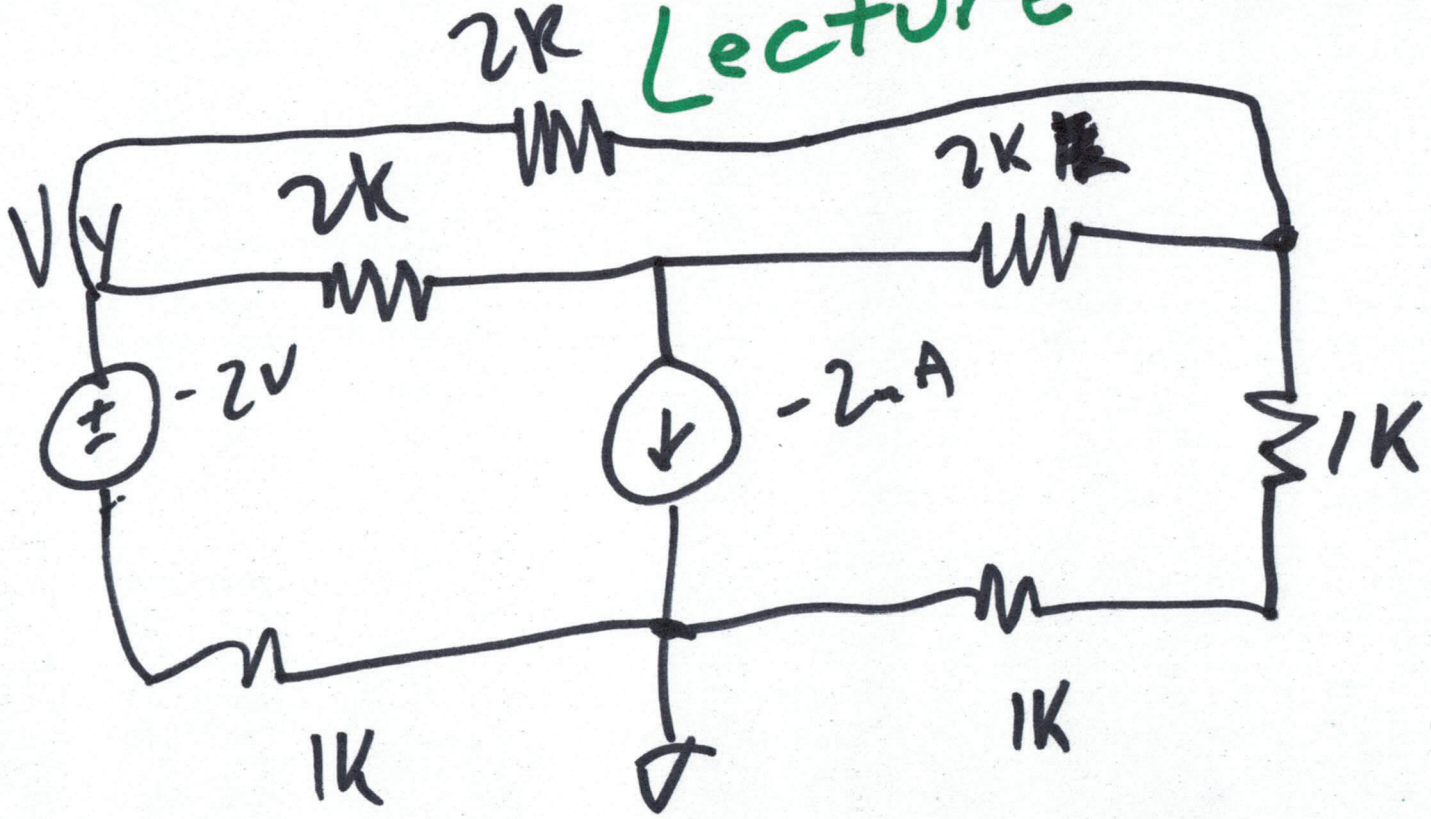
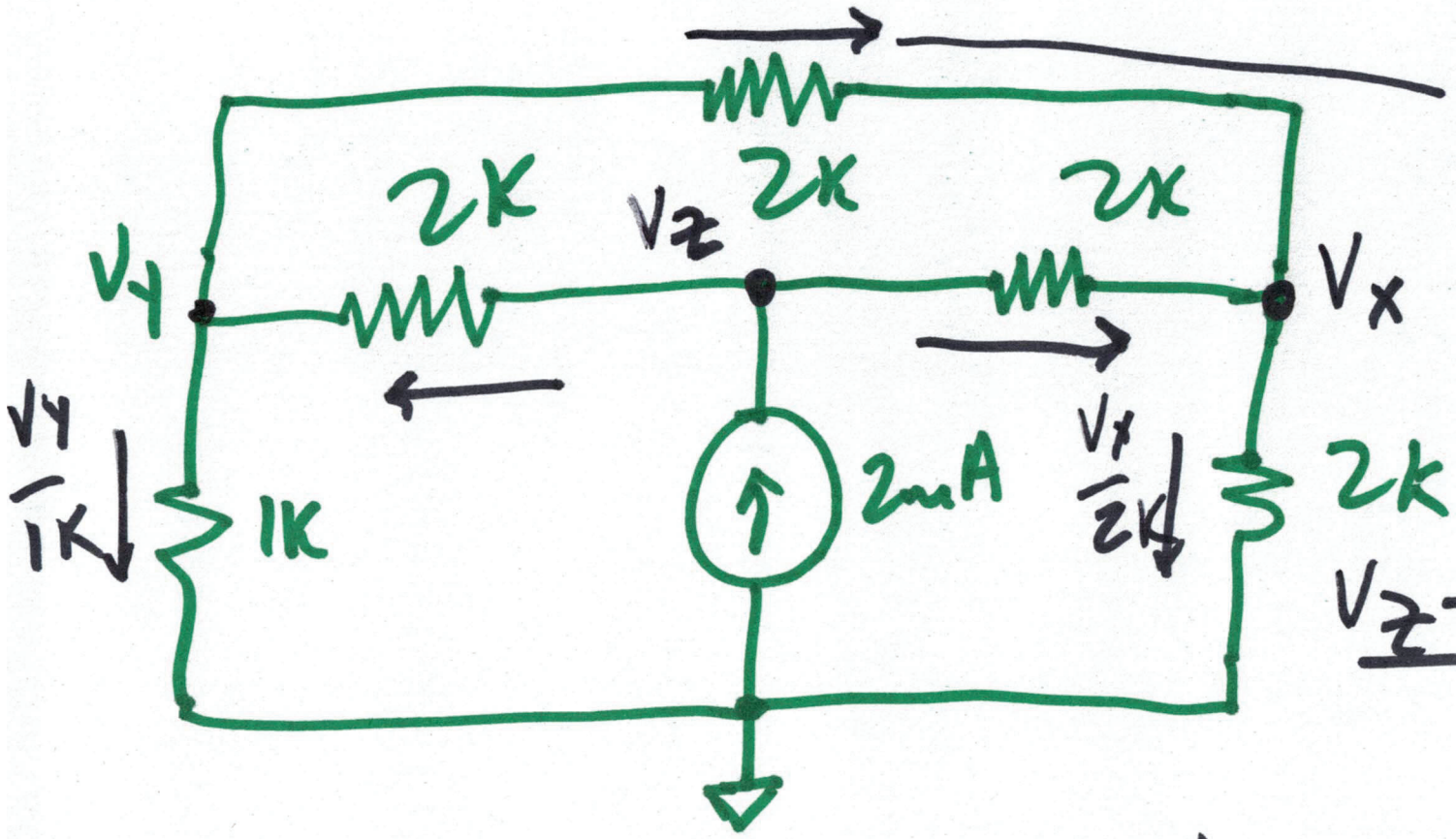
EE 221 Circuits II

