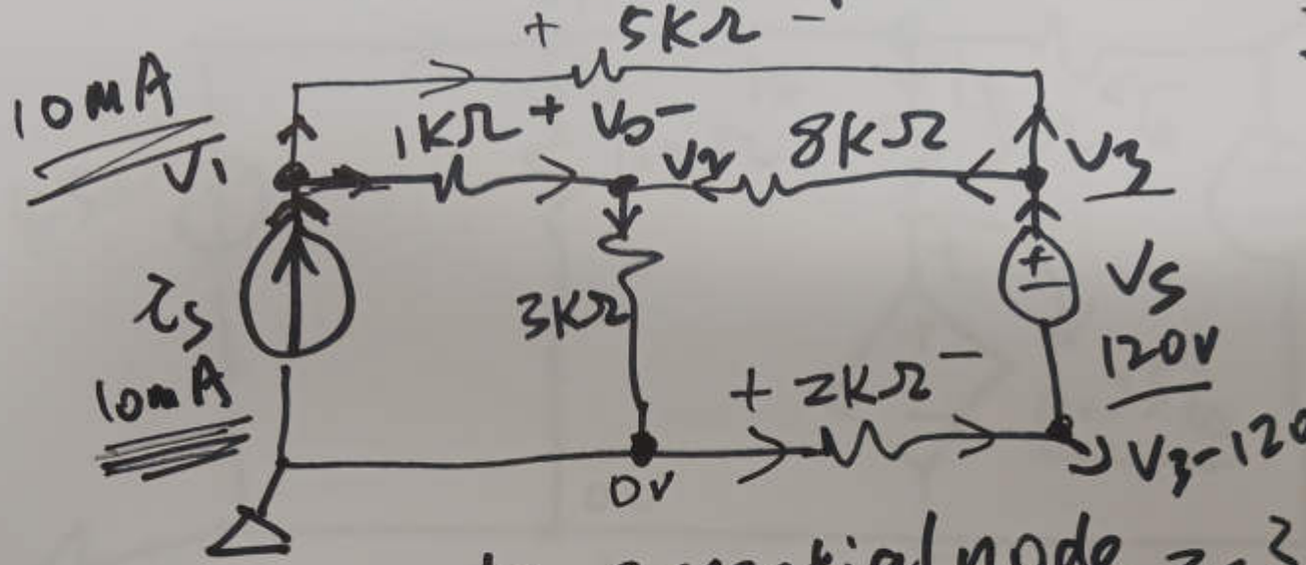
Node Voltage Method (KCL)



