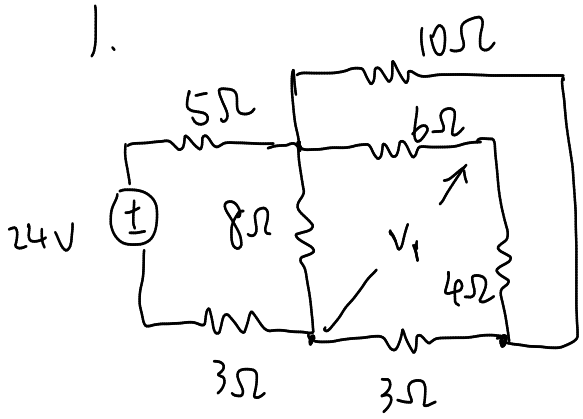
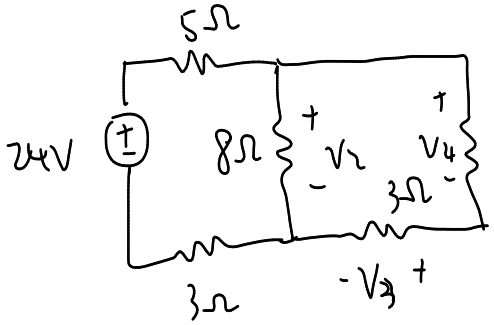
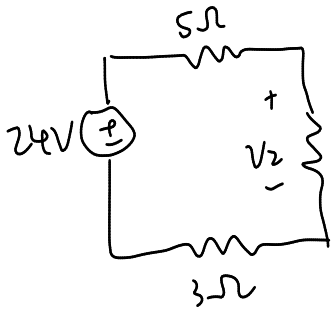
1.





$(4+6)\,//\,10 = 5\,\Omega$



$(3+5)\,//\,8 = 4\,\Omega$

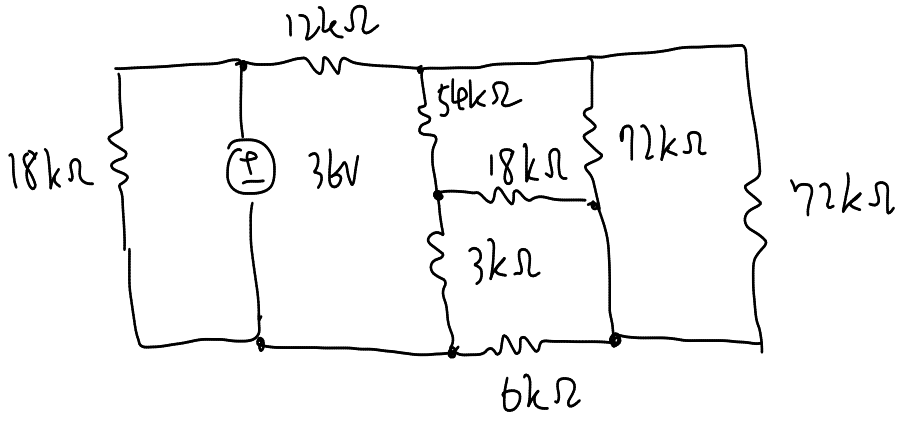
$$V_2 = \frac{24(4)}{5+4+3} = 8\,(V)$$

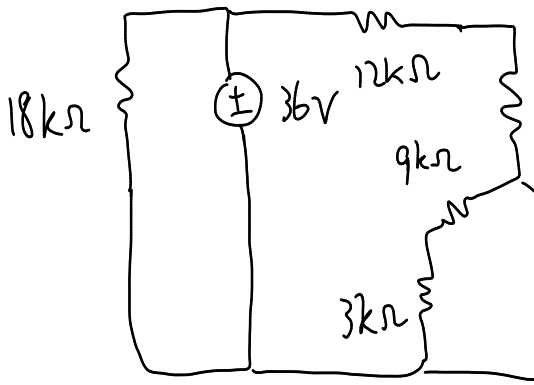
$$V_3 = \frac{V_2(3)}{5+3} = 3\,(V)$$

$$V_4 = V_2 - V_3 = 5\,(V)$$

$$V_1 = \frac{V_4(4)}{6+4} + V_3 = 2+3 = 5\,(V)$$ #

2.

