國立臺灣科技大學答案卷

National Taiwan University of Science and Technology Answer Sheet

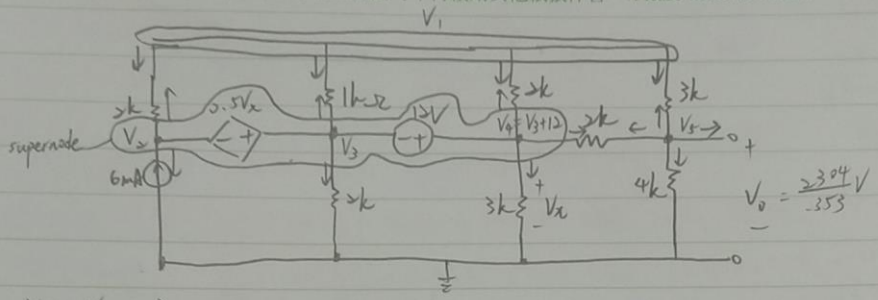
評分 Score	教師簽章 Signature of Lecturer
92	

姓名/Name _____ 學號/Student ID _____ 班級/Class _____

科目/Course title 電路學 日期/Date 111.10.17

記分欄 1. 20

從此處開始寫起。試卷用紙務須節用，非經主試認可不得續用其他紙張作答。/Please write from here.



$V_0 = \frac{2304}{353} V$

$V_0 = V_5 = ?$

@ V_1: $\frac{V_1-V_2}{2k} + \frac{V_1-V_5}{1k} + \frac{V_1-(V_3+12)}{2k} + \frac{V_1-V_5}{3k} = 0 \xrightarrow{\times 6k} (3V_1-3V_2)+(6V_1-6V_3)+(3V_1-3V_3-36)+(2V_1-2V_5)=0 \Rightarrow 14V_1-3V_2-9V_3-2V_5=36$

supernode: $\frac{V_2-V_1}{2k} - 6m + \frac{V_3-V_1}{1k} + \frac{V_3}{2k} + \frac{V_3+12-V_1}{2k} + \frac{V_3+12}{3k} + \frac{V_3+12-V_5}{2k} = 0 \xrightarrow{\times 6k} (3V_2-3V_1)+(6V_3-6V_1)+(3V_3)+(3V_3+36-3V_1)+(2V_3+24)+(3V_3+36-3V_5)$

@ V_5: $\frac{V_5-V_1}{3k} + \frac{V_5-V_3-12}{2k} + \frac{V_5}{4k} = 0 \xrightarrow{\times 12k} (4V_5-4V_1)+(6V_5-6V_3-72)+3V_5=0$

$\Rightarrow -12V_1+3V_2+17V_3-3V_5=-60$ —(2)

$\Rightarrow -2V_1-3V_3+6.5V_5=36$ —(3)

$V_x = V_3+12 \Rightarrow V_3 = V_x-12$ —(4)

$V_2+0.5V_x = V_3 \Rightarrow V_2 = V_3-0.5V_x = V_x-12-0.5V_x = 0.5V_x-12$ —(5)

(4) 代 (1) (2) (3):

$14V_1-3V_2-9(V_x-12)-2V_5=36 \Rightarrow 14V_1-3V_2-9V_x+108-2V_5=36 \Rightarrow 14V_1-3V_2-9V_x-2V_5=-72$ —(6)

$-12V_1+3V_2+17(V_x-12)-3V_5=-60 \Rightarrow -12V_1+3V_2+17V_x-12\cdot17-3V_5=-12\cdot5 \Rightarrow -12V_1+3V_2+17V_x-3V_5=144$ —(7)

$-2V_1-3(V_x-12)+6.5V_5=36 \Rightarrow -2V_1-3V_x+36+6.5V_5=36 \Rightarrow -2V_1-3V_x+6.5V_5=0$ —(8)

(5) 代 (6) (7) (8):

$14V_1-3(0.5V_x-12)-9V_x-2V_5=-72 \Rightarrow 14V_1-1.5V_x+36-9V_x-2V_5=-72 \Rightarrow 14V_1-10.5V_x-2V_5=-108$ —(9)

$-12V_1+3(0.5V_x-12)+17V_x-3V_5=144 \Rightarrow -12V_1+1.5V_x-36+17V_x-3V_5=144 \Rightarrow -12V_1+18.5V_x-3V_5=180$ —(10)

by (8) (9) (10):

$\boxed{V_0 = V_5 = \frac{2304}{353} V}$ ✱

$V_1 = \frac{940}{353}$

$V_4 = \frac{392}{353} = \frac{2304}{353}$

$\frac{V_5-V_4}{2k} + \frac{V_1-V_5}{3k} + \frac{V_5}{4k} =$

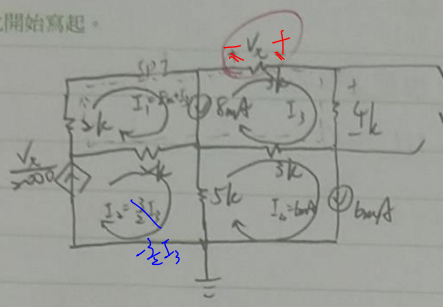
可轉頁再寫。

記分欄

轉頁從此開始寫起。

2.