2/3/2021

Lecture 5





$$\frac{V_z - V_y}{2K} = \frac{V_y}{1K} + \frac{V_y - V_x}{2K}$$

$$\frac{V_z - V_y}{2K} + \frac{V_z - V_x}{2K} = 2\,mA$$

$$\frac{V_z - V_x}{2K} + \frac{V_y - V_x}{2K} = \frac{V_x}{2K}$$

$$V_z - V_y - 2V_y - V_y + V_x = 0$$

$$V_z - V_y + V_z - V_x - 4 = 0$$

$$V_z - V_x + V_y - V_x - V_x = 0$$

$$V_z - 4V_y + V_x = 0 \rightarrow V_x = 4V_y - V_z$$

$$2V_z - V_y - V_x - 4 = 0$$

$$V_z + V_y - 3V_x = 0$$

$$2V_z - V_y - 4V_y + 12V_z - 4 = 0$$

$$V_z + V_y - 12V_y + 3V_z = 0$$

3)

$$3V_z - 5V_y - 4 = 0$$

$$4V_z - 11V_y = 0$$

$$V_z = \frac{5}{3}V_y + \frac{4}{3}$$

$$\frac{20}{3}V_y + \frac{16}{3} - 11V_y = 0$$

$$20V_y + 16 - 33V_y = 0$$

$$-13V_y = -16$$

$$V_{y1} = \frac{16}{13}$$

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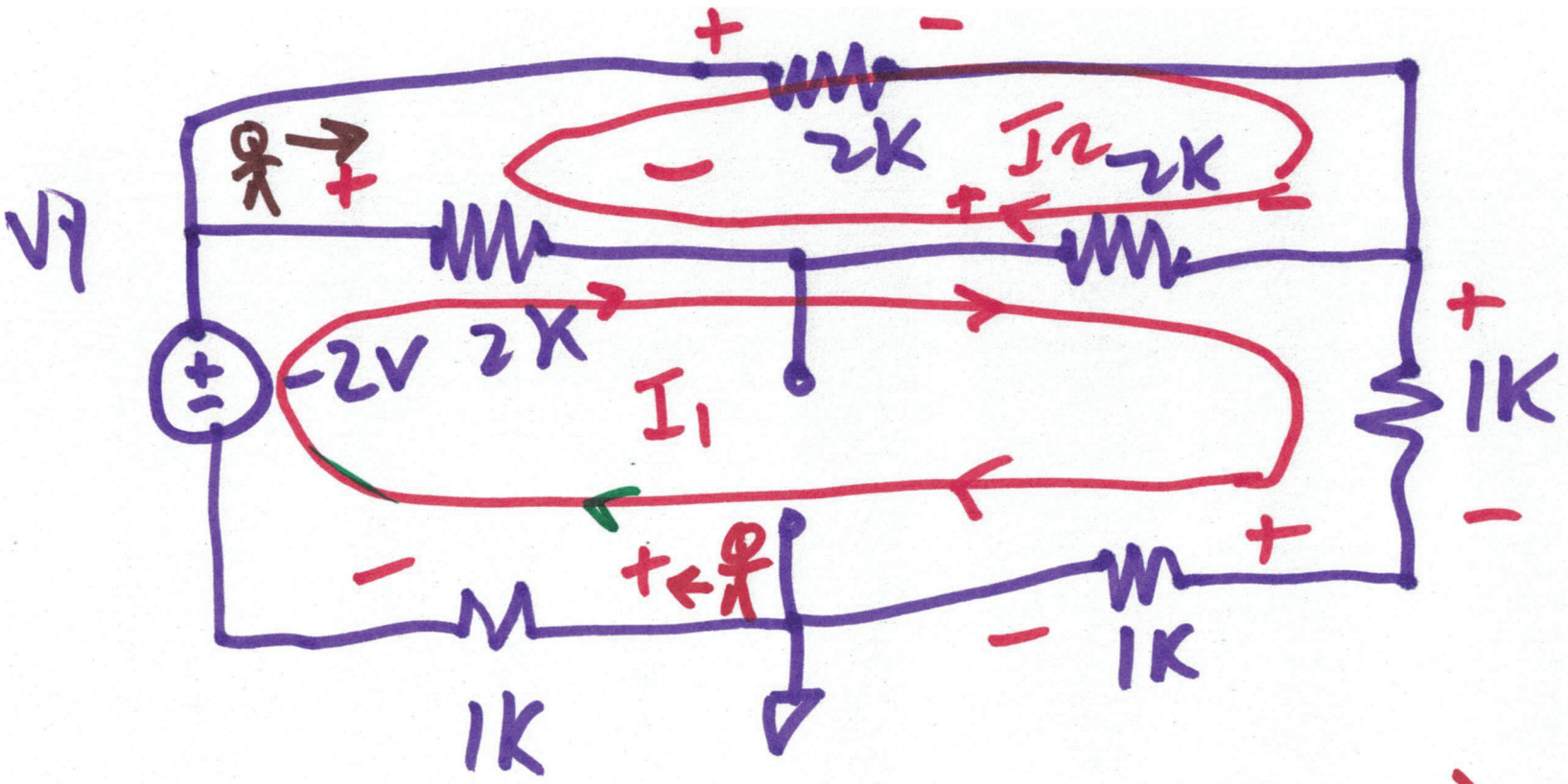
4)