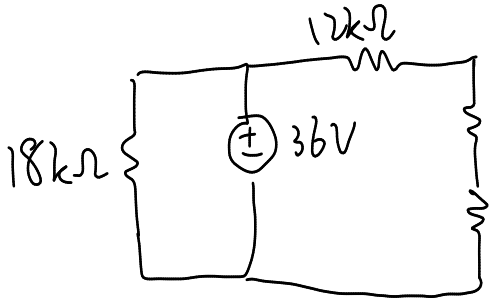




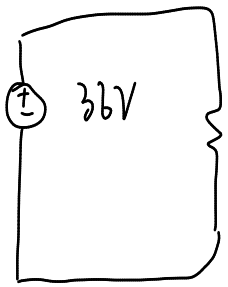
$$18k\Omega = \frac{54k(72k\,//\,72k)}{54k+(72k\,//\,72k)+18k}$$

$$6k\Omega = \frac{18k(72k\,//\,72k)}{(54k+(72k\,//\,72k)+18k)}$$

$$9k\Omega = \frac{18k(54k)}{(54k+(72k\,//\,72k)+18k)}$$



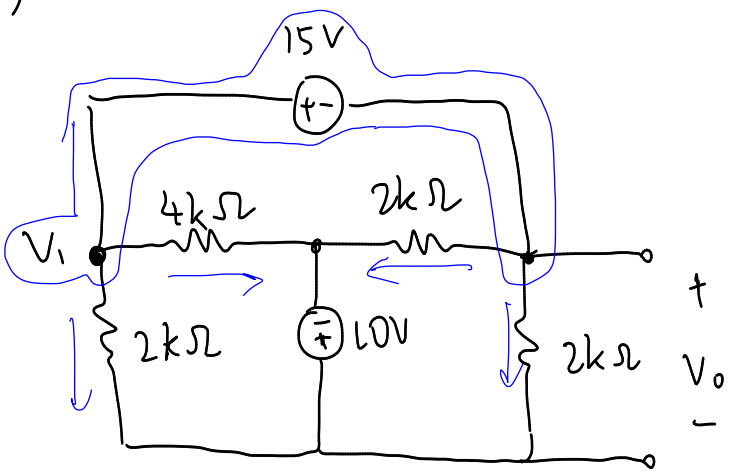
$$6k\Omega = (9k+3k)\,//\,(6k+6k)$$



$$12k\Omega = 18k\,//\,(12k+18k+6k)$$

$$P_{36V} = \frac{V^2}{R} = \frac{36^2}{12k} = 108\,(mW)\ *$$

3



by nodal analysis :

$$\frac{V_1}{2k} + \frac{V_1 - (-10)}{4k} + \frac{V_o - (-10)}{2k} + \frac{V_o}{2k} = 0$$

$$3V_1 + 4V_o = -30 \quad \cdots (1)$$

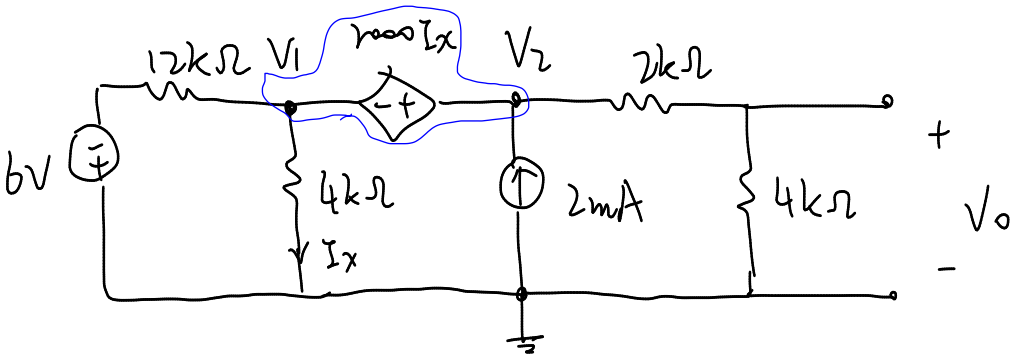
$$V_1 - 15 = V_o$$

$$V_1 - V_o = 15 \quad \cdots (2)$$

by (1)、(2)

$$7V_o = -75 \ , \ V_o = -10.714 \ (V) \ \#$$

4.



