台灣科技大學一百零六學年度上學期平時考（一）

科目名稱：電路學(一)　開課系所：電子系 ET2103301　地點：國際大樓 IB501

考試時間：107 年 10 月 18 日 下午 13:20 至 15:10 (不可使用工程計算機)

1. (10%) Please find R_{AB} in Fig. 2. (4Ω)

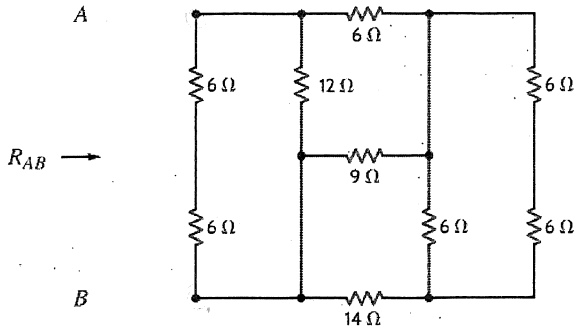
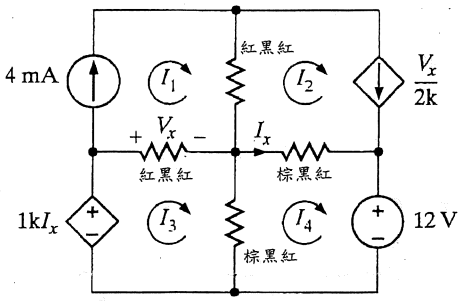


Fig. 1.

2. (15%) Please determine the currents of I_1, I_2, I_3 and I_4 in the following circuit.



$I_1 = 4mA$

$I_2 = -6mA$

$I_3 = -2mA$

$I_4 = -10mA$

$V_x = -12V$

$I_x = -4mA$

Fig. 2.

3. (20%) Please find V_o in Fig. 3.

$V_o = \frac{-24}{7}$ V

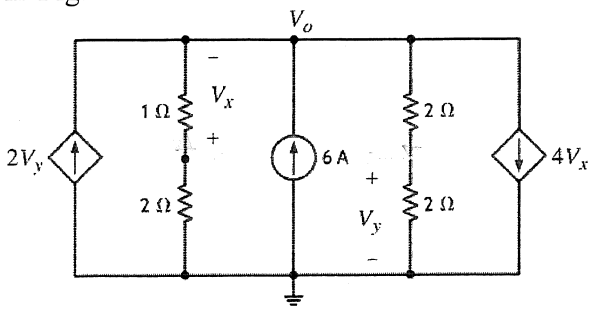


Fig. 3.

4. (20%) Using loop analysis, please find I_o in Fig. 4.

$I_o = -2.88mA$

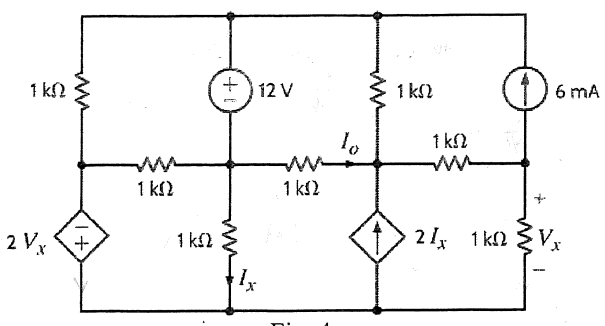


Fig. 4.