$$-1K I_1 + (-2V) - 2K(I_1 - I_2) - 2K \cdot (I_1 - I_2)$$

$$-1K \cdot I_1 - 1K I_1 = 0$$

$$-2K(I_1 - I_2) - 2K(I_1 - I_2) + 2K I_2 = 0$$

$$0 = I_1 + 2mA + 2I_1 - 2I_2 + 2I_1 - 2I_2 + I_1 + I_1$$

$$0 = 7I_1 - 4I_2 + 2mA$$

$$I_1 - I_2 + I_1 - I_2 - I_2 = 0$$

$$2I_1 - 3I_2 = 0$$

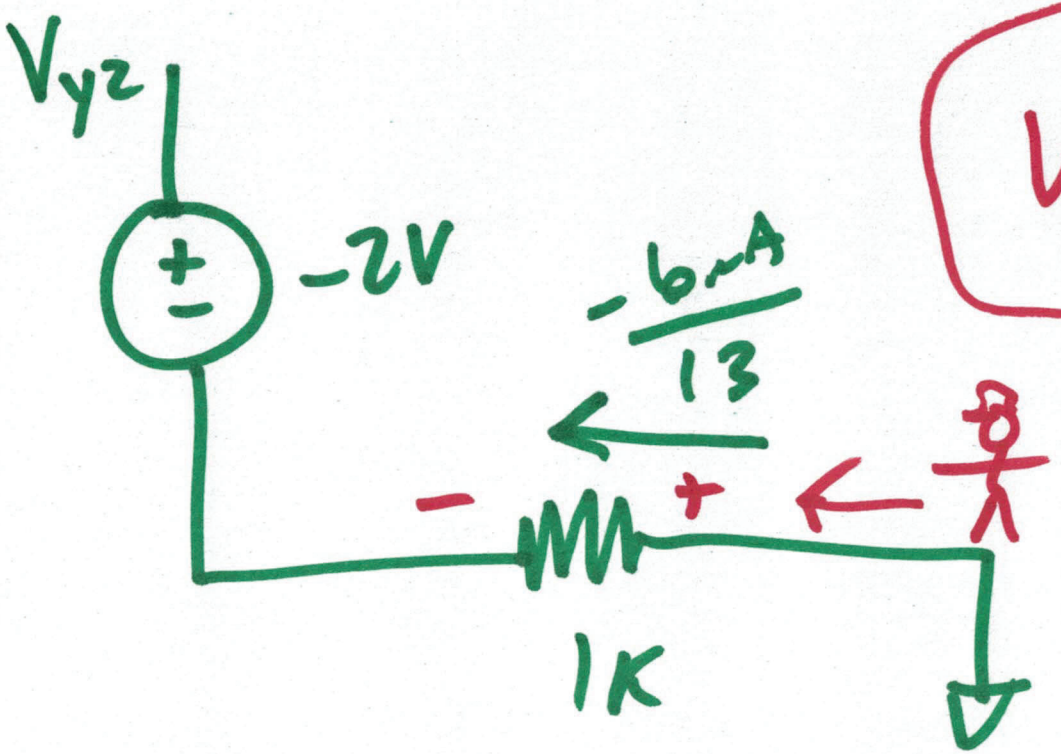
$$I_2 = \frac{2}{3} I_1$$

$$0 = 7I_1 - \frac{8}{3} I_1 + 2mA$$

$$0 = 21I_1 - 8I_1 + 6mA$$

$$13I_1 + 6mA = 0$$

$$I_1 = -\frac{6mA}{13}$$



$$V_{y2} = \frac{-20}{13} V$$

$$-1K\left(\frac{-6mA}{13}\right) + (-2) = V_{y2}$$

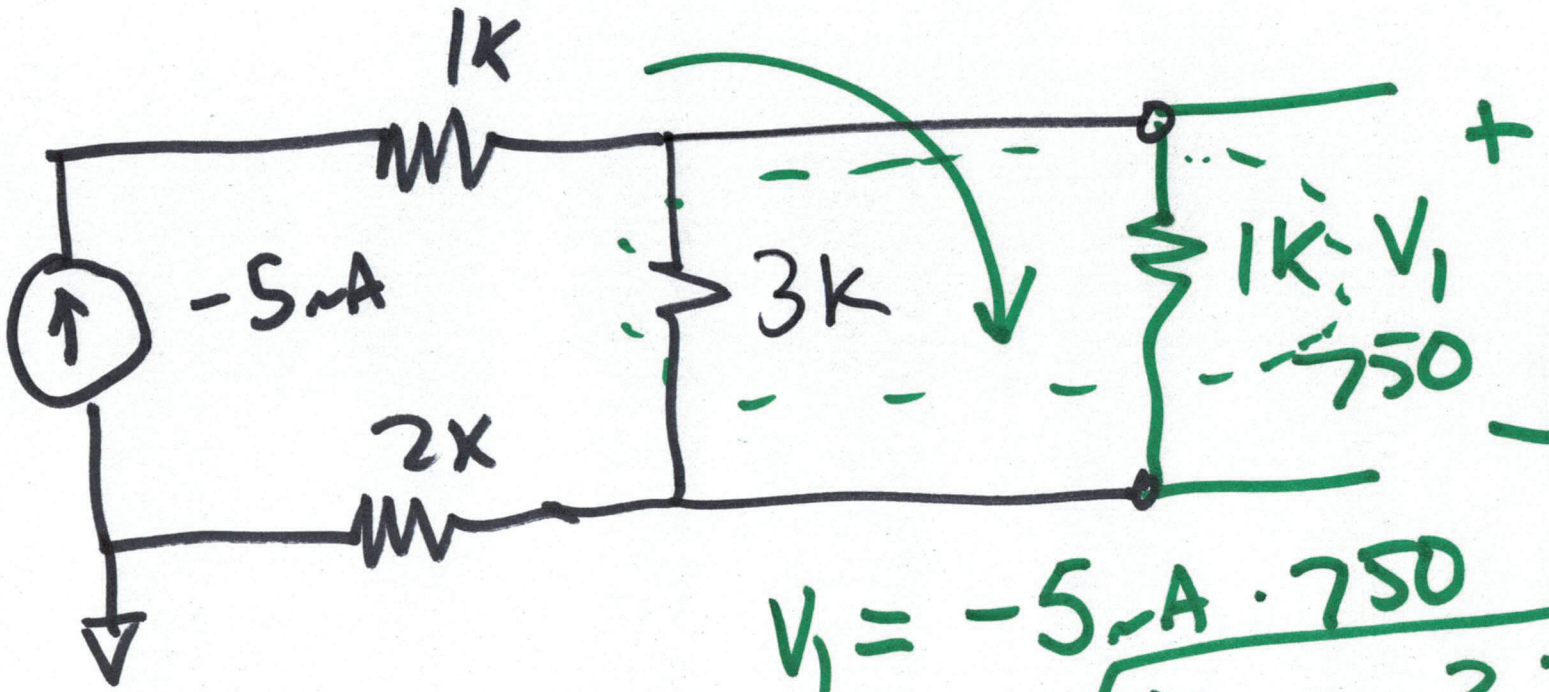
$$\frac{6}{13} - \frac{26}{13} = V_{y2}$$