by nodal analysis :

$$I_x = \frac{V_1}{4k}$$

$$\frac{V_1+6}{12k} + \frac{V_1}{4k} + (-2m) + \frac{V_2}{(2k+4k)} = 0$$

$$\Rightarrow 4V_1 + 2V_2 = 18 \quad \cdots (1)$$

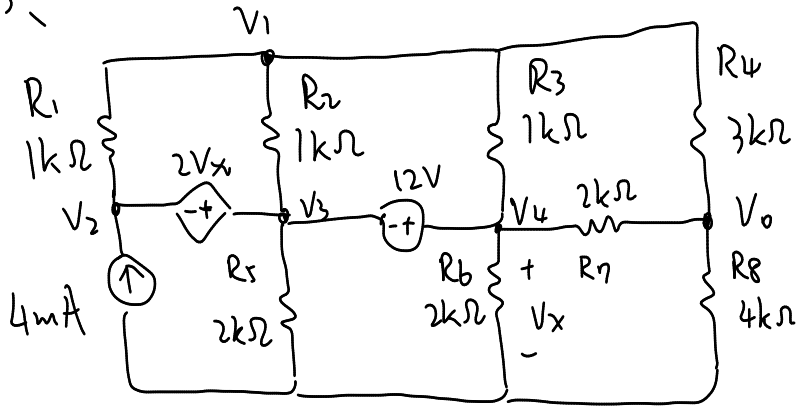
$$V_1 - V_2 = -2000\left(\frac{V_1}{4k}\right)$$

$$\Rightarrow 3V_1 - 2V_2 = 0 \quad \cdots (2)$$

$$(1)+(2) = 7V_1 = 18 \quad , \quad V_1 = \frac{18}{7}(V), \; V_2 = \frac{27}{7}(V)$$

$$V_o = V_2 \times \frac{4k}{2k+4k} = \frac{36}{14} = 2.57\,(V) \; \#$$

5、



by nodal analysis :

$$V_3 - V_2 = 2V_x \quad \cdots (1)$$

$$V_4 - V_3 = 12V \quad \cdots (2)$$

$$V_x = V_4 \quad \cdots (3)$$

KCL @ V_1 : $\frac{V_1 - V_2}{R_1} + \frac{V_1 - V_3}{R_2} + \frac{V_1 - V_4}{R_3} + \frac{V_1 - V_o}{R_4} = 0$

$$-3V_4 - 3V_3 - 3V_2 + 10V_1 - V_o = 0 \quad \cdots (4)$$

KCL @ reference : $\frac{V_3}{R_5} + \frac{V_4}{R_6} + \frac{V_o}{R_8} = 4\,mA$

$$4V_3 + V_o = -8 \quad \cdots (5)$$

KCL @ V_o : $\frac{V_o - V_1}{R_4} + \frac{V_o - V_4}{R_7} + \frac{V_o}{R_8} = 0$

$$V_1 = \frac{13V_o - 6V_4}{4} \quad \cdots (6)$$

by solving (1), (2), (3), (6), (4)

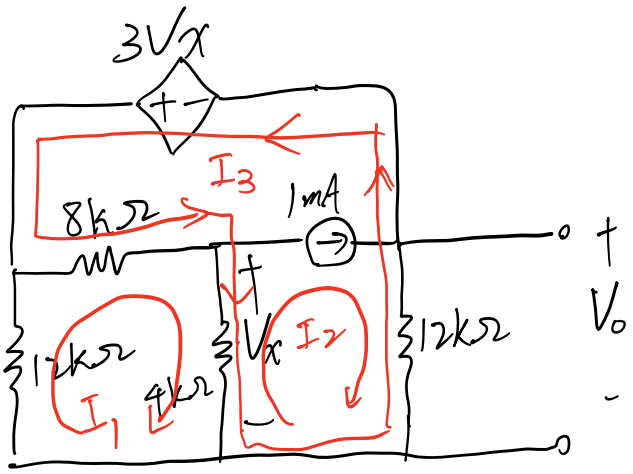
$$-3V_4 - 3V_3 - 3V_2 + 10\left(\frac{13V_o - 6V_4}{4}\right) - V_o = 0$$

$$-18(12 + V_3) - 3V_3 - 3\left(V_3 - 2(12 + V_3)\right) + \frac{63}{2}V_o = 0$$

$$-4V_3 + 7V_o = 32 \quad \cdots (7)$$

by (5), (7) $\quad V_o = 3\,(V)$ #

6.