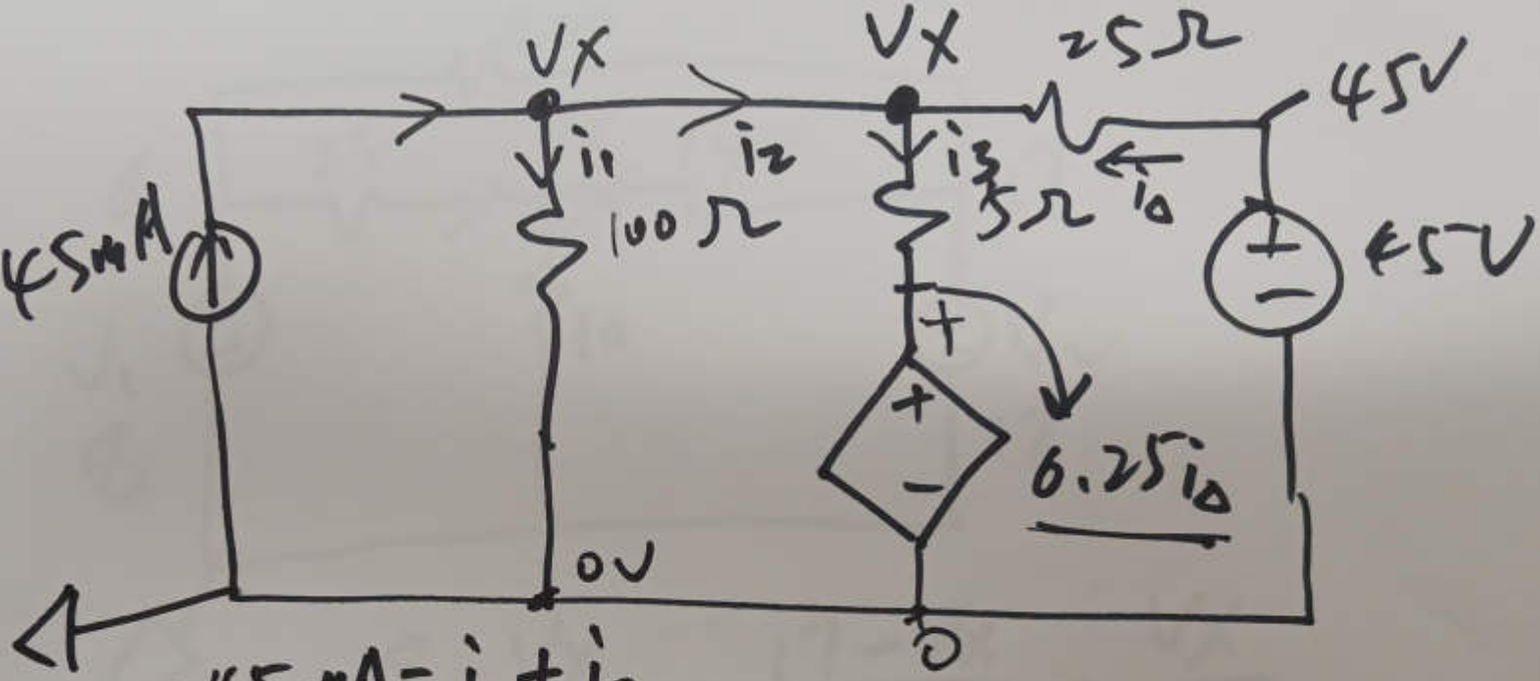
node essential node ≥ 3 branches

└ ≥ 2 branches

$$i_s = 10mA = \frac{V_1 - V_3}{5K} + \frac{V_1 - V_2}{1K}$$

$$\frac{V_1 - V_2}{1K} + \frac{V_3 - V_2}{8K} = \frac{V_2}{3K}$$

$$\frac{0 - (V_3 - 120)}{2K} = \frac{V_3 - V_2}{8K} + \frac{V_3 - V_1}{5K}$$