$$V_Y = V_{Y1} + V_{Y2}$$

$$V_Y = \frac{16}{13} - \frac{20}{13} = -\frac{4}{13}$$

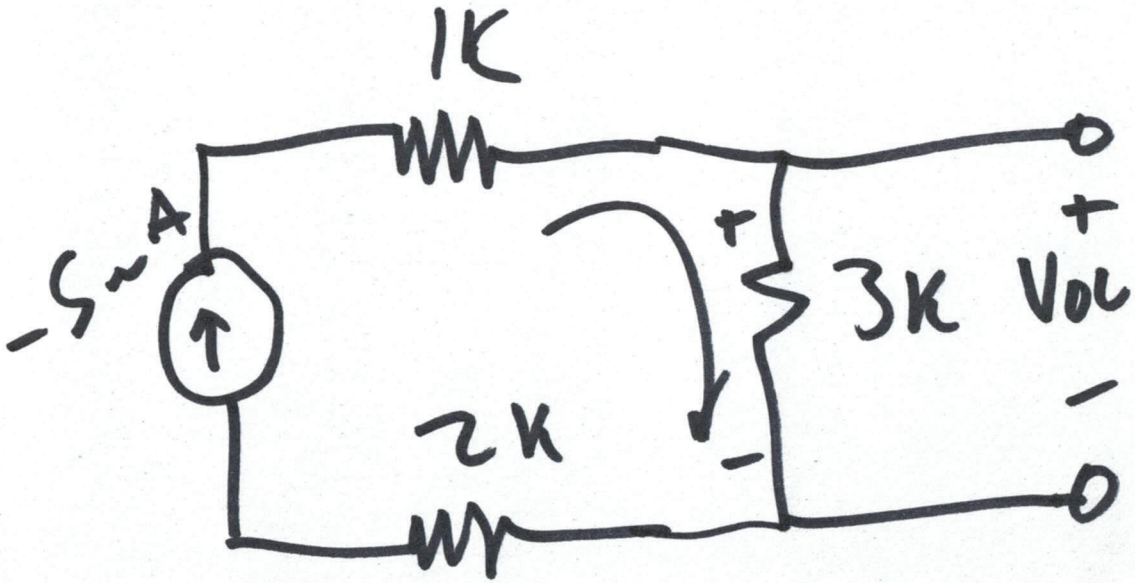
$$\boxed{V_Y = -.307V}$$

8)