$I_2 = 1\,mA$, $V_x = 4k(I_1 + I_3 - \underbrace{I_2}_{1mA})$

loop I_3 :

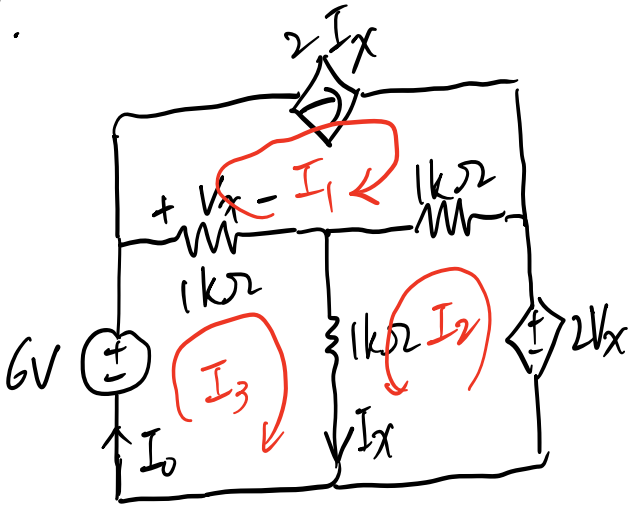
$3V_x = 8k(I_3 + I_1) + V_x + 12k(I_3 - I_2)$

$\Rightarrow 12kI_1 + 12kI_3 - 12 = 12kI_1 - 16 + 24kI_3$

$\Rightarrow 12kI_3 = 4 \Rightarrow I_3 = \frac{1}{3}\,mA$

$V_o = 12k(1m - \frac{1}{3}m) = 8V$

7.



$I_x = I_2 + I_3$, $V_x = 1k(I_3 - I_1)$

$I_1 = 2I_x = 2I_2 + 2I_3$

loop I_3 :

$6 = V_x + 1k(I_3 + I_2)$

$\Rightarrow 6 = 1kI_3 - 1kI_1 + 1kI_3 + 1kI_2$

$\Rightarrow 6 = -1kI_2$

$I_2 = -6\,mA$

loop I_2:

