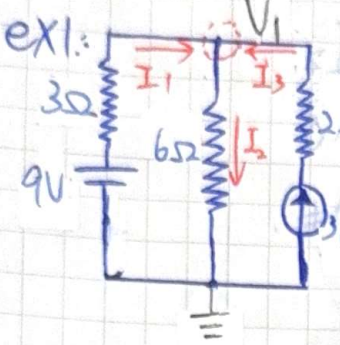
CH4 直流分析網路.

4-1 節點電壓法(節點分析) 基礎理論

1. 主要利用歐姆定律及克希荷夫電流定律

ex1:



$I_2 = I_1 + I_3$

$\frac{V_1}{6} = \frac{9-V_1+9}{3}$

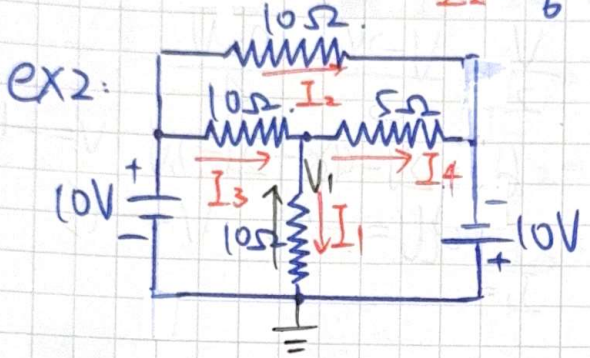
$3V_1 = 108 - 6V_1$

$9V_1 = 108$

$V_1 = 12V$.

$I_2 = \frac{V_1}{6} = 2A$. $I_1 = \frac{9-12}{3} = -1A$ #.

ex2:



$I_3 = I_1 + I_4$

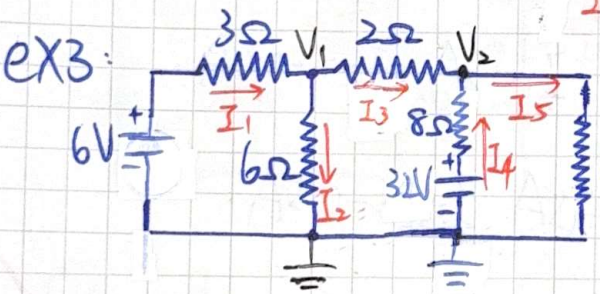
$\frac{10-V_1}{10} = \frac{V_1}{10} + \frac{V_1+10}{5}$.

$10 - V_1 = V_1 + 2V_1 + 20$.

$-10 = 4V_1$ $V_1 = -2.5V$.

$I_1 = \frac{-2.5}{10} = -0.25A$ #.

ex3:



$I_1 = I_2 + I_3$ $I_5 = I_3 + I_4$

(1) $\frac{6-V_1}{3} = \frac{V_1}{6} + \frac{V_1-V_2}{2}$

$12 - 2V_1 = V_1 + 3V_1 - 3V_2$

$12 = 6V_1 - 3V_2$

(2) $\frac{V_2}{8} = \frac{32-V_2}{8} + \frac{V_1-V_2}{2}$.

$V_2 = 32 - V_2 + 4V_1 - 4V_2$

$-4V_1 + 6V_2 = 32$

(3) $\begin{cases} 12V_1 - 6V_2 = 24 \\ +) \; -4V_1 + 6V_2 = 32 \end{cases}$

$8V_1 = 56$.

$V_1 = 7V$.

$V_2 = 16V$.

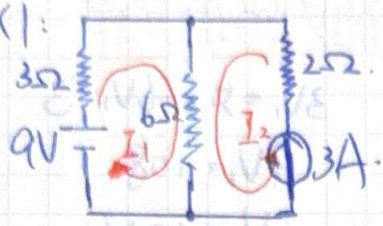
4-2 迴路電流法(網目電流法) 基礎理論.

