電路學(一)　第二次考試　　NOV. 2017

每題 20 分，滿分 120 分。可使用計算器，不得參考任何書本及筆記。

1. Find the mesh currents I_1 and I_2 in the circuit shown in **Fig. 1**.
2. If an 8-Ω load is connected to terminals *a, b* of the network shown in **Fig. 2**, V_{ab}=16 V. If a 2-Ω load is connected to the terminals, V_{ab}=8 V. Find V_{ab} if a 20-Ω load is connected to the terminals. (Hint: Assume a Thévenin equivalent circuit in the black box.)

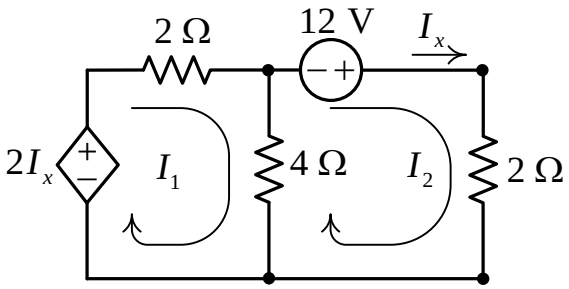

Fig. 1

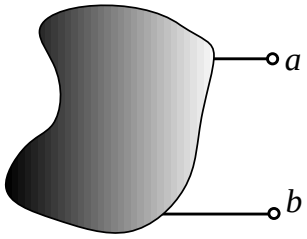

Fig. 2

3. In the circuit shown in **Fig. 3**, v_1=1.2 V, v_2=3.4 V. Find the output voltage v_o and the current *i*.
4. In the circuit shown in **Fig. 4**, v_1=0.5 V, v_2=1.0 V, v_3=1.5 V. Find the output voltage v_o

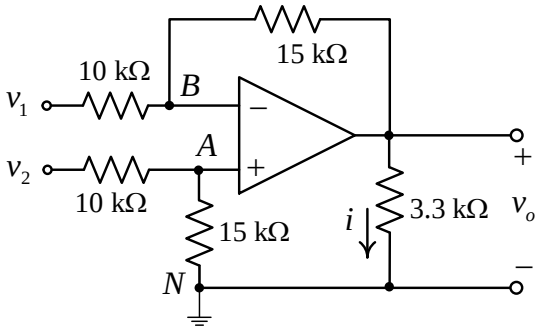

Fig. 3

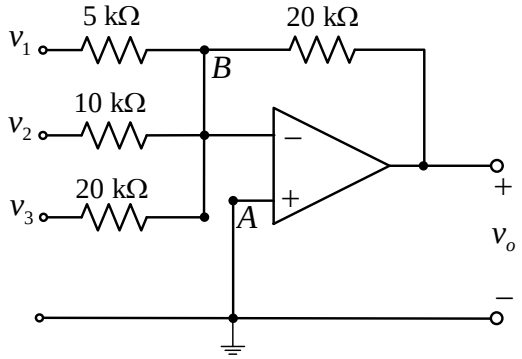

Fig. 4

5. Find the Thévenin equivalent circuit (V_{th} and R_{th}) at the terminals *a* and *b* of the circuit of **Fig. 5.**
6. In the circuit of **Fig. 6**, find the Thévenin equivalent circuit seen by resistor R_L, and determine the maximum power that can be transferred to R_L.