$$2V_x = 1k(I_2 + I_1) + 1k(I_2 + I_3)$$

$$\Rightarrow 2kI_3 - 2kI_1 = 1kI_2 + 1kI_1 + 1kI_2 + 1kI_3$$

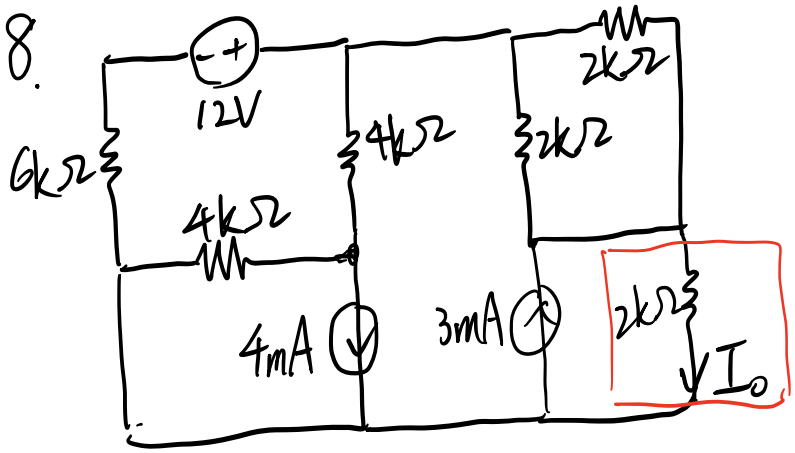
$$\Rightarrow 5kI_3 + 8kI_2 = 0$$

$$I_3 = -\frac{8}{5} \times -6m = \frac{48}{5} mA$$

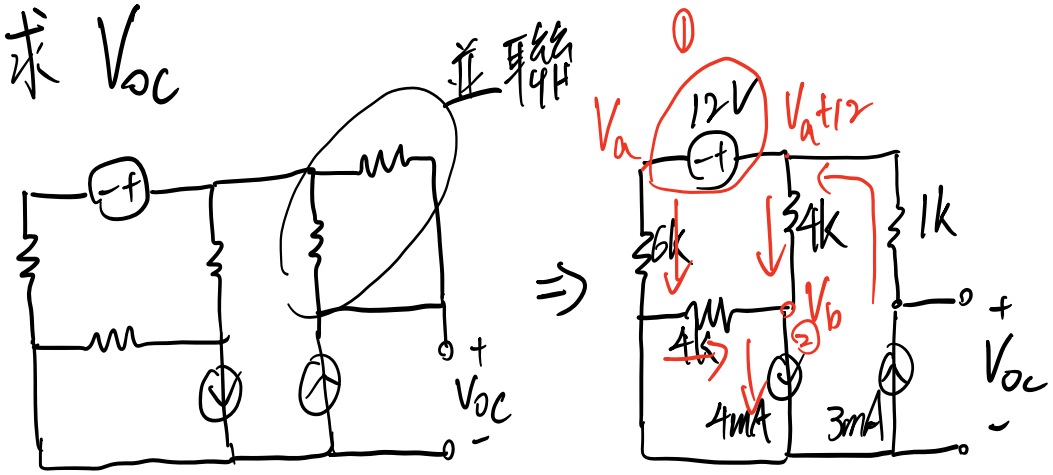
$$\therefore I_o = I_3$$

$$I_o = \frac{48}{5} mA$$

8.



求 V_{oc}



node 1:

$$3m = \frac{(V_a+12)-V_b}{4k} + \frac{V_a}{6k} \Rightarrow 5V_a - 3V_b = 0 \quad -①$$

node 2:

$$4m = \frac{V_a - V_b}{4k} + \frac{(V_a+12)-V_b}{4k} \Rightarrow V_a - 2V_b = 4 \quad -②$$

