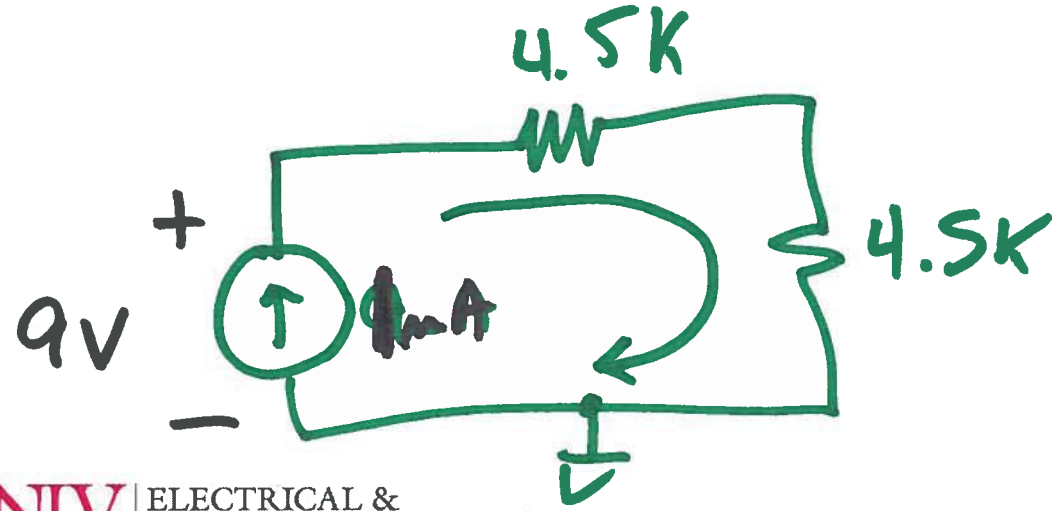
$4.5 \cdot 1mA$

$Power = VI$

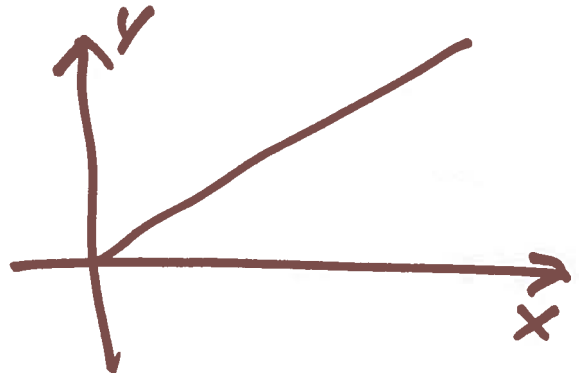
$= 4.5mW$

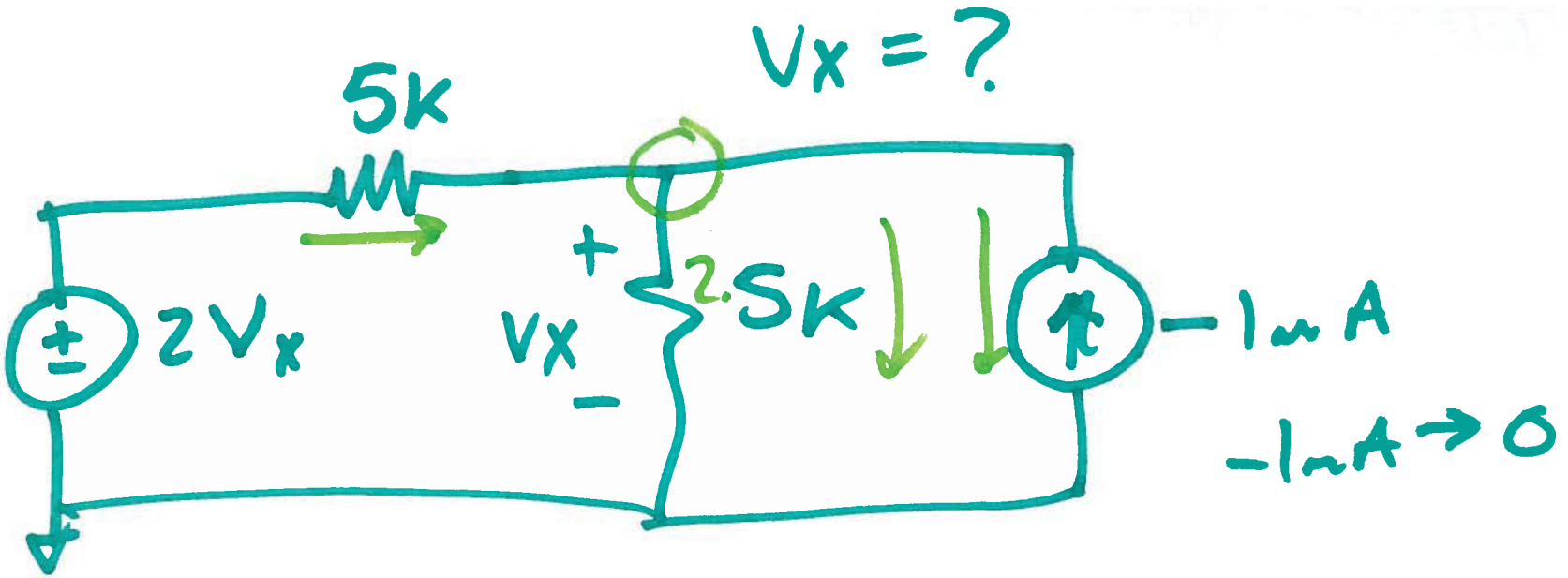
$V_O = V_{IN} \cdot \frac{1}{2} = \frac{R_1}{R_1 + R_2}$