1. 主要利用歐姆定律及克希荷夫電壓定律

電壓升 = 電壓降

電壓源相加 = 迴路電流 × 電阻

ex1:



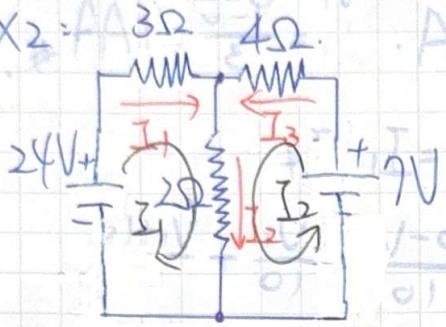
$9=(3\times I_1)+(6\times I_1)+6I_2$

$9=9I_1+6I_2$

$9=9I_1+18$

$I_1=-1A$ #

ex2:



$I_2=I_1+I_3$

① $24=3I_1+2I_1+2I_2$

② $7=4I_2+2I_2+2I_1$

$\begin{cases}5I_1+2I_2=24\\ 2I_1+6I_2=7\end{cases}$ $I_1=5A$ $I_2=-0.5A$

$I_{3\Omega}=5A$ $I_{2\Omega}=4.5A$ $I_{3\Omega}=-0.5A$

4-3 重疊定理

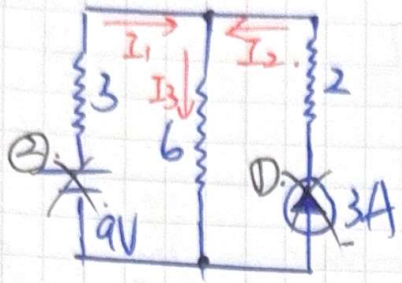
1. 唯一不使用方程式解開複雜網路方式
2. 將電源(電壓源、電流源)單獨考慮
3. 方法:

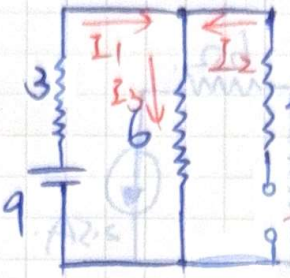
① 只留下一個分析用的電源，並將其他以內阻取代

② 電壓源以短路取代，電流源以開路取代

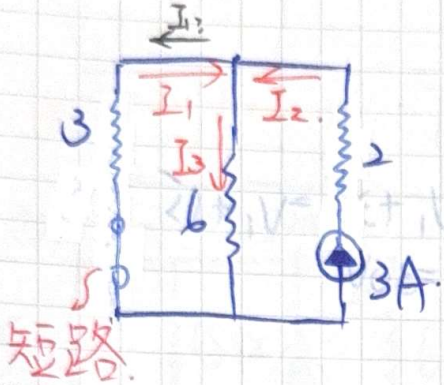
內阻=0　　內阻=∞

ex1.





$(\longrightarrow)\ I_3 = I_1 = \frac{9}{3+6} = 1A$

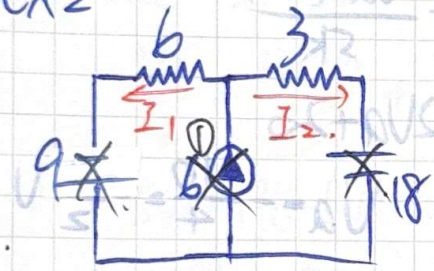


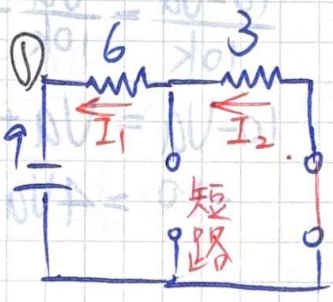
$(\longleftarrow)\ I_1 = 3 \times \frac{2}{3} = 2A$

$I_3 = 3 \times \frac{1}{3} = 1A$

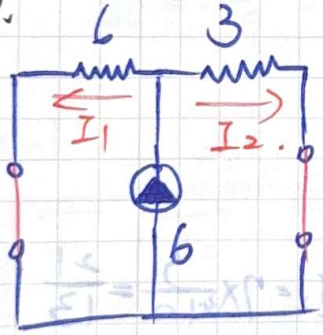
A: $\begin{cases} I_1 = 2-1 = 1A \\ I_2 = 3A \\ I_3 = 1+1 = 2A \end{cases}$

ex2.



