電路學 (一)　第二次測驗　　四電機二 A　2016 年 11 月 7 日　(星期一)

1) 滿分 130 分，考試時間 2 小時。
2) 答案應有正確之數值與單位。
3) 可使用計算器，但<u>不得</u>使用電腦、行動電話等通訊器材。<u>不得</u>參閱任何書本及筆記。
4) 請確實遵守考試規則，違反考試規則者依本校校規處置。

1. Find V_o in the network of **Fig. 1** using *nodal analysis*. (20 %)
2. In the circuit of **Fig. 2**, find the mesh currents I_1 and I_2. Also find the branch current I_0. (20 %)

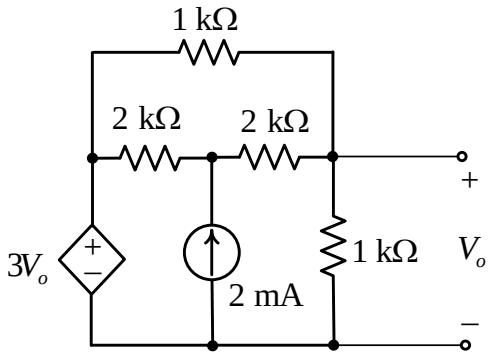


Fig. 1

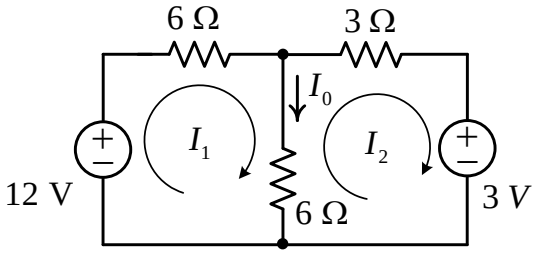


Fig. 2

3. In the circuit of **Fig. 3**, if V_1=3V and V_2=9V, find the amplifier's output V_0. (20 %)
4. In the circuit of **Fig. 4**, find the amplifier's output V_0. (20 %)

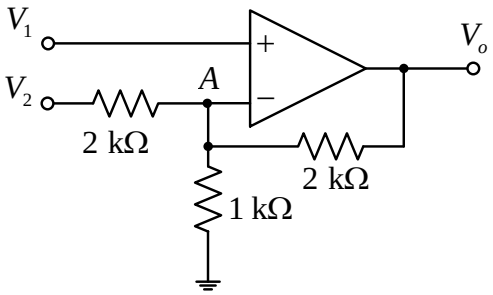


Fig. 3

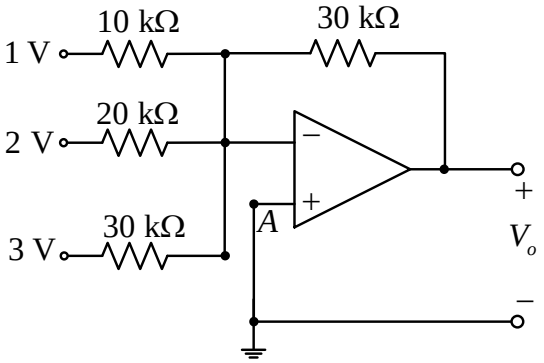


Fig. 4

5. Find the Thévenin equivalent circuit (V_{th} and R_{th}) at the terminals *a* and *b* of the circuit shown in **Fig. 5**. (20 %)
6. Find the value of R_L in **Fig. 6** for maximum power transfer, and the maximum power that can be delivered to R_L. (30 %)

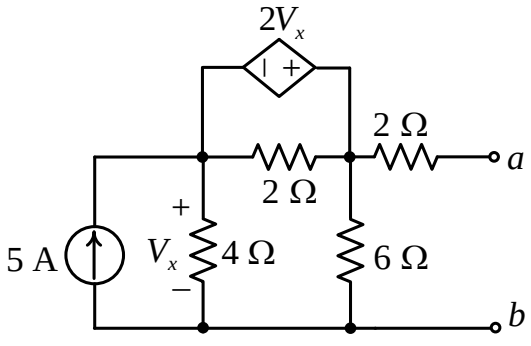


Fig. 5

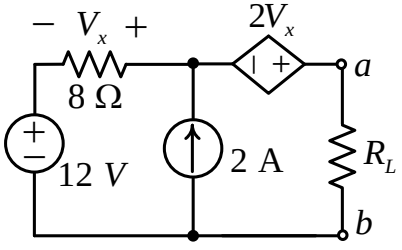
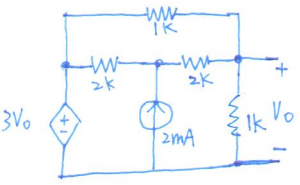


Fig. 6

1.