5. (15%) Please determine V_o in Fig. 5. $V_o = 10V$

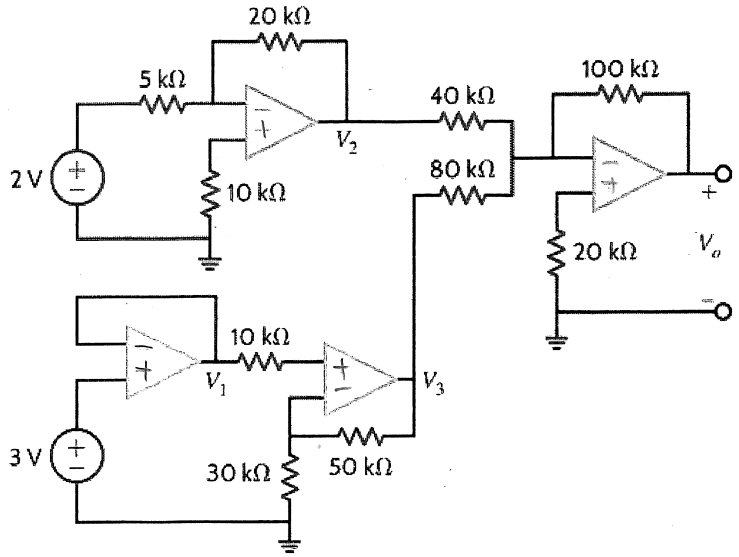


Fig. 5.

6. (20%) (a) Please find V_o in terms of V_1 and V_2 in Fig. 6. (5%) (b) If $V_1 = V_2 = 4$V, please find V_o. (5%) (c) If the op-amp power supplies are ±15V and $V_2 = 2$V, what is the allowable range of V_1 without saturation region? (10%)

(a) $V_o = -2V_1 + \frac{7}{2}V_2$

(b) $V_o = 6V$

(c) $-4V \le V_1 \le 11V$

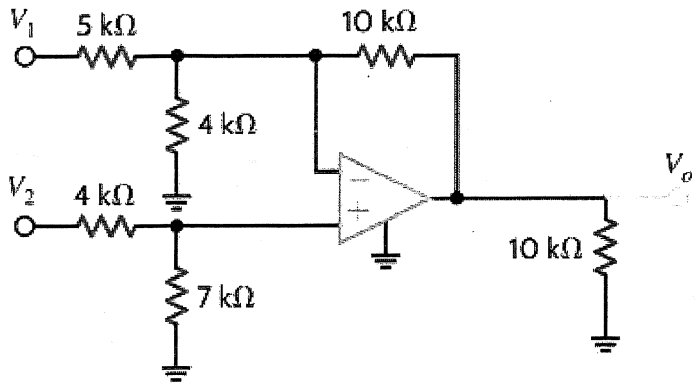


Fig. 6.

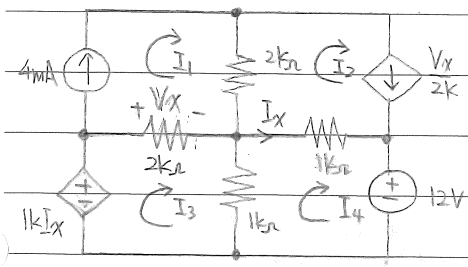
電路學(一) 平時考(一)

NO.

DATE / /

1. $R_{AB} = 4\Omega$

2.



find I_1、I_2、I_3 and I_4

$I_1 = 4mA$, $I_2 = \frac{V_x}{2k}$, $\frac{V_x}{2k} = I_3 - I_1 \Rightarrow V_x = 2kI_3 - 8$, $I_x = I_4 - I_2 = I_4 - \frac{V_x}{2k}$

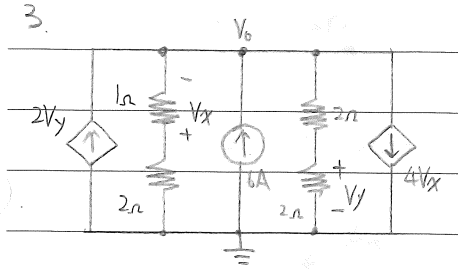
$$\begin{cases} 1kI_x = V_x + 1k(I_3 - I_4) \\ -12 = -1kI_x + 1k(I_4 - I_3) \end{cases} \Rightarrow \begin{cases} I_4 - I_3 + 4m = 2I_3 - 8m + I_3 - I_4 & = I_4 - (I_3 - 4m) \\ -12m = -I_4 - I_3 + 4m + I_4 - I_3 & = I_4 - I_3 + 4m \end{cases}$$

$$\Rightarrow \begin{cases} 4I_3 - 2I_4 = 12m \\ 2I_3 - 2I_4 = 16m \\ (4I_3 - 4I_4 = 32m) \end{cases} \Rightarrow I_4 = -10mA \text{ , } I_3 = -2mA \text{ , } I_1 = 4mA \text{ , } I_2 = -6mA$$