17



$V_o = ? = -\frac{56}{11}V$

$V_o = I_3 \cdot 4k = ?$

$V_x = \cancel{3kI_3} \; -3kI_3$

$I_2 = \frac{V_x}{5k} = -\frac{3}{5} \cdot I_3$

$I_1 - I_3 = 8mA \Rightarrow I_1 = 8m + I_3$

super loop: $2k(8m+I_3) + 3kI_3 + 4kI_3 + 3k(I_3 - 6m) + 2k(8m + I_3 - \frac{(-\frac{3}{5}I_3)}{\frac{3}{5}+1}) = 0$

$\Rightarrow \cancel{16 + 2kI_3 + 3kI_3 + 4kI_3 + 3kI_3 - 18 + 16 + 2kI_3 - 3kI_3 = 0}$

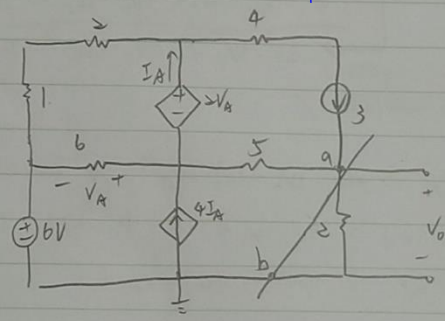
$16 + 2kI_3 + 3kI_3 + 4kI_3 + 3kI_3 - 18 + 16 + 2kI_3 + 3kI_3 = 0$

$\cancel{17}kI_3 = -14 \Rightarrow I_3 = -\frac{14}{17}mA$

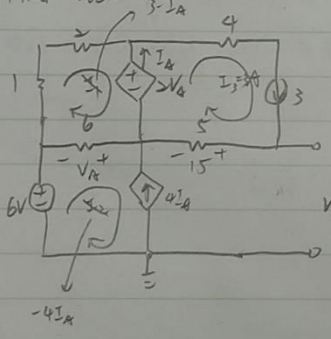
$\Rightarrow \boxed{V_o} = I_3 \cdot 4k = \boxed{-\frac{56}{17}V}$ #2 ✗

3.

18



step 1: Find V_{oc}:



$I_A = 3 - I_1 \Rightarrow I_1 = 3 - I_A$

$1(3-I_A) + 2(3-I_A) + 2V_A + V_A = 0$ — (1)

$V_A = 6 \times (I_1 - I_2) = 6(3 - I_A + 4I_A) = 18 + 18I_A$ — (2)

(2) 代 (1):

$3 - I_A + 6 - 2I_A + 54 + 54I_A = 0$

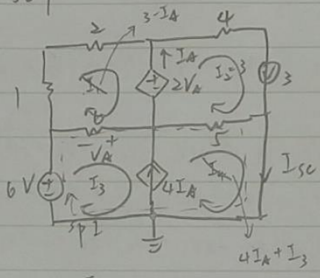
$\cancel{17}I_A = \frac{-21}{63} \Rightarrow I_A = -\frac{21}{17}A$

$\Rightarrow V_A = -\frac{72}{17}V$

可轉頁再寫。

$\Rightarrow \boxed{V_{oc}} = 6 + (-\frac{72}{17}) + 15 = \boxed{\frac{285}{17}V}$

step 2: Find I_{sc} =?



$I_{sc} = I_4 = ?$

$I_A = 3 - I_1 \Rightarrow I_1 = 3 - I_A$

$I_4 - I_3 = 4I_A \Rightarrow I_4 = 4I_A + I_3$

$V_A = 6(3 - I_A - I_3)$

loop 1: $1(3-I_A) + 2(3-I_A) + 2\cdot[6(3-I_A-I_3)] + 6(3-I_A-I_3) = 0$

$\Rightarrow 9 - 3I_A + 54 - 18I_A - 18I_3 = 0 \Rightarrow -21I_A - 18I_3 = -63$ — (1)

super loop 1: $-6 - 6(3-I_A-I_3) + 5(4I_A + I_3 - 3) = 0$

$\Rightarrow -6 - 18 + 6I_A + 6I_3 + 20I_A + 5I_3 - 15 = 0$

$\Rightarrow 26I_A + 11I_3 = 39$ — (2)

by (1) (2):

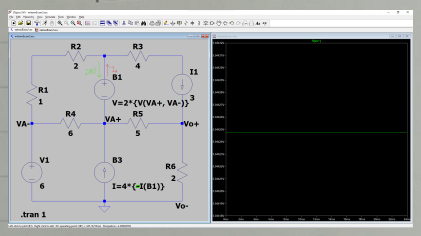
$I_A = \frac{3}{17}A \quad I_3 = \frac{273}{17}$

$\boxed{I_{sc}} = 4I_A + I_3 = \boxed{\frac{285}{17}}$ ✗

$\boxed{R_{th}} = \frac{V_{oc}}{I_{sc}} = \frac{\frac{285}{17}}{\frac{285}{17}} = \boxed{1\Omega}$

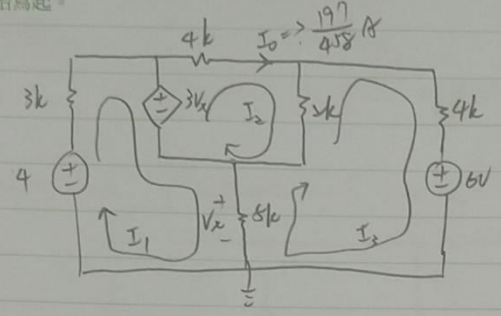
$\boxed{V_o} = \frac{285}{17} \times (\frac{2}{2 + \frac{285}{17}}) = \boxed{\frac{570}{109} \approx 5.04V}$

$\frac{570}{113}$ #3 ✗



記分欄 轉頁從此開始寫起。

4.