$9V \cdot 1mA = -9mW$



$y = x = f(x)$





$$\frac{2V_x - V_x}{5k} = \frac{V_x}{2.5k} + 1mA$$

$$\frac{V_x}{5k} = \frac{V_x}{2.5k} + I_x \qquad 1mA \rightarrow 0 \qquad 0 < I_x < 1mA$$

$$V_x = 2V_x + 5kI_x \rightarrow -V_x = 5 - 0 \qquad V_x = 0 \rightarrow -5$$

$$\boxed{V_x = -5V}$$

$$V_x = -|5kI_x|$$

5)

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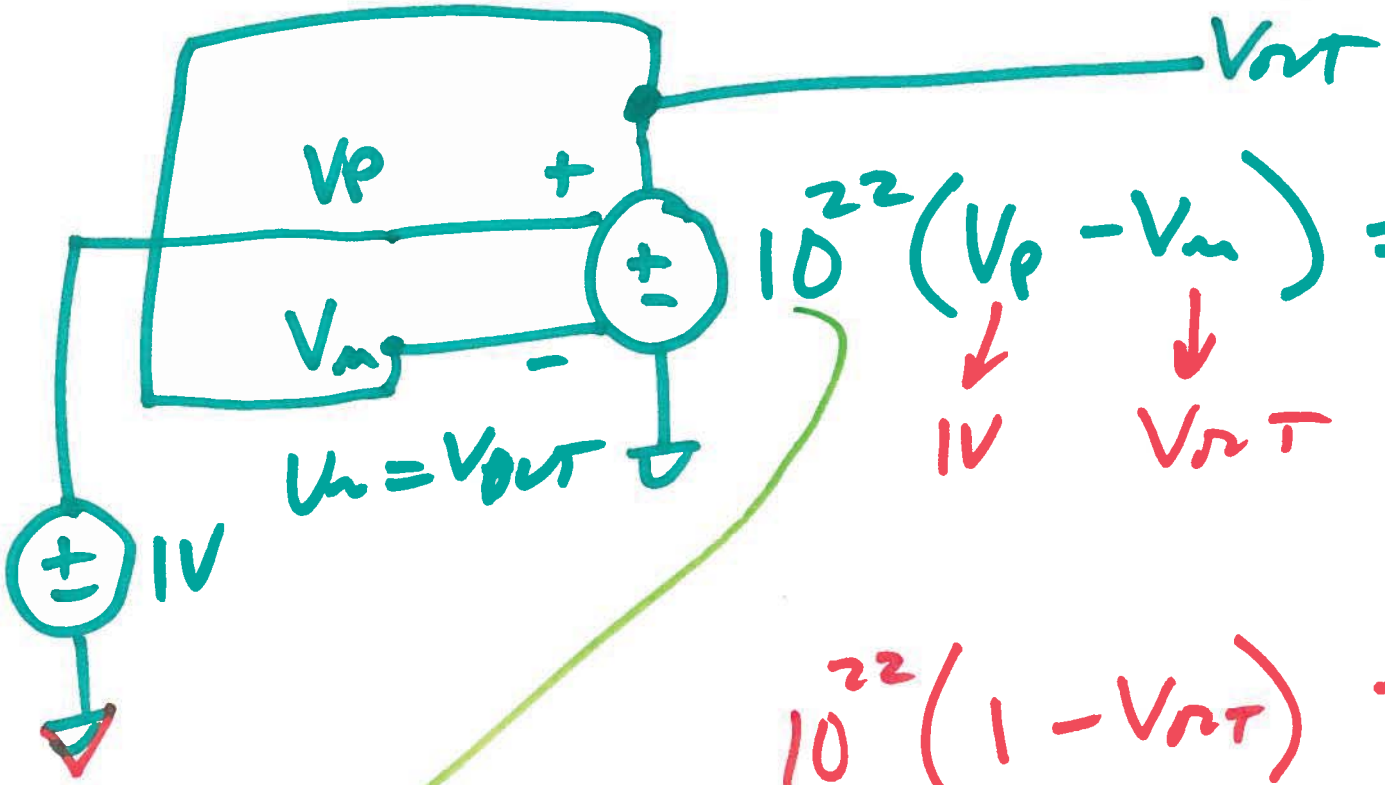