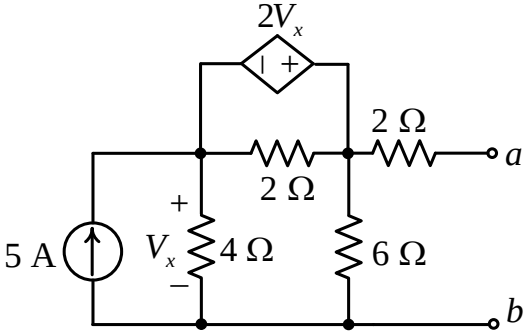

Fig. 5

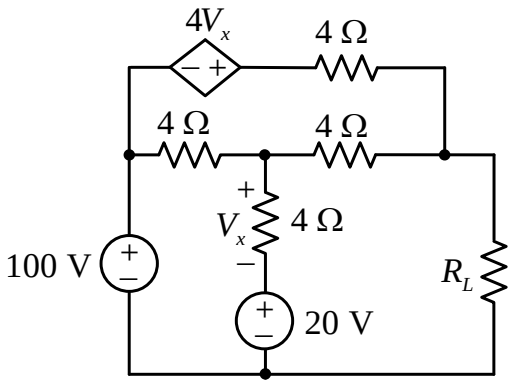

Fig. 6

電路學(一) 第二次考試 NOV. 2017

每題 20 分，滿分 120 分。可使用計算器，不得參考任何書本及筆記。

1. Find the mesh currents I_1 and I_2 in the circuit shown in **Fig. 1**.

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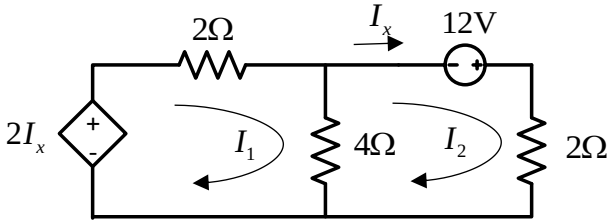

Fig. 1

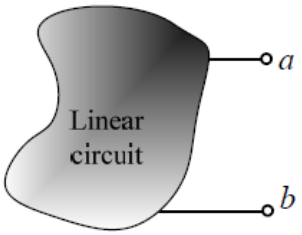

Fig. 2

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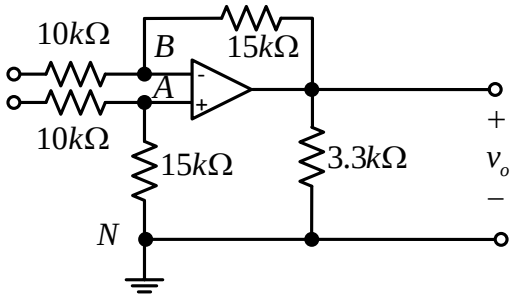

Fig. 3

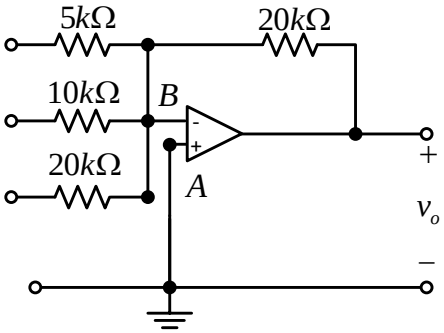

Fig. 4

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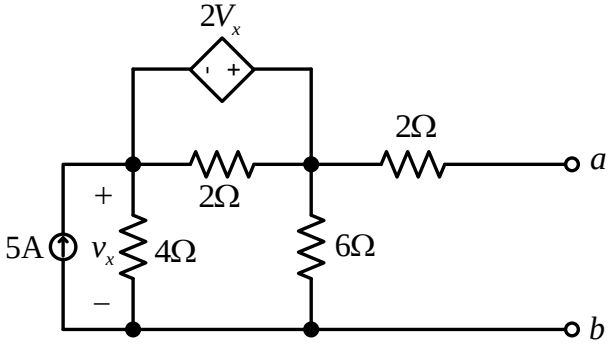