19

loop 1: $-4 + 3kI_1 + 3V_x + V_x = 0 \Rightarrow 3kI_1 + 4V_x = 4$ —(1)

loop 2: $-3V_x + 4kI_2 + 2k(I_2 - I_3) = 0 \Rightarrow 6kI_2 - 2kI_3 - 3V_x = 0$ —(2)

loop 3: $-V_x + 2k(I_3 - I_2) + 4kI_3 + 6 = 0 \Rightarrow -2kI_2 + 6kI_3 - V_x = -6$ —(3)

$V_x = 5k(I_1 - I_3) = 5kI_1 - 5kI_3$ —(4)

(4) 代入 (1) (2) (3):

$3kI_1 + 20kI_1 - 20kI_3 = 4 \Rightarrow 23kI_1 - 20kI_3 = 4$ —(5)

$6kI_2 - 2kI_3 - 15kI_1 + 15kI_3 = 0 \Rightarrow -15kI_1 + 6kI_2 + 13kI_3 = 0$ —(6)

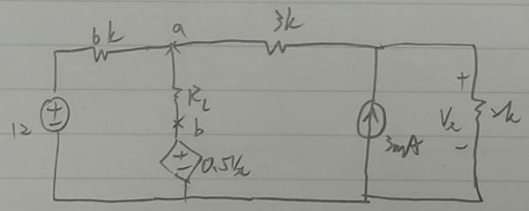
$-2kI_2 + 6kI_3 - 5kI_1 + 5kI_3 = -6 \Rightarrow -5kI_1 - 2kI_2 + 11kI_3 = -6$ —(7)

by (5) (6) (7):

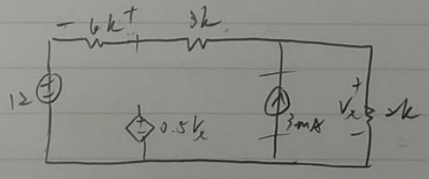
$I_0 = I_2 = \boxed{\frac{197}{458}}$ ~~A~~ mA ✓ #4.

mA.

5.



step 1: Find V_{oc}:



by superposition:

V_x { 12V Voltage source: $12 \times \frac{2}{6+3+2} = \frac{24}{11}$ V

3mA Current source: $3m \times \left(\frac{9}{9+2}\right) \times 2k = \frac{54}{11}$ V

$\Rightarrow V_x = \frac{78}{11}$ V

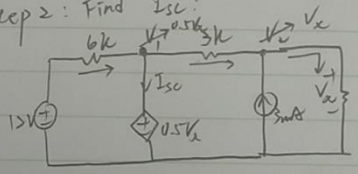
$V_{6k\Omega}$ { 12V Voltage source: $12 \times \frac{-6}{6+3+2} = \frac{-72}{11}$ V

3mA Current source: $3m \times \left(\frac{2}{9+2}\right) \times 6k = \frac{36}{11}$ V

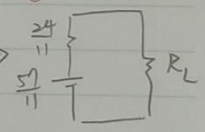
$\Rightarrow V_{6k\Omega} = -\frac{36}{11}$ V

$\boxed{V_{oc}} = 12 + V_{6k} - 0.5V_x = \boxed{\frac{57}{11}}$ V

step 2: Find I_{sc}:



$\Rightarrow$



18

$\frac{12 - 0.5V_x}{6k} = I_{sc} + \frac{0.5V_x - V_x}{3k}$ —(1)

$\frac{0.5V_x - V_x}{3k} + 3m = \frac{V_x}{2k} \Rightarrow V_x - 3V_x + 18 = 3V_x$

$\Rightarrow V_x = \frac{18}{4} = \frac{9}{2}$ V —(2)

(2) 代入 (1):

$12 - 0.5(\frac{9}{2}) = 6I_{sc} - \frac{9}{2}$

$\boxed{I_{sc} = \frac{19}{8}}$ A

$R_{th} = \frac{V_{oc}}{I_{sc}} = \frac{\frac{57}{11}}{\frac{19}{8}} = \frac{24}{11}$ kΩ ✓

kΩ.

#5-1

So:

When $\boxed{R_L = \frac{24}{11}\Omega}$, It has a maximum power dissipation $\left(\frac{57}{11} \times \frac{1}{2}\right)^2 \times \frac{24}{11} = \frac{1083}{352} \approx \boxed{3.08}$ mW ✓

#5-2

可轉頁再寫。