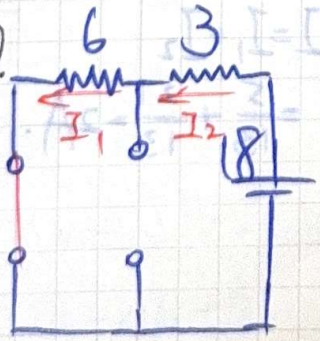
① 

$(\longleftarrow)\ I_1 - I_2 = \frac{9}{9} = 1$

②. 

$(\longleftarrow)\ I_1 = \frac{3}{4.5} \times 6 = 2A$

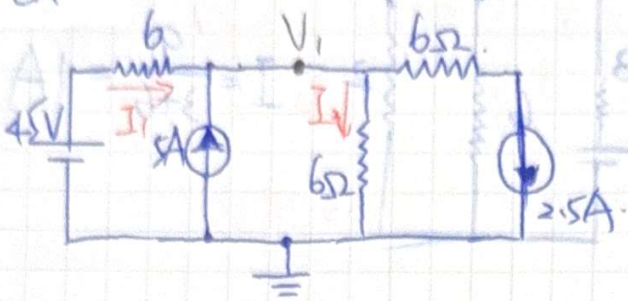
$(\longrightarrow)\ I_2 = 4A$

③. 

$(\longleftarrow)\ I_1 = I_2 = 2A$

A: $\begin{cases} I_1 = 1+2+2 = 5A \\ I_2 = 1-4+2 = -1A \end{cases}$

ex:



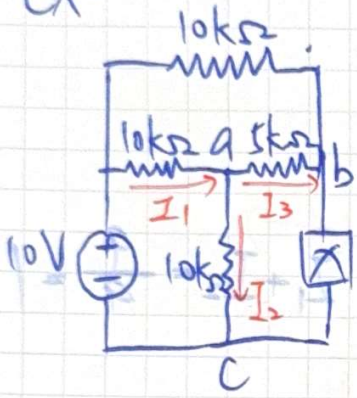
$I_1 + 5 = I_2 + 2.5$

$\frac{45-V_1}{6} + 5 = \frac{V_1}{6} + 2.5 \quad 45 - V_1 + 30 = V_1 + 15$

$V_1 = 30V$

$I = 5A$

ex:



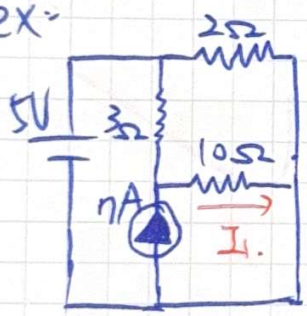
$I_1 = I_2 + I_3$.

$\frac{10-Va}{10k} = \frac{Va}{10k} + \frac{Va-(-10)}{5k}$

$10 - Va = Va + 2Va + 20$

$-10 = 4Va \quad Va = -\frac{10}{4} = -\frac{5}{2}V$

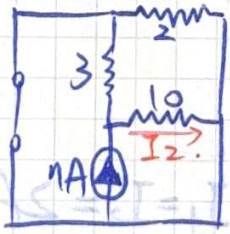
ex:



① 電流源開路

$I = \frac{5}{3+10} = \frac{5}{13}$.

② 電壓源短路.

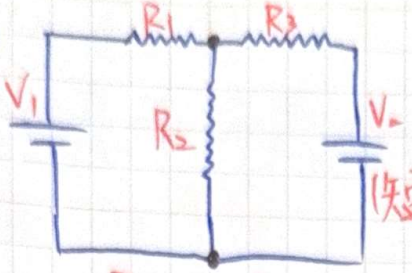


$I_2 = 7 \times \frac{3}{3+10} = \frac{21}{13}$

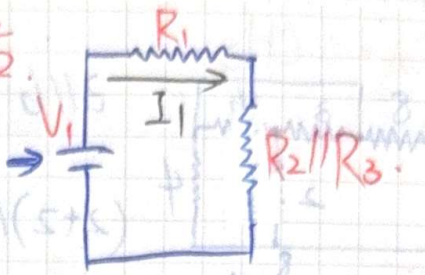
$I = I_1 + I_2$

$= \frac{5}{13} + \frac{21}{13} = 2A$.