$$45\,mA = i_1 + i_2$$

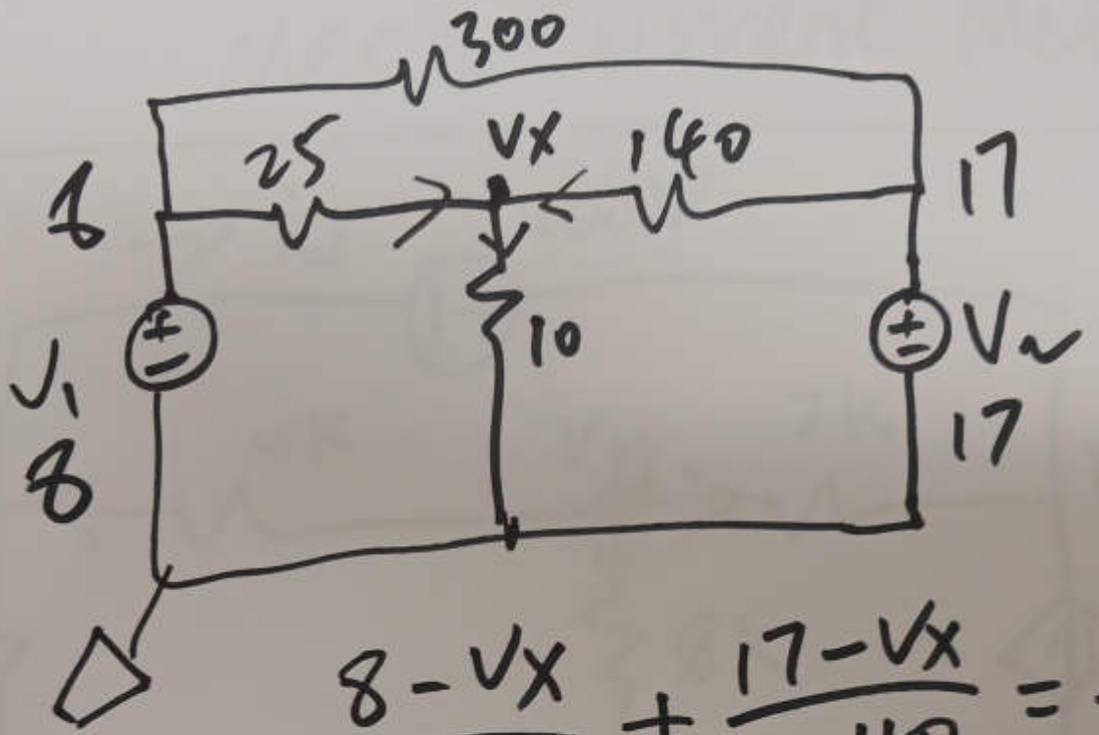
$$i_2 + i_o = i_3$$

$$i_o = \frac{45 - V_x}{25}$$

$$i_3 = \frac{V_x - 6.25\,i_o}{5}$$

$$i_1 = \frac{V_x - 0}{100}$$

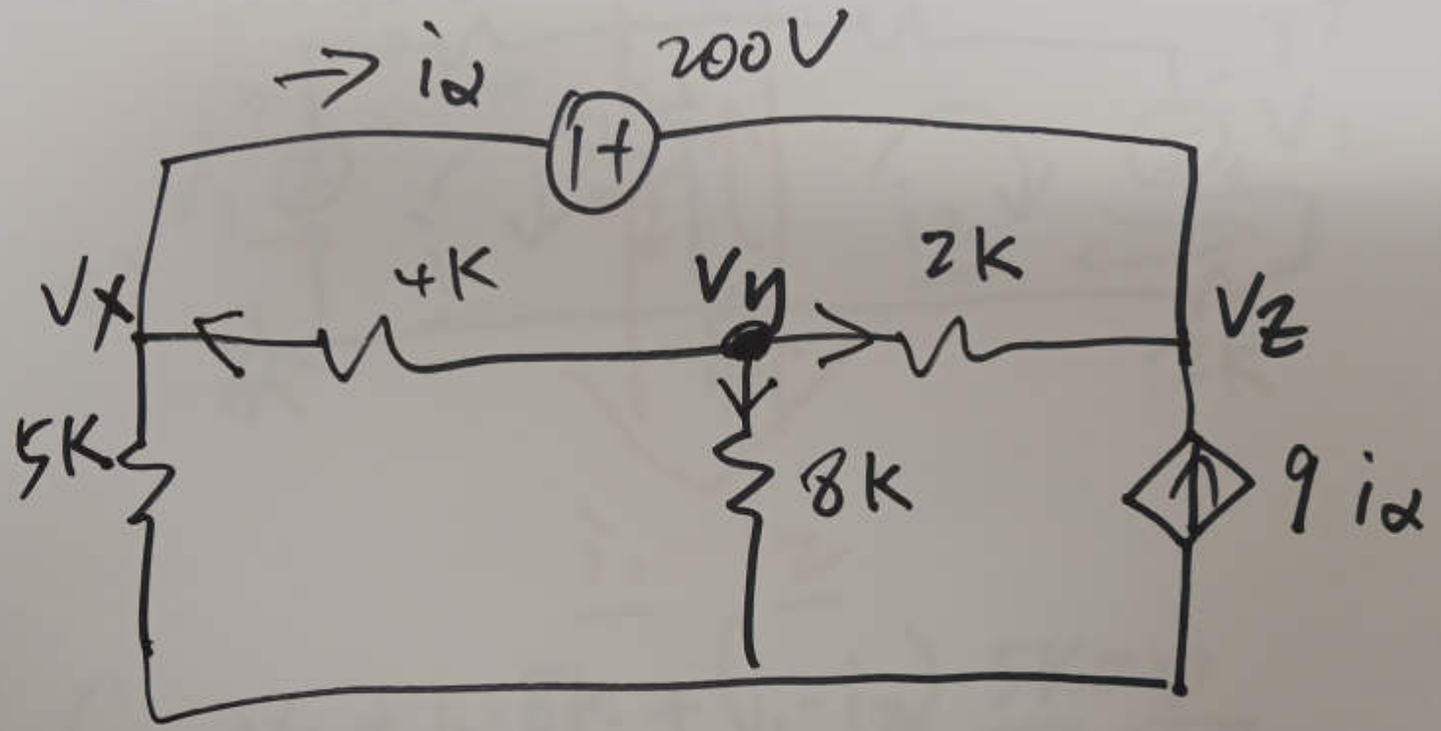
(2)