$V_1 = -5\text{mA} \cdot 750$

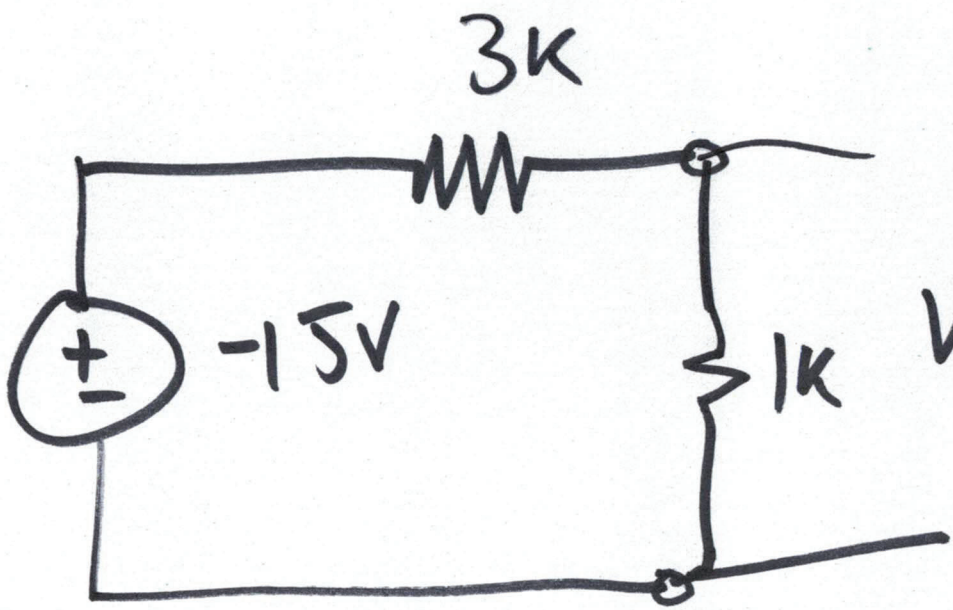
$V_1 = -3.75\text{V}$



$R_{TH} = 3\text{K}$

$V_{OC} = V_{TH} = -5\text{mA} \cdot 3\text{K}$

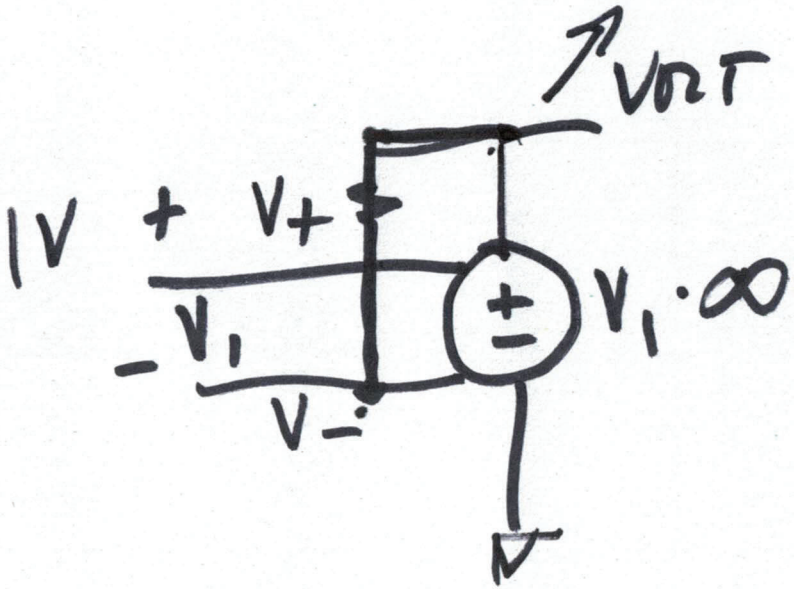
$V_{TH} = -15\text{V}$



$$V_1 = -15 \cdot \frac{1K}{1K + 3K}$$

$$= \frac{-15}{4}$$

$$V_1 = -3.75V$$



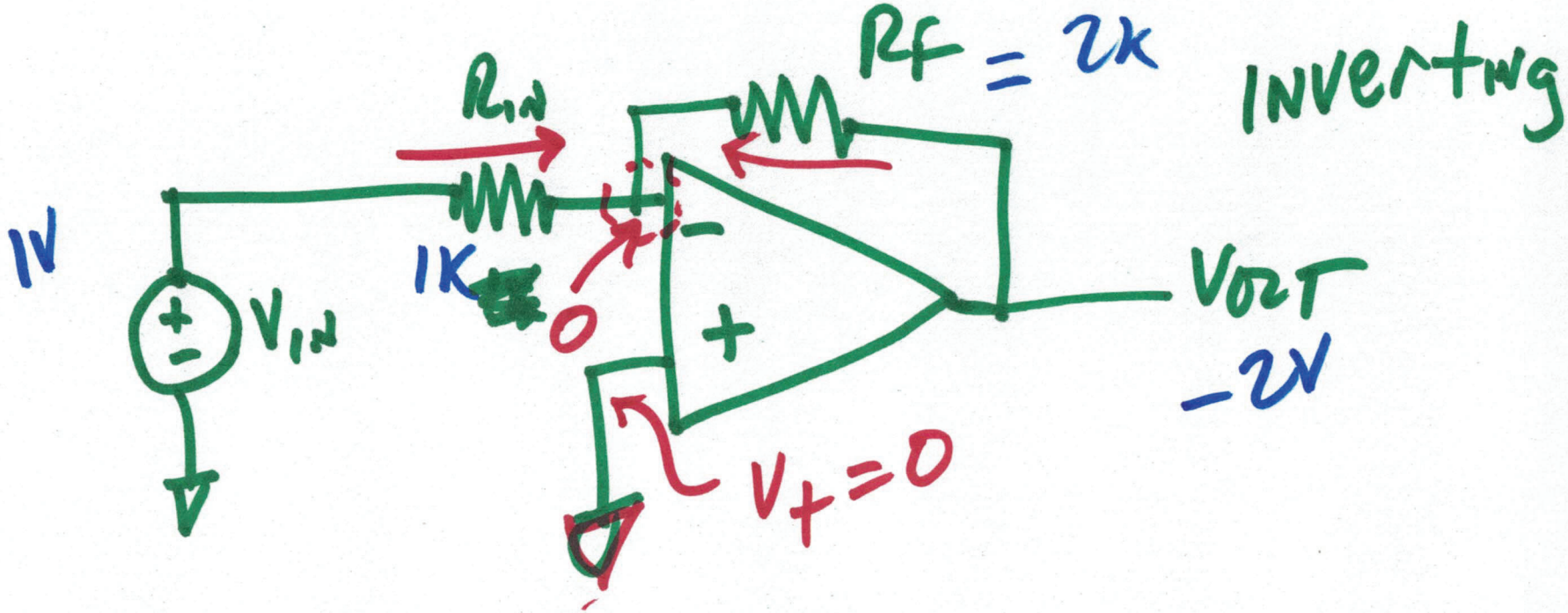
$V_1 \cdot \infty = (V_+ - V_-) \cdot \infty$

1) find V_+ (voltage on the NON-INVERT terminal)