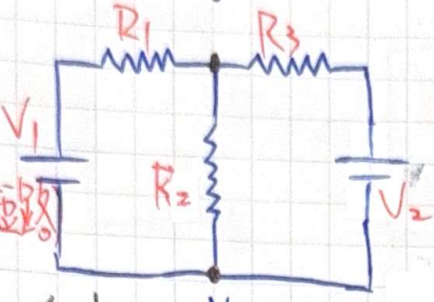
(1)



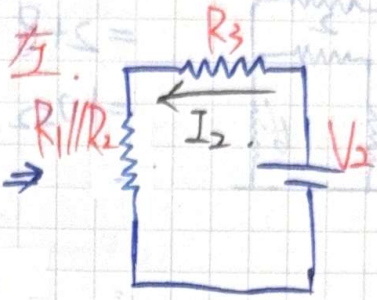
右.



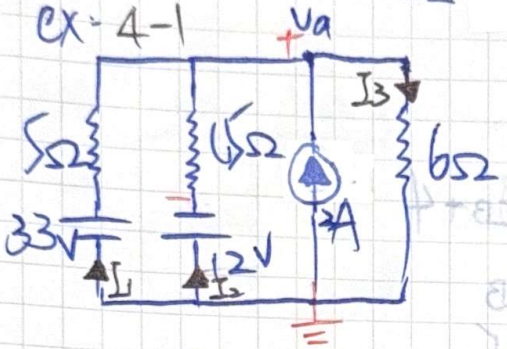
(2)



左.



ex: 4-1



$I_3 = I_1 + I_2$

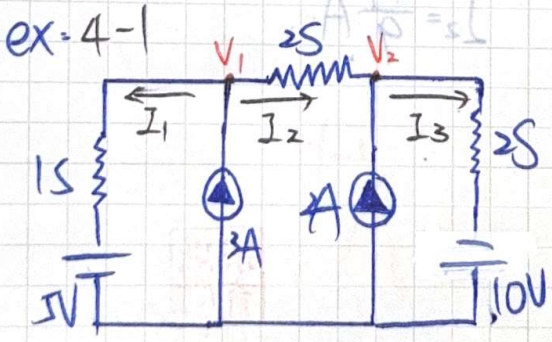
$$\frac{V_a}{6} = \frac{33 - V_a}{5} + \frac{12 + V_a}{15} + 2$$

$$5V_a = 198 - 6V_a + 24 + 2V_a + 60$$

$$9V_a = 282$$

$$V_a = \frac{282}{9} = \frac{94}{3}\ V_{\#}.$$

ex: 4-1



$I_3 = I_2 + 2$

$[2(V_1 - V_2)] + 2$

$I_3 = 2V_1 - 2V_2 + 2$

$3 = I_1 + I_2.$

$3 = 1(V_1 - 5) + 2(V_1 - V_2)$

$3 = V_1 - 5 + 2V_1 - 2V_2$

$\Phi.\ 3V_1 - 2V_2 = 8$

$I_3 = 2(V_2 + 10) = 2V_2 + 20$

$2V_2 + 20 = 2V_1 - 2V_2 + 2$

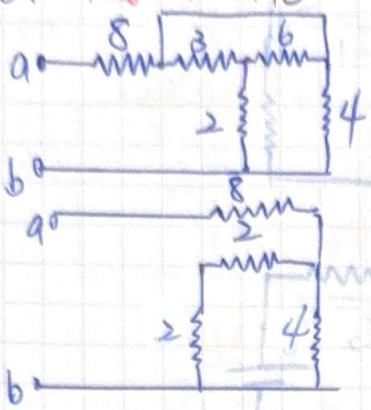
$\begin{cases} V_1 - 2V_2 = 9 \\ 3V_1 - 2V_2 = 8 \end{cases}$