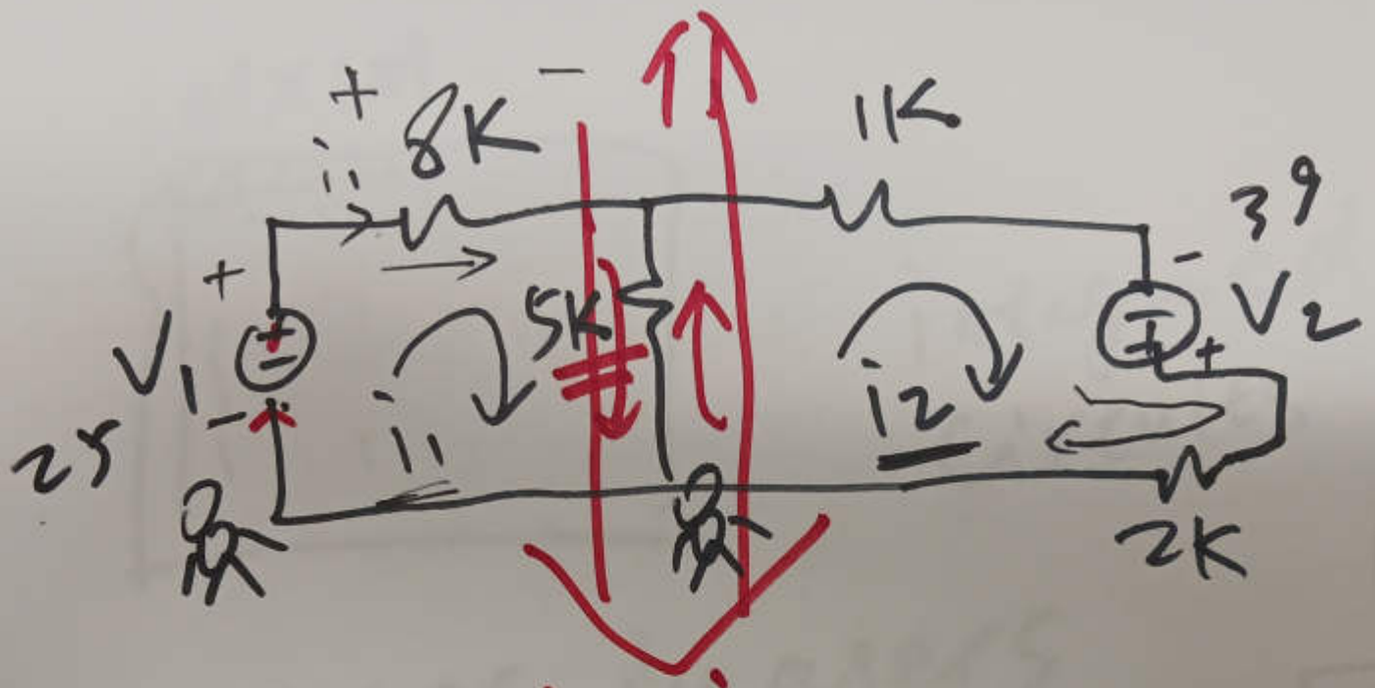
$$\frac{8-V_x}{25}+\frac{17-V_x}{140}=\frac{V_x}{10}$$

(3)