Fig. 5

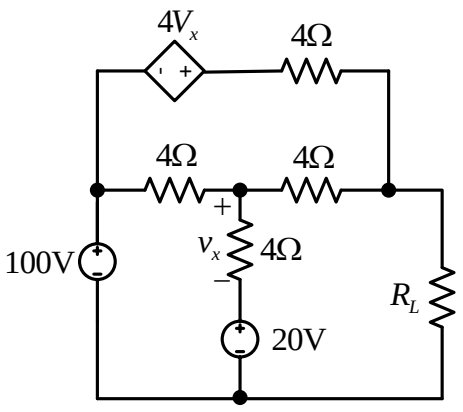


Fig. 6

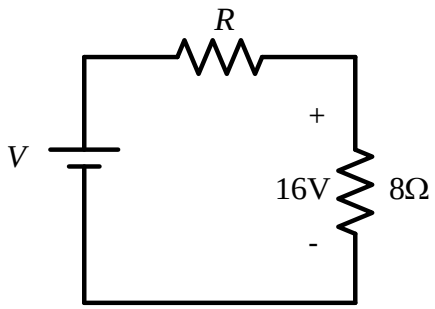
電路學(一) 第二次考試 參考解答

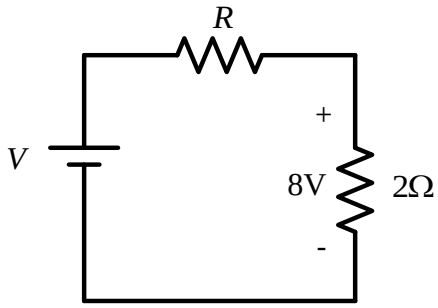
1. 在所求出之網路的迴路中,利用克希荷夫電壓定律寫出兩迴路方程式以求出各迴路之電流

$$\begin{cases} 2I_x = 2I_1 + 4(I_1 - I_2) \\ 12 = 2I_2 + 4(I_2 - I_1) \\ I_2 = I_x \end{cases}$$

求得 $I_1 = 6\text{A}$, $I_2 = 6\text{A}$

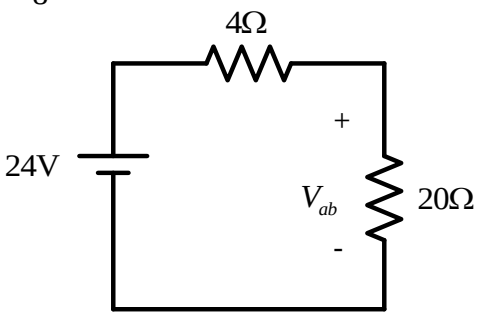
2. 假設電壓源裡有一內阻:R 及電壓:V,依照題目敘述可以列出兩個方程式,求得內阻:R 及電壓:V。





$$\begin{cases} V \times \dfrac{8}{R+8} = 16 \\ V \times \dfrac{2}{R+2} = 8 \end{cases}$$

求解得知 $V = 24\text{V}$, $R = 4\Omega$



當 V_{ab} 是 20Ω 時,

$$V_{ab} = 24 \times \frac{20}{4+20} = 20\text{V}$$

3. 利用克希荷夫電流定律求出 V_o 和 i

$$V_A = 3.4 \times \frac{15k}{10k + 15k} = 2.04\text{V} = V_B$$

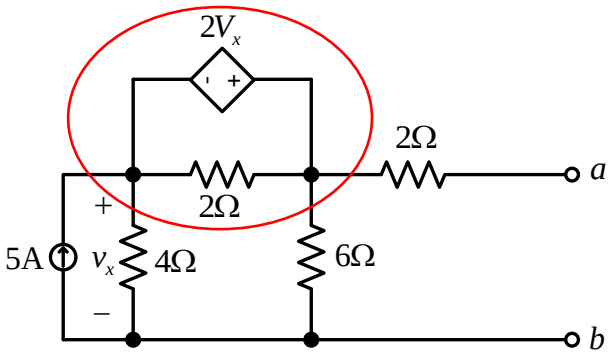
$$\frac{2.04 - 1.2}{10k} - \frac{V_o - 2.04}{15k} = 0$$

$$V_o = 3.3\text{V}, i = \frac{3.3}{3.3k} = 1\text{mA}$$

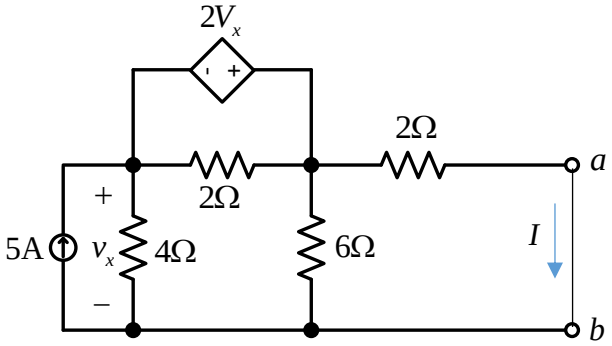
4. 圖 4 是一個反向放大器, 可用公式求得V_o

$$V_o = -(0.5\times\frac{20k}{5k}+1\times\frac{20k}{10k}+1.5\times\frac{20k}{20k})=-5.5\text{V}$$