$-2V_1 = 1 \quad V_2 = -\frac{19}{4}$

$V_1 = -\frac{1}{2}$

A. $\begin{cases} I_1 = -\frac{11}{2}\ A \\ I_2 = \frac{19}{2}\ A \\ I_3 = \frac{21}{2}\ A \end{cases}$

ex. R_{ab} = ? Ω



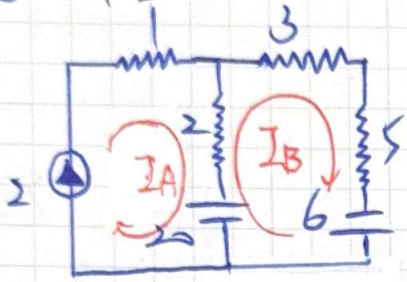
$3//6 = 2$.

$(2+2)//4+8$

$= 2+8$

$= 10\Omega$ #.

ex. 4-2.



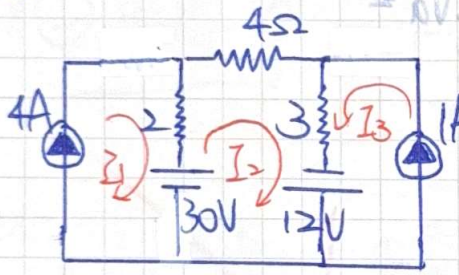
$I_A = 2A$.

$20+6 = 10I_B - 4$

$30 = 10I_B$

$I_B = 3A$.

ex. 4-2.



$I_3 = 1A$. $I_1 = 4A$.

$42 = 9I_2 - 2I_1 + 3I_3$

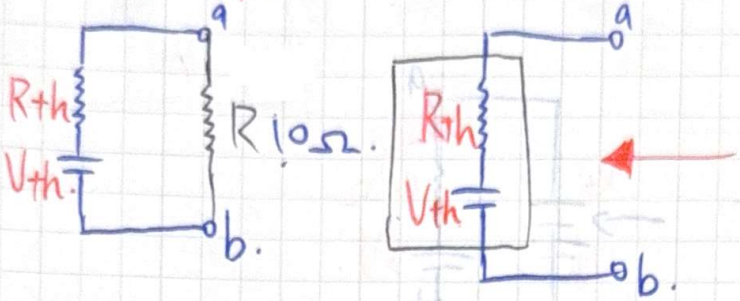
$42 = 9I_2 - 8 + 3$

$47 = 9I_2$

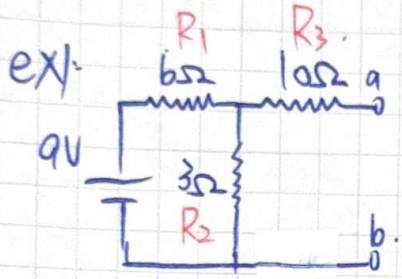
$I_2 = \frac{47}{9}A$.

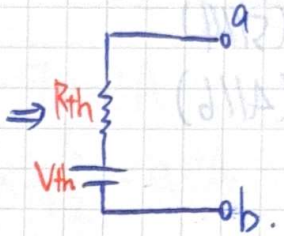
4-4 戴維寧定理

1. 從任意兩端點看進去的電路，都可以轉換成 R_{th}、V_{th} 串聯

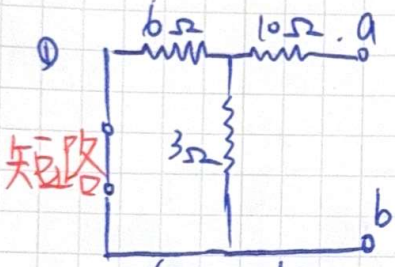


ex:



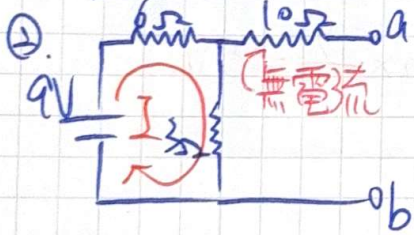


①



$R_{th} = (6 // 3) + 10 = 12\Omega$.