$$10^{22}(V_P - V_m) = V_{OUT}$$

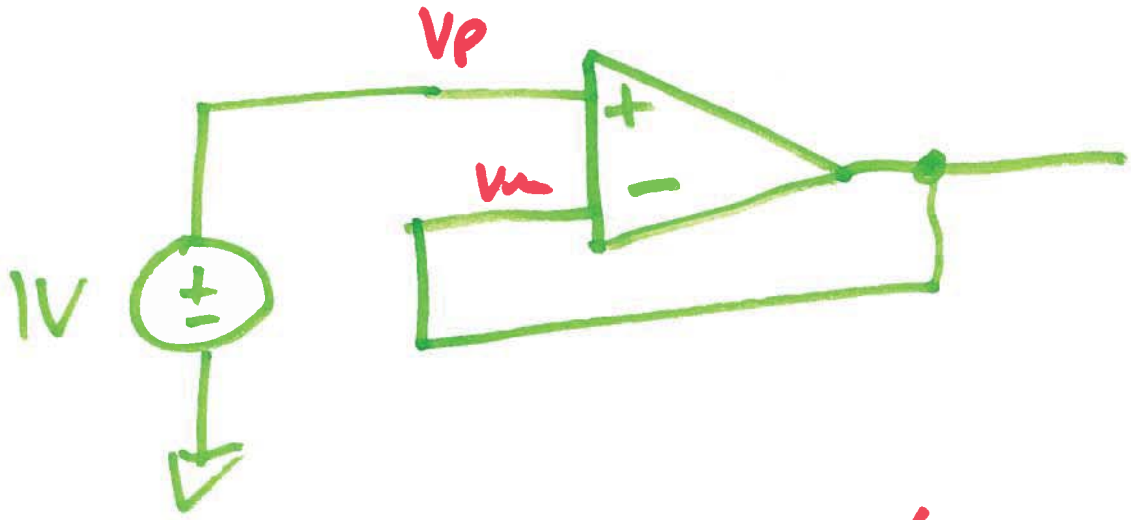
V_P → 1V, V_m → V_{OUT}

$$10^{22}(1 - V_{OUT}) = V_{OUT}$$

$$10^{22} - 10^{22} V_{OUT} = V_{OUT}$$

$$V_{OUT}(1 + 10^{22}) = 10^{22}$$

$$V_{OUT} = \frac{10^{22}}{1 + 10^{22}} = 1$$



$B_{1/\beta}(\infty)$

$V_{OUT} = A_{OL}(V_P - V_n)$

$1V \quad V_{OUT}$

$$V_{OUT} = A_{OL}(1 - V_{OUT})$$

$$\lim_{A_{OL}\to\infty} V_{OUT} = \frac{A_{OL}}{1 + A_{OL}} \to 1V$$