Mesh Current Method (KVL)



$$\frac{V_y - V_x}{4K} + \frac{V_y - V_z}{2K} + \frac{V_y - 0}{8K} = 0$$



$i_1 - i_2$

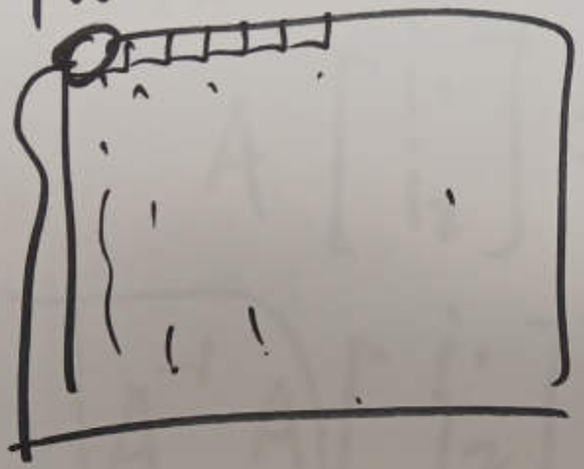
$$\begin{cases} -V_1 + i_1 \cdot 8K + (i_1 - i_2) \cdot 5K = 0 \\ (i_2 - i_1) \cdot 5K + i_2 \cdot 11K - V_2 + i_2 \cdot 2K = 0 \end{cases}$$

$$\begin{cases} i_1 \cdot 13K - i_2 \cdot 5K = 25 \\ -i_1 \cdot 5K + i_2 \cdot 8K = 39 \end{cases}$$

$$A \begin{bmatrix} 13K & -5K \\ -5K & 8K \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = B \begin{bmatrix} 25 \\ 39 \end{bmatrix}$$

(15)