$V_x = -12V$, $I_x = -4mA$

#

3.



find V_o

$2V_y + 6 - 4V_x = \frac{V_o}{3} + \frac{V_o}{4}$

$12(2V_y + 6 - 4V_x) = 7V_o \Rightarrow 12(V_o + 6 + \frac{4V_o}{3}) = 7V_o$

$\Rightarrow 21V_o = -72 \Rightarrow V_o = -\frac{24}{7}V$

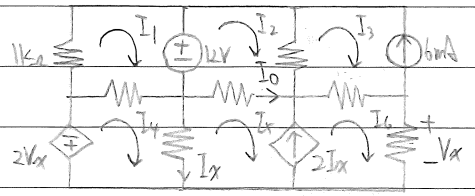
$\frac{V_o}{3} \times 1 = -V_x$, $\frac{V_o}{4} \times 2 = V_y$

#

NO.

DATE / /

4.



$I_3 = -6$, $2I_x = I_6 - I_5$, $V_x = I_6$, $I_x = I_4 - I_5$

$12 = -2I_1 + I_4 \Rightarrow 2I_1 = I_4 - 12$ $\quad I_6 = 2I_4 - I_5$

$12 = 2I_2 - I_3 - I_5 \Rightarrow 12 = 2I_2 + 6 - I_5 \Rightarrow 2I_2 - I_5 = 6$

$-2V_x = 2I_4 - I_1 - I_5 \Rightarrow 2I_4 - I_1 - I_5 + 2I_6 = 0 \Rightarrow 6I_4 - I_1 - 3I_5 = 0$ (12) (2) (-6)

$-V_x = 2I_5 + I_6 - I_4 - I_2 - I_3 \Rightarrow 2I_5 + 2I_6 - I_4 - I_2 = -6 \Rightarrow 11I_4 - 6I_5 = -12$

$\Rightarrow 3I_4 - I_2 = -6$

$$\begin{cases} 2I_2 - I_5 = 6 \\ 11I_4 - 6I_5 = -12 \\ -I_2 + 3I_4 = -6 \end{cases} \qquad \Delta = \begin{vmatrix} 2 & 0 & -1 \\ 0 & 11 & -6 \\ -1 & 3 & 0 \end{vmatrix} = -(11 - 36) = 25$$

$$\Delta I_2 = \begin{vmatrix} 6 & 0 & -1 \\ -12 & 11 & -6 \\ -6 & 3 & 0 \end{vmatrix} = (36) - (66 - 108) = 78$$

$I_2 = \frac{78}{25} = 3.12\text{mA}$ $\quad \Delta I_4 = \begin{vmatrix} 2 & 6 & -1 \\ 0 & -12 & -6 \\ -1 & -6 & 0 \end{vmatrix} = (36) - (-12 + 72) = -24$

$I_4 = \frac{-24}{25} = 0.96\text{mA}$

$I_5 = \frac{6}{25} = 0.24\text{mA}$ $\quad \Delta I_5 = \begin{vmatrix} 2 & 0 & 6 \\ 0 & 11 & -12 \\ -1 & 3 & -6 \end{vmatrix} = (-132) - (-66 - 72) = 6$

$I_0 = I_5 - I_2 = 0.24\text{m} - 3.12\text{m} = -2.88\text{mA}$ ※

5. $V_1 = 3V$, $V_2 = 2 \times (-\frac{20k}{5k}) = -8V$, $V_3 = 3 \times (1 + \frac{30k}{30k}) = 8V$

$V_{th} = (\frac{-8}{40k} + \frac{8}{80k})(80k // 40k) = \frac{-8}{80k} \times \frac{80k}{3} = \frac{-8}{3}V$

$R_{th} = 40k // 80k = \frac{80}{3}k$, $V_0 = \frac{-8}{3} \times (-\frac{100k}{\frac{80}{3}k}) = 10V$ ※

6. (a) $V_0 = -2V_1 + \frac{7}{2}V_2$ (b) $V_0 = 6V$ (c) $-4V \le V_1 \le 11V$ ※