聯立①.②式，解 $V_a = -\frac{12}{7}V$

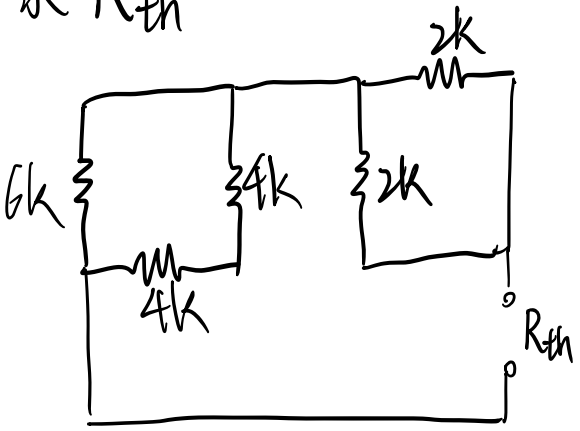
$V_b = -\frac{20}{7}V$

$$V_{OC} = 3m \times 1k + 12 + V_a$$

$$= 15 - \frac{12}{7}$$

$$= \frac{93}{7} \ (V)$$

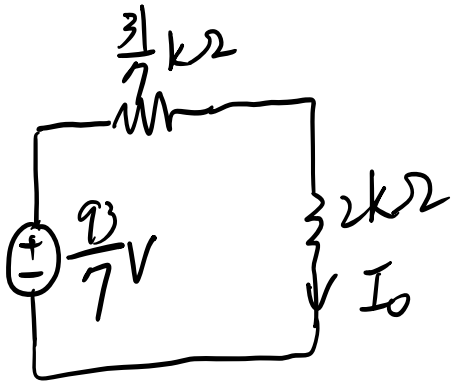
求 R_{th}



$$R_{th} = [6k // (4k+4k)] + (2k // 2k)$$

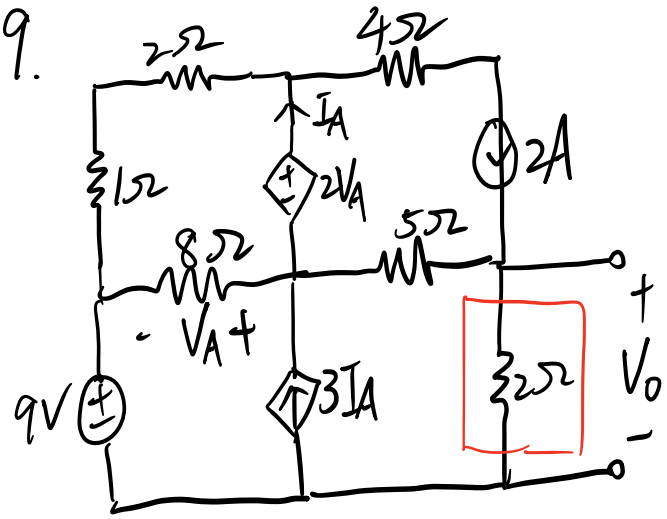
$$= \frac{24}{7}k + 1k$$

$$= \frac{31}{7}k(\Omega)$$

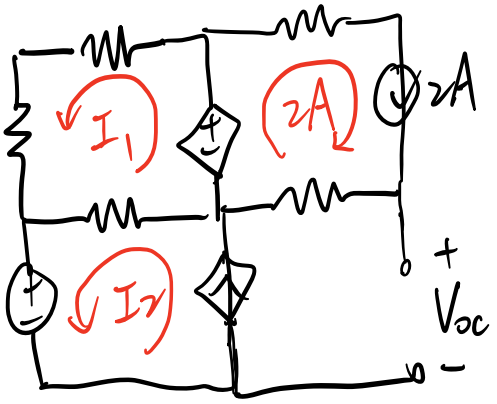


$$I_o = \frac{\frac{93}{7}}{\frac{31}{7}k + 2k} = \frac{93}{45} \ mA$$

9.



求 V_{oc}



$V_A = 8(I_2 - I_1)$

$I_A = I_1 + 2$

$I_2 = 3I_A = 3I_1 + 6$ — ①

loop I_1 :