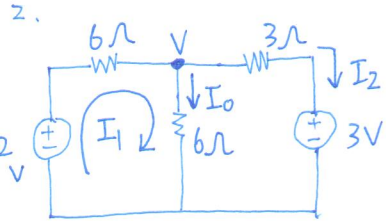
$$\frac{3V_0 - V_1}{2} + 2 = \frac{V_1 - V_0}{2} \quad \cdots ① $$

$$\frac{3V_0 - V_0}{1} + \frac{V_1 - V_0}{2} = \frac{V_0}{1} \quad \cdots ②$$

① + ② $\Rightarrow$ $3V_0 = -2$

$V_0 = -0.67\ V$ ※

2.



$$\frac{V-12}{6} + \frac{V}{6} + \frac{V-3}{3} = 0$$

$V - 12 + V + 2V - 6 = 0$

$4V = 18$

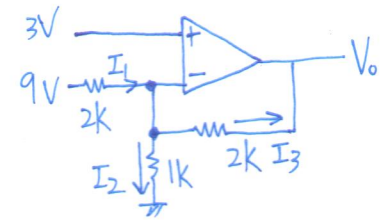
$V = 4.5$

$I_0 = \frac{4.5}{6} = 0.75\ A$

$I_2 = \frac{4.5-3}{3} = 0.5\ A$

$I_1 = I_0 + I_2 = 1.25\ A$

3.



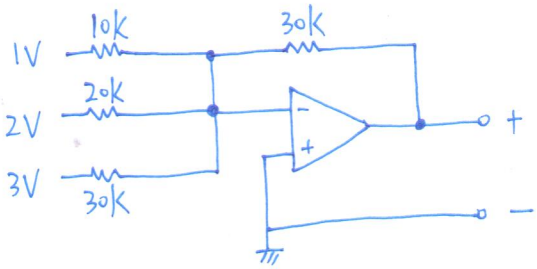
$I_1 = \frac{9-3}{2} = 3mA$

$I_2 = \frac{3}{1} = 3mA$

$I_3 + I_2 = I_1 \Rightarrow I_3 = 0mA$

$V_0 = -I_3 \cdot 2 + I_2 \times 1 = \underline{3V}$

4.



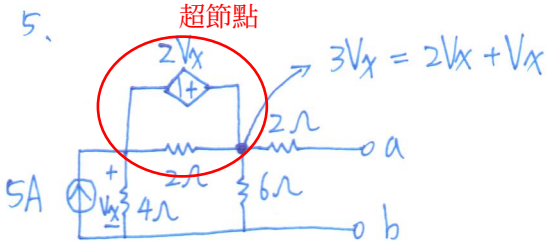
$$V_0 = -\left(\frac{30}{10} \times 1 + \frac{30}{20} \times 2 + \frac{30}{30} \times 3\right)$$

$= -(3+3+3)$

$= \underline{-9\ V}$

5.

超節點



$$5 + \frac{-V_x}{4} + \frac{-2V_x}{2} + \frac{2V_x}{2} + \frac{-3V_x}{6} = 0$$

$V_x = \frac{20}{3}$

$\underline{V_{th} = 3V_x = 20\ V}$

Rth:

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

$-V_x = \frac{V_x}{4} - V_x - 5 + \frac{V_x}{2} + \frac{3V_x}{2}$

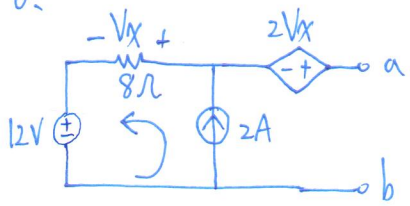
$V_x = \frac{20}{9}$

$I = 3 \times \frac{20}{9} \times \frac{1}{2} = \frac{10}{3}\ A = I_{th}$

$R_{th} = \frac{V_{th}}{I_{th}}$

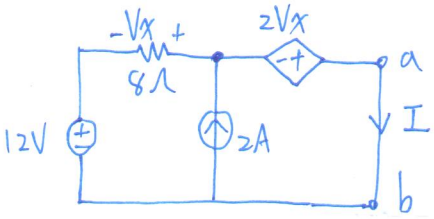
$= \frac{20}{\frac{10}{3}} = \underline{6\Omega}$

6.



$V_x = 16\ V$

$V_{ab} = 3V_x + 12 = 48 + 12 = 60\ V = V_{th}$



$V_x = -2V_x - 12$, $V_x = -4$

$2 + \frac{12 + 2V_x}{8} = I$, $\Rightarrow I = 2 + 0.5 = 2.5\ A = I_{th}$

$R_{th} = \frac{V_{th}}{I_{th}} = \frac{60}{2.5} = 24\ \Omega$

$P_{max} = \frac{V_{th}^2}{4 \times R_{th}} = \frac{60 \times 60}{4 \times 24} = \underline{37.5\ W}$