2) $V_+ = V_-$

3) KCL @ V_-

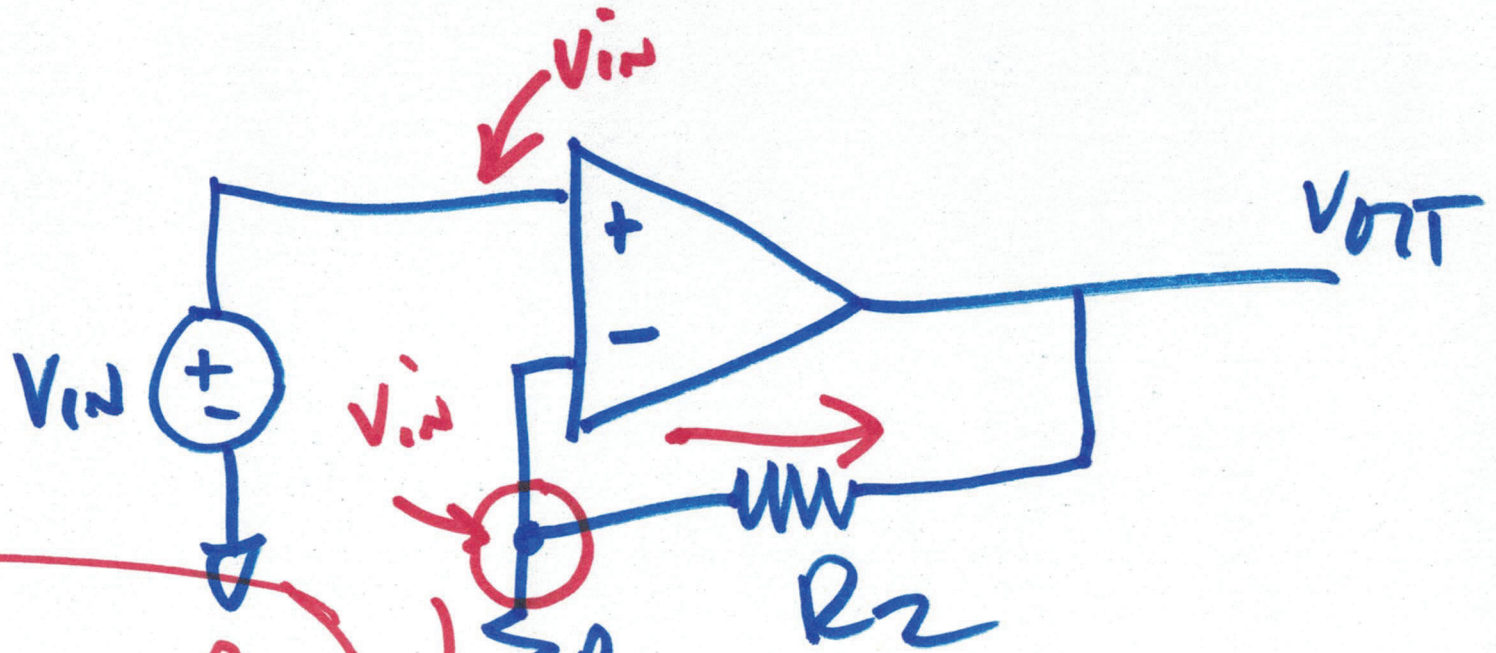
11)



