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
100	

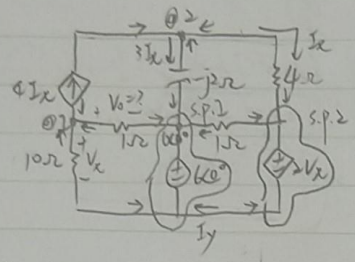
姓名/Name _____ 學號/Student ID _____ 班級/Class _____

科目/Course title 電路學 日期/Date 111.4.7

記分欄

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.

1.



By (7) (8):

$$V_x = \frac{\begin{vmatrix} 6 & 4 \\ -j3 & 3-j2 \end{vmatrix}}{\begin{vmatrix} 1.1 & 4 \\ -j & 3-j2 \end{vmatrix}} = \frac{6(3-j2)+j12}{1.1(3-j2)+j4} \doteq 4.204 - j2.293$$

$$\Rightarrow \boxed{V_o = V_x - 6 \doteq 2.913\angle -128.1° \text{ V}}$$ ✓

@1:

$$\frac{-V_x}{10} + \frac{6-V_x}{1} - 4I_x = 0$$

S.P.1: $\frac{V_x}{10} + \frac{V_x-6}{1} + 3I_x + \frac{2V_x-6}{1} + I_y = 0$ — (2)

S.P.2: $I_x + \frac{6-2V_x}{1} - I_y = 0$ — (3)

(1) $\Rightarrow -1.1V_x - 4I_x = -6$ — (4)

(2) $\Rightarrow 3.1V_x + 3I_x + I_y = 12$ — (5)

(3) $\Rightarrow -2V_x + I_x - I_y = -6$ — (6)

~~(5)+(6):~~

~~$1.1V_x + 4I_x = 6$ — (7)~~

$$I_x = \frac{\begin{vmatrix} 11 & 0 & -6 \\ -20 & 1 & 6 \\ 0 & -1 & 0 \end{vmatrix}}{\begin{vmatrix} 11 & 0 & -4 \\ -20 & 1 & -1 \\ 0 & -1 & 5+j6 \end{vmatrix}} = \frac{-6\cdot 20 - 6(-11) + 0}{-4(20) + 1(-11) + (5+j6)11} \doteq 0.7183\angle 61.37°$$

$$I_1 = \frac{\begin{vmatrix} -6 & 0 & -4 \\ 6 & 1 & -1 \\ 0 & -1 & 5+j6 \end{vmatrix}}{\begin{vmatrix} 11 & 0 & -4 \\ -20 & 1 & -1 \\ 0 & -1 & 5+j6 \end{vmatrix}} = \frac{-6(4+j6) - 6(-4) + 0}{11(5+j6-1) + 20(-4) + 0} \doteq 0.4789\angle 151.4°$$

~~$\Rightarrow V_o = I_1 - 4I_x \doteq 2.913\angle -128.1° \text{ V}$~~ #1

@2:

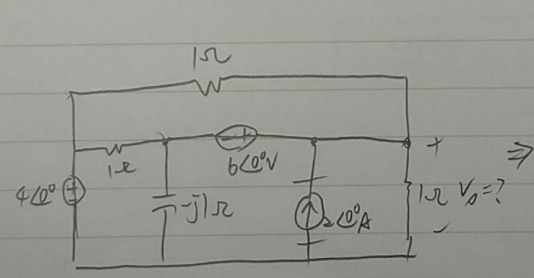
$$4I_x + \frac{6-V_2}{-j2} + \frac{2V_x - V_2}{4} = 0$$

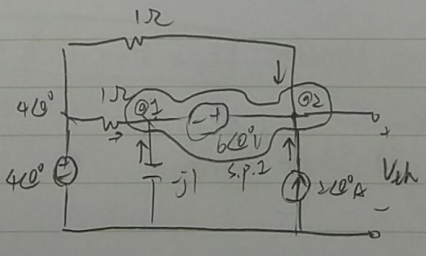
$$V_2 = 2V_x + 4I_x$$

$$\Rightarrow 4I_x + \frac{6-2V_x-4I_x}{-j2} + \frac{2V_x-2V_x-4I_x}{4} = 0$$

$$\Rightarrow -jV_x + (3-j2)I_x = -j3 \text{ — (5)}$$

2.

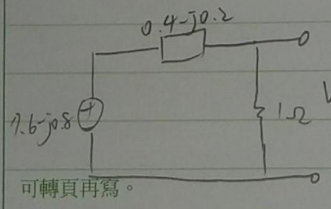




$$Z_{th} = \underbrace{(1 \,//\, -j1)}_{0.5-j0.5} //\, 1 = 0.4 - j0.2$$ ✓

S.P.2: $\frac{4-V_1}{1} + \frac{-V_1}{-j} + \frac{4-V_1-6}{1} + 2 = 0$

$(2-j)V_1 = -4 \Rightarrow V_1 = 1.6 - j0.8 \Rightarrow V_{th} = V_1 + 6 = 7.6 - j0.8$ ✓



$$V_o = (7.6 - j0.8) \cdot \frac{1}{1.4 - j0.2} \doteq 5.404\angle 2.121° \text{ V}$$ ✓

#2

可轉頁再寫。

記分欄　轉頁從此開始寫起。

3.

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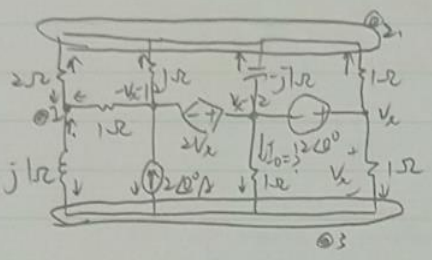

① 1: $\frac{V_2-V_1}{2}+\frac{-V_x-12-V_1}{1}+\frac{-V_1}{j1}=0$

$\Rightarrow (1.5+j)V_1+0.5V_2-V_x=12$ — (1)

① 2: $\frac{V_1-V_2}{2}+\frac{-V_x-12-V_2}{1}+\underbrace{\frac{V_x-12-V_2}{-j1}}_{j(V_x-12-V_2)}+\frac{V_x-V_2}{1}=0$

$\Rightarrow 0.5V_1+(-2.5-j)V_2+jV_x=12+j12$ — (2)

① 3: $\frac{V_1-\cancel{V_3}^{0}}{j1}-2+\frac{V_x-12-\cancel{V_3}^{0}}{1}+\frac{V_x-\cancel{V_3}^{0}}{1}=0$

$-jV_1+2V_x=14$ — (3)

By (1) (2) (3):

$