5. 圖 5 需用超節點求解



$$5=\frac{V_x}{4}+\frac{3V_x}{6}, V_x=\frac{20}{3}\text{V}, V_{th}=3V_x=20\text{V}$$



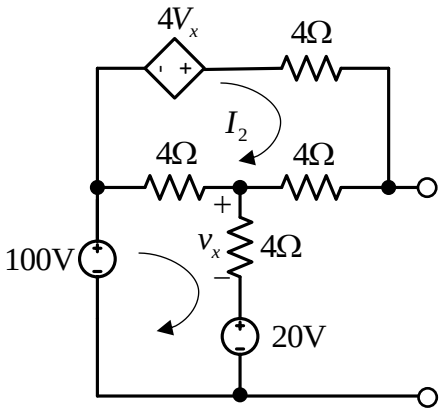
$$\begin{cases} 5+I=\frac{V_x}{4}-\frac{2V_x}{2} \\ -\frac{2V_x}{2}=I+\frac{3V_x}{6}+\frac{3V_x}{2} \end{cases}$$

$$V_x=\frac{20}{9}\text{V}$$

$$I=\frac{10}{3}\text{A}=I_{th}$$

$$R_{th}=\frac{V_{th}}{I_{th}}=\frac{20}{\frac{10}{3}}=6\Omega$$

6. 圖 6 是一個包含獨立電源與相依電源的戴維寧等效電路,在此情形下,將所有電源設為 0 來求得戴維寧等效電阻的方法將不適用,而須使用開路電壓及短路電流來求等效電阻。

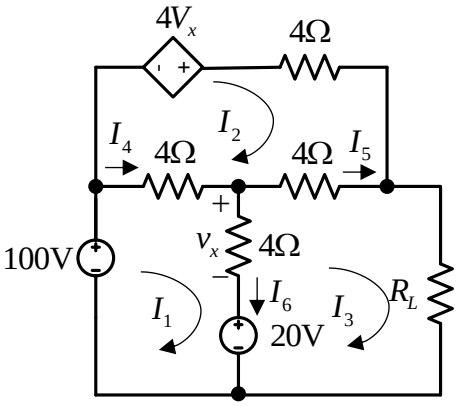


$$\begin{cases} 100 = I_1(4+4) - 4I_2 + 20 \\ 4V_x = I_2(4+4+4) - 4I_1 \\ 20 = -I_1 - 4I_2 + V_{oc} \\ V_x = 4I_1 \end{cases}$$

$I_1 = 60\text{A}$

$I_2 = 100\text{A}$

V_{oc}=660V



$I_4 = I_1 - I_2$

$I_5 = I_1 - I_3$

$V_x = 4I_6 = 4(I_1 - I_3)$

$100 + 4V_x = 4I_2$ (6-1)

$100=4I_4+4I_6+20$ (6-2)

$I_5=I_3-I_2$

$4I_1-8I_2+4I_3=100$ (6-3)

(6-1)~(6-3)式解聯立,

$I_1 = 60\text{A}$

$I_2 = 45\text{A}$

$I_3 = 55\text{A}=I_{oc}$

$R_{th} = \dfrac{V_{oc}}{I_{oc}} = 12\Omega$

當 $R_{\text{L}} = R_{th}$ 可求得最大功率

$\text{P}_{\max} = \dfrac{V_{oc}{}^2}{4R_{th}} = \dfrac{660^2}{4\times 12} = 9075\text{W}$