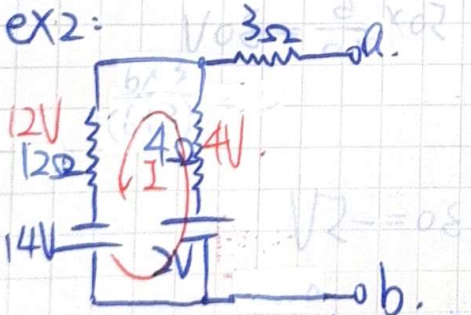
②



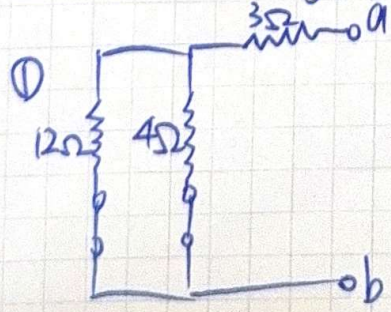
$I = 9 \div (6+3) = 1A$.

$V_{th} = 3 \times 1 = 3V$

ex2:



①



$R_{th} = (12 // 4) + 3$

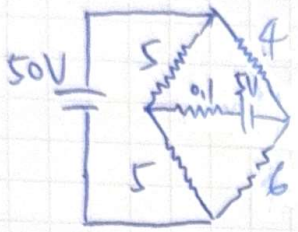
$= 3 + 3$

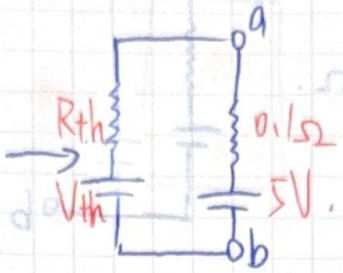
$= 6\Omega$.

④ $I = \frac{14+2}{12+4} = 1A.$

$V_{th} = -4+2 = -2V$

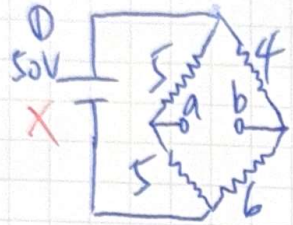
ex3:



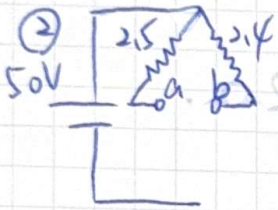


① (5//5)

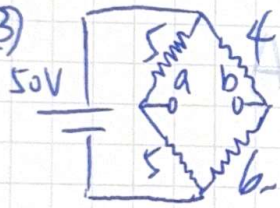
(4//6)