$$\frac{V_{IN} - 0}{R_{IN}} + \frac{V_{OUT} - 0}{R_f} = 0$$

$$\frac{V_{OUT}}{V_{IN}} = -\frac{R_f}{R_I}$$

NON-INVERTING

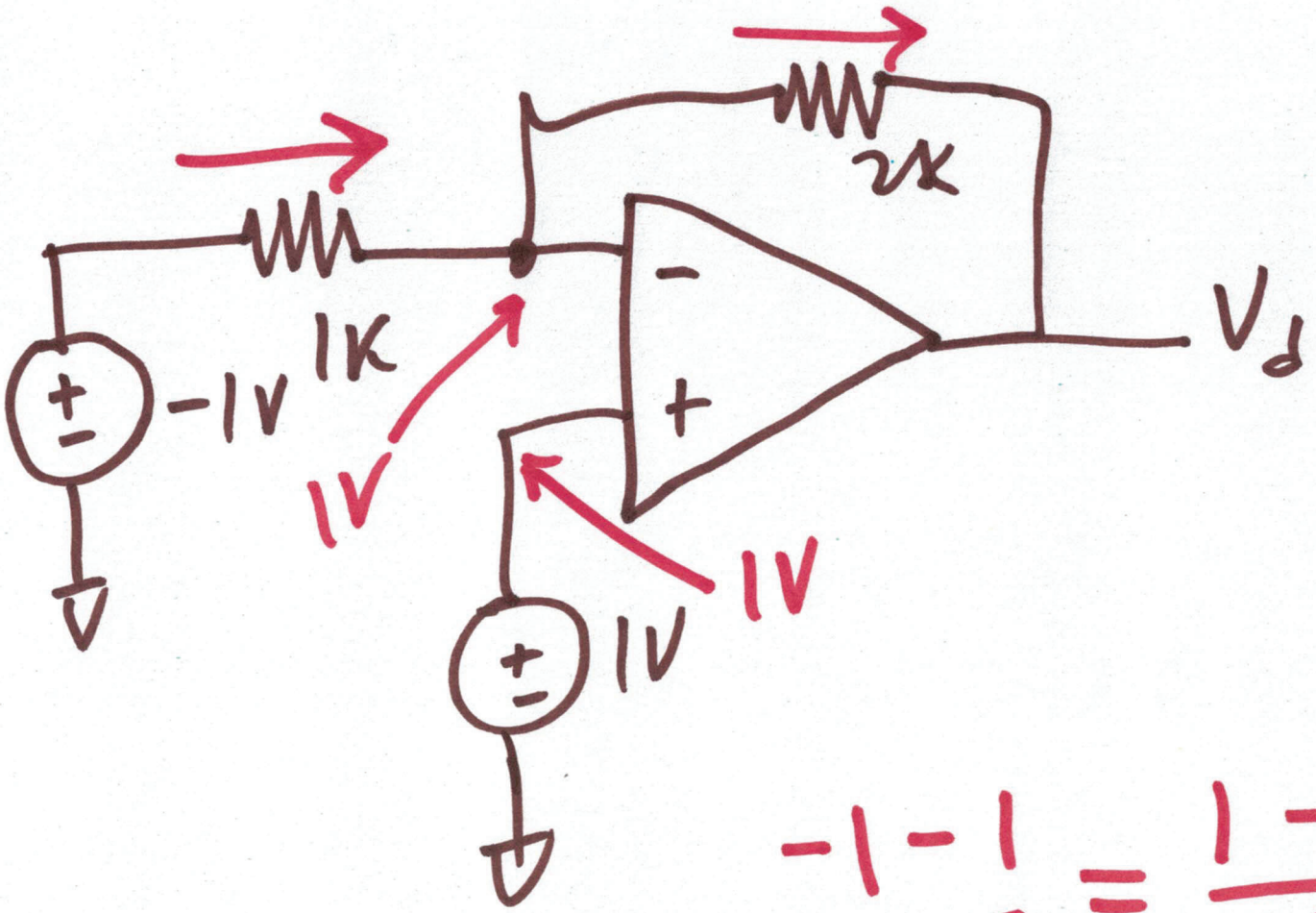


$$\frac{V_{OUT}}{V_{IN}} = 1 + \frac{R_2}{R_1}$$

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

$$\frac{V_{IN}}{R_1} + \frac{V_{IN} - V_{OUT}}{R_2} = 0$$