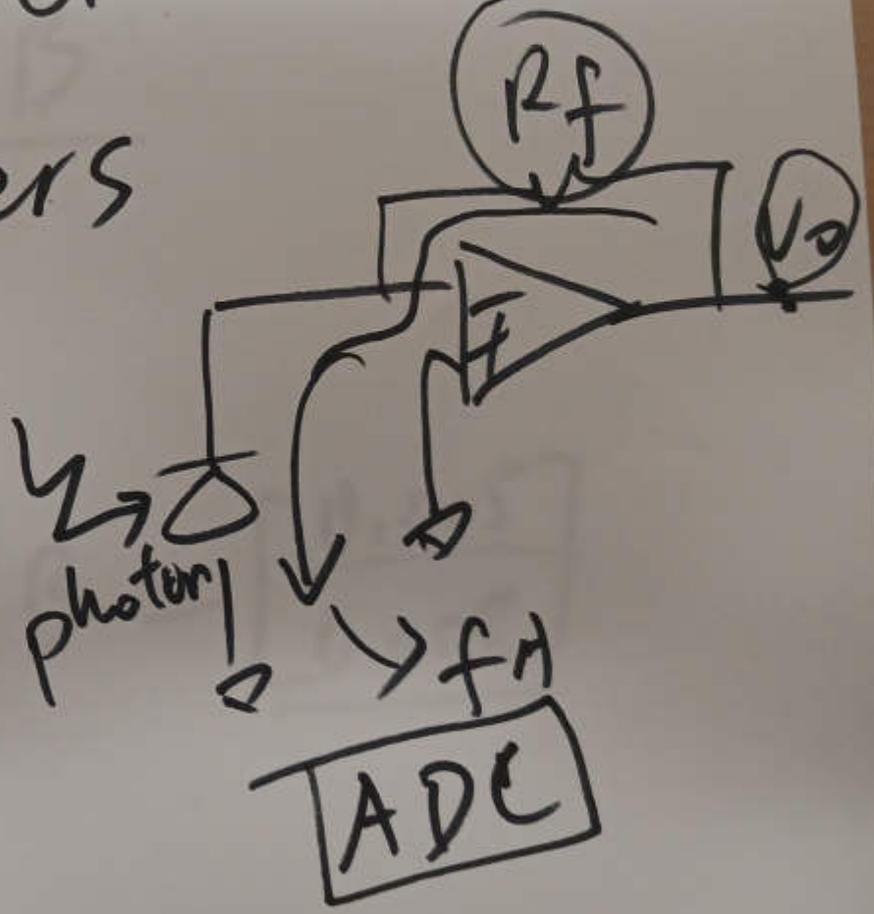
1M x 1M



integrated circuits

CMOS imagers

1MΩ



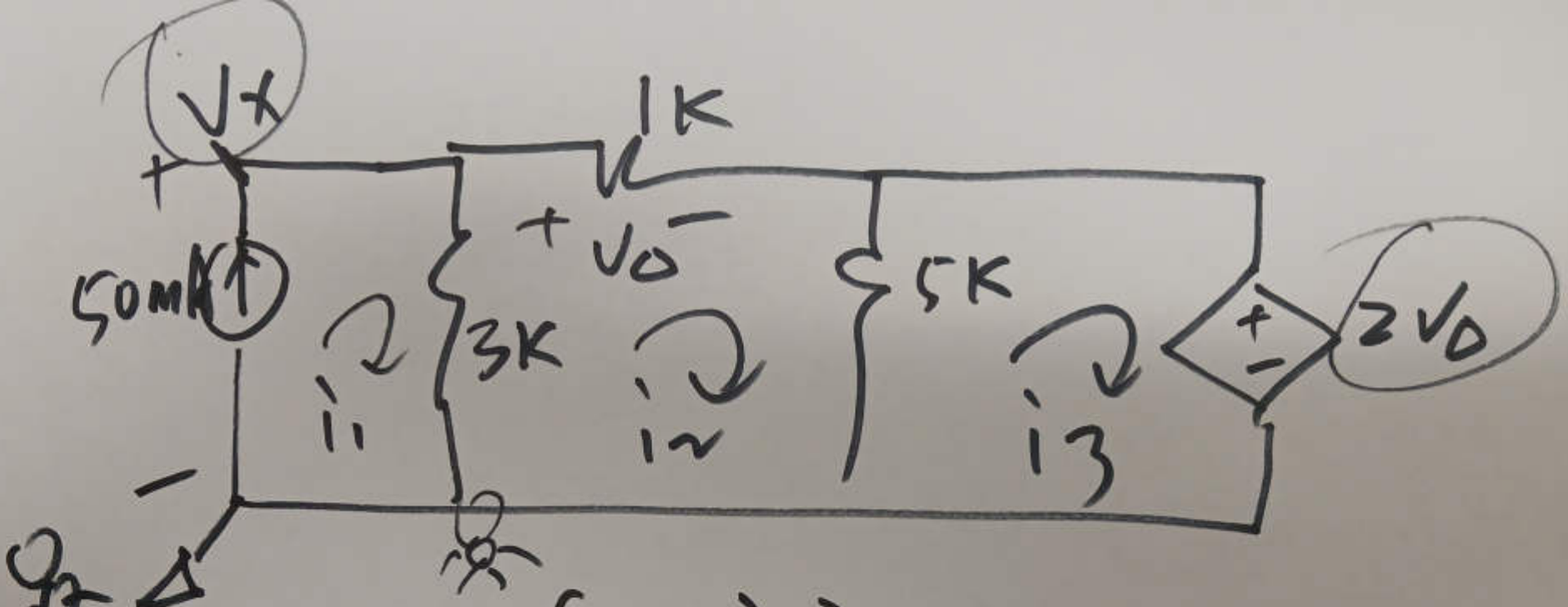
inverse matrix

$$A \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = B$$

$$A^{-1} A \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = A^{-1} B$$

$$\begin{bmatrix} 1 & \\ & 1 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$$

$$\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = A^{-1} B = \begin{bmatrix} 0,005 \\ 0,008 \end{bmatrix}$$



$$\begin{cases} -V_x + (i_1 - i_2)\cdot 3K = 0 \\ (i_2 - i_1)\cdot 3K + i_2 \cdot 1K + (i_2 - i_3)\cdot 5K = 0 \\ (i_3 - i_2)\cdot 5K + 2V_o = 0 \end{cases}$$

$V_o = i_2 \cdot 1K$

$i_1 = 50mA$

(b)