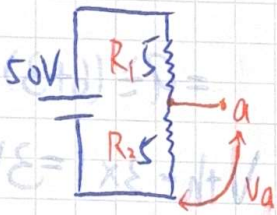


② $R_{th} = 2.5 + 2.4 = 4.9$

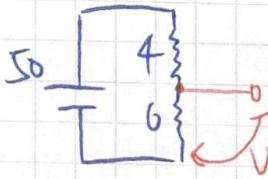


③



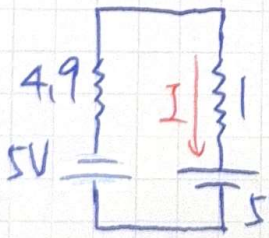


$50 \times \frac{5}{10} = 25V.$



$50 \times \frac{6}{10} = 30V.$

$V_{th} = V_a - V_b = 25 - 30 = -5V.$

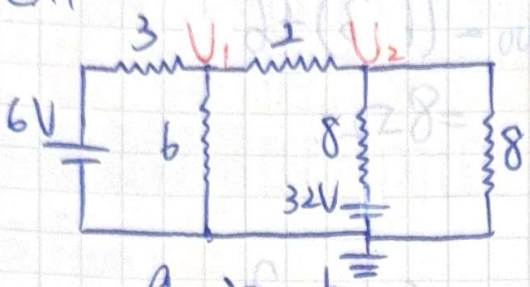


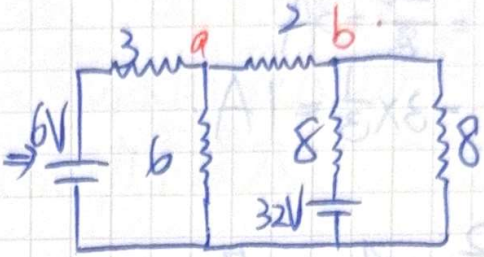
$I = \frac{-(5+5)}{4.9+0.1}$

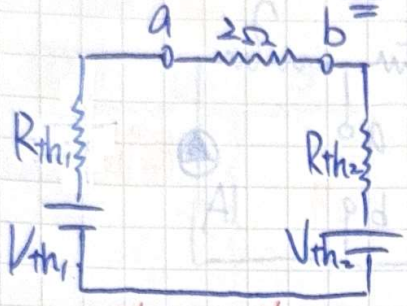
$= -2A.$

2. 戴維寧進階進用

ex1:

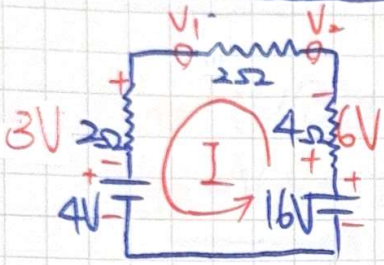






$R_{th_1} = 3 // 6 = 2\Omega$. $R_{th_2} = 8 // 8 = 4\Omega$

$V_{th_1} = 6 \times \frac{6}{9} = 4V$ $V_{th_2} = 32 \times \frac{1}{2} = 16V$



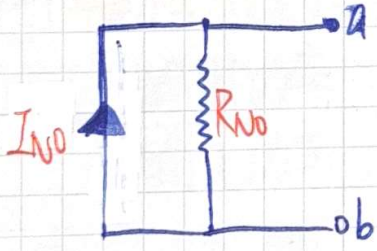
$I = \frac{16-4}{8} = \frac{3}{2}A$.

$V_1 = 4+3 = 7V$.

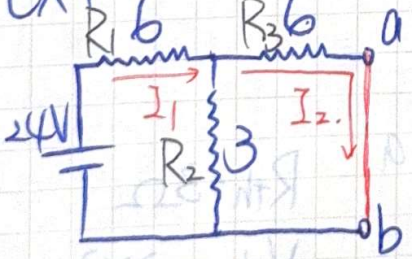
$V_2 = 16-6 = 10V$.

4-5 諾頓定理.

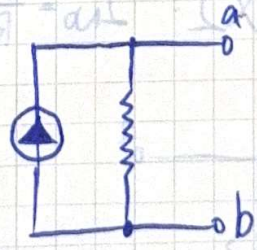
1. 差別：轉換成 R_{NO} 並聯 I_{NO} 的電路.



ex1:



⇒



$R_T = (6/\!/3)+6 = 8\Omega$.

$I_1 = \frac{24}{8} = 3A$

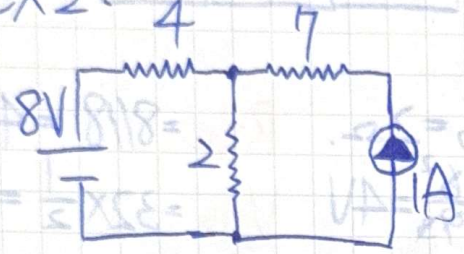
$I_{NO} = I_2 = 3\times\frac{1}{3} = 1A$.

$R_{NO} = (R_1/\!/R_2)+R_3$

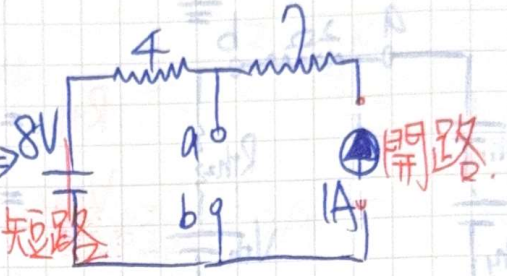
$R_{NO} = (6/\!/3)+6$

$= 8\Omega$.