$$V_{IN}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \frac{V_{OUT}}{R_2}$$



$$\frac{-1-1}{1K} = \frac{1-V_d}{2K}$$

$$-4 = 1 - V_d$$

$$V_d = 5V$$

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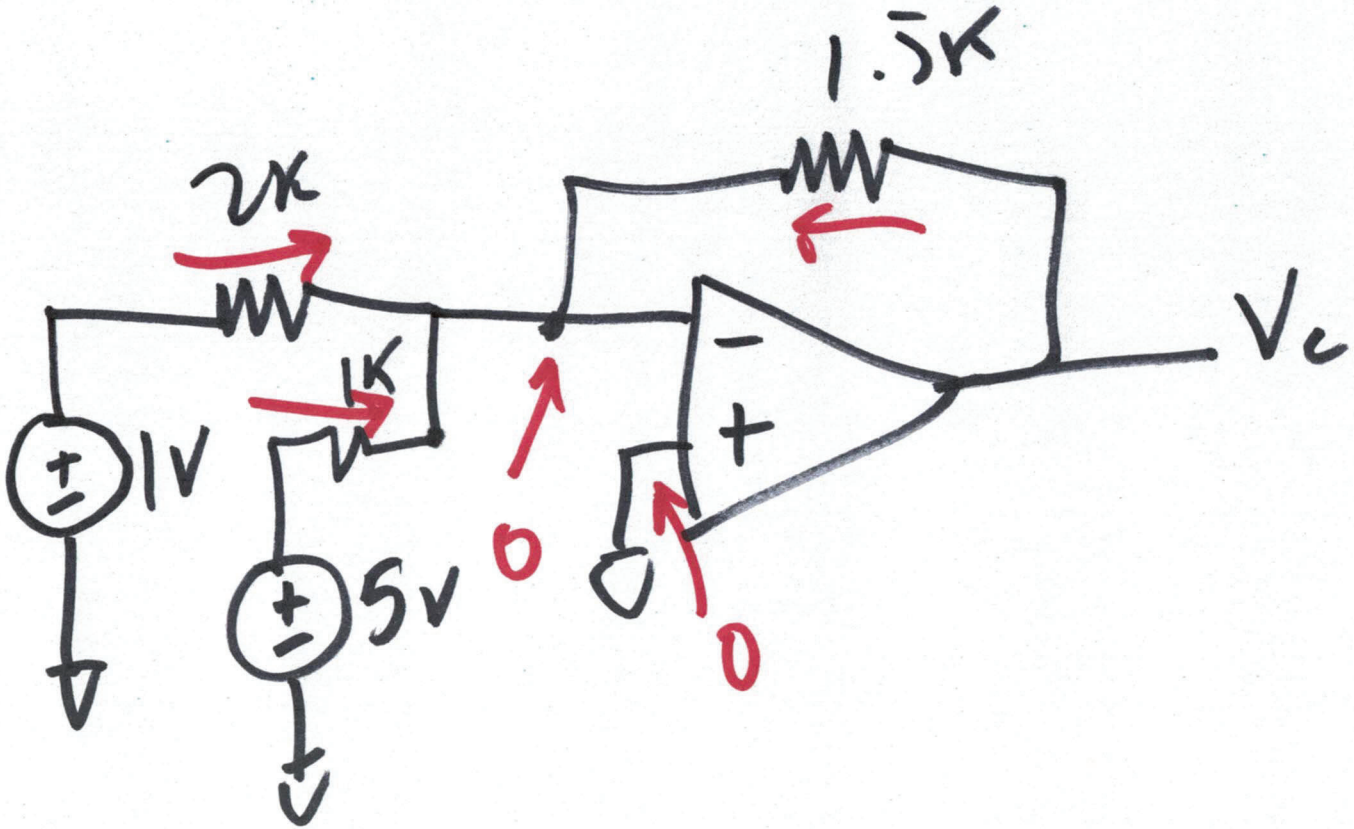

$$\frac{1-0}{2K} + \frac{5-0}{1K} + \frac{V_c-0}{1.5K} = 0$$