$2V_A = 2I_1 + I_1 + 8(I_1 - I_2)$

$\Rightarrow 27I_1 - 24I_2 = 0$ — ②

①式代入②式，得 $I_1 = -3.2A$

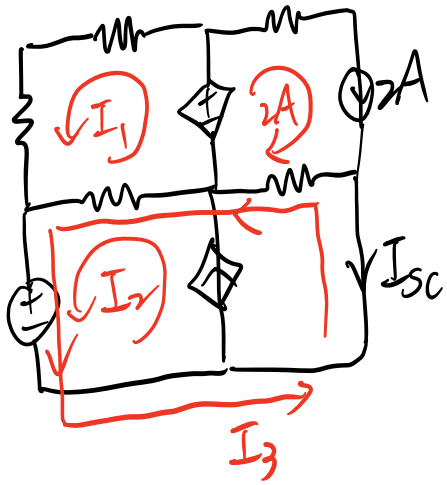
$I_2 = -3.6A$

$$V_{oc} = 5\times 2 + V_A + 9$$

$$= 19 + 8(-3.6+3.2)$$

$$= 15.8\,V$$

求 I_{sc}



$$V_A = (I_2 + I_3 - I_1)\times 8$$

$$I_A = I_1 + 2$$

$$I_2 = 3I_A = 3I_1 + 6$$

loop I_1

$$2V_A = 3I_1 - V_A \Rightarrow 3I_1 - 3V_A = 0$$

$$\Rightarrow 27I_1 - 24I_2 - 24I_3 = 0$$

$$\Rightarrow -45I_1 - 24I_3 = 144 \quad -①$$

loop I_3

$5(I_3+2)+V_A+9=0$

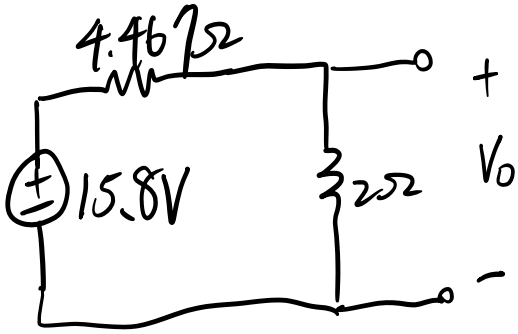
$\Rightarrow -16I_1-13I_3=67$ - ②

聯立①、②式，解 $I_1=-1.313\ A$

$I_3=-3.537\ A$

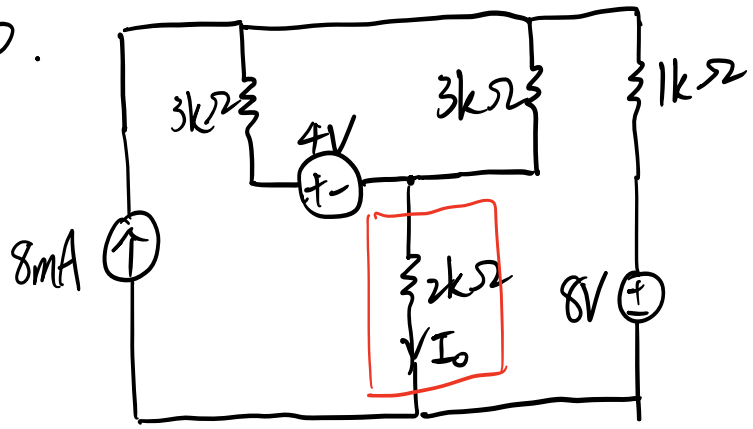
$I_{SC}=-I_3=3.537\ A$

$R_{th}=\frac{V_{OC}}{I_{SC}}=\frac{15.8}{3.537}=4.467\ \Omega$

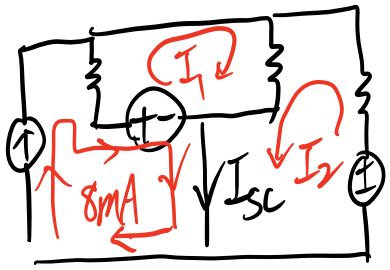


$V_o=15.8\times\frac{2}{4.467+2}=4.886\ V$

10.



求 I_{sc}



loop I_1 :

$4 = 3k(I_1 - 8m) + 3k(I_1 + I_2)$

$\Rightarrow 6k I_1 + 3k I_2 = 28$ — ①

loop I_2 :

$8 = 1k I_2 + 3k(I_2 + I_1)$

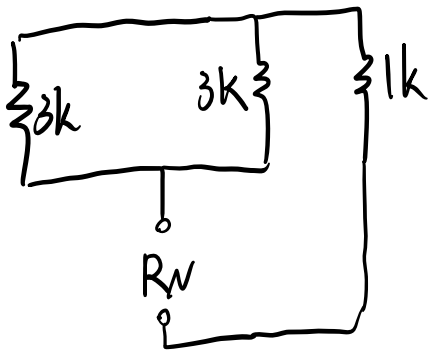
$\Rightarrow 3k I_1 + 4k I_2 = 8$ — ②

聯立①,②式，解 $I_1 = 5.9\,mA$

$I_2 = -2.4\,mA$

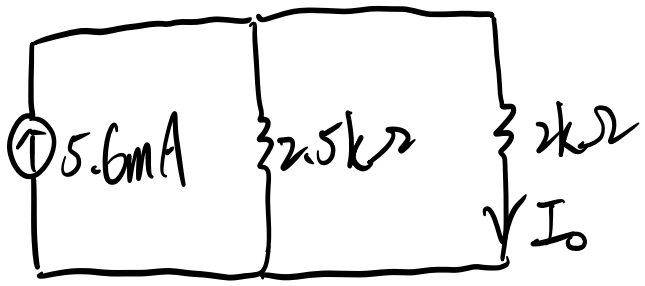
$I_{SC} = 8m + I_2 = 5.6\,mA$

求 R_N



$R_N = (3k // 3k) + 1k$

$= 2.5k\Omega$



$$I_o = 5.6m \times \frac{2.5k}{2.5k+2k} = \frac{28}{9}\,mA$$