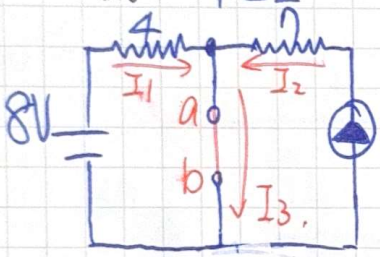
ex2:



$\Rightarrow$



$R_{NO} = 4\Omega$

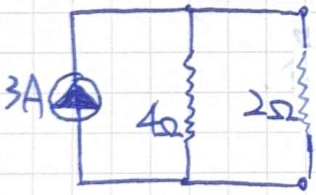


$I_3 = I_1 + I_2$.

$I_1 = 2A$.

$I_2 = 1A$

$I_3 = 3A = I_{NO}$

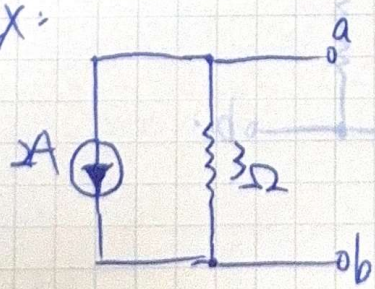


$I_{2\Omega} = 3\times\frac{4}{6} = 2A$.

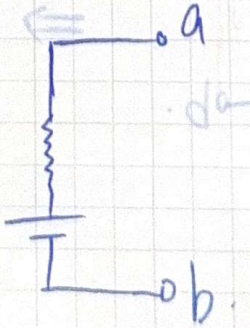
4-6 戴維寧及諾頓互換.

1. 戴維寧等效 $V = V_{th} = I_{NO} \times R_{NO}$
2. 諾頓等效 I: $I_{NO} = \frac{V_{th}}{R_{th}}$

ex:



$\Rightarrow$



$R_{th} = 3\Omega$

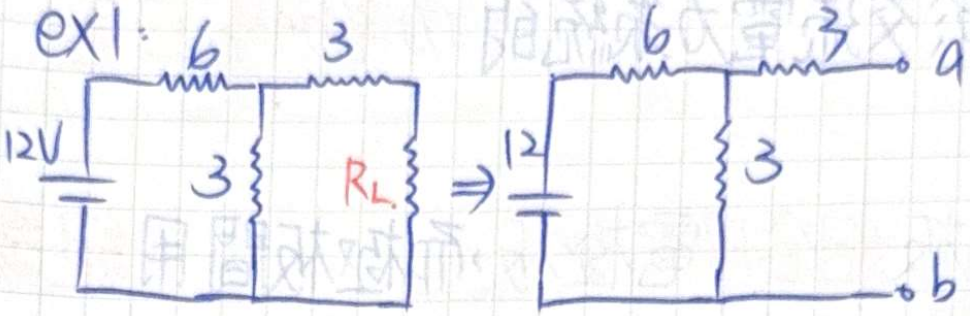
$V_{th} = -2\times3$

$= -6V$.

4-7 最大功率轉移

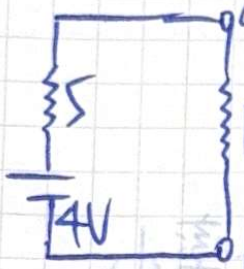
1. 具有一個內阻的電壓源，唯一可改變的是 R_L 值，可利用改變 R_L 值從電源得最大功率
2. 當負載電阻 = 內阻，負載功率最大
3. $P_{MAX} = \frac{V^2}{4R}$

ex1：



$R_{th} = (6 // 3) + 3 = 5$

$V_{th} = V_{ab} = 12 \times \frac{3}{9} = 4V$.



$R_L = R_{th} = 5\Omega$

$I = \frac{4}{10} = 0.4$

$P_{MAX} = (0.4)^2 \times 5 = 0.8W$.

4-7-1 轉移的效率

$$\eta = \frac{\text{輸出功率}}{\text{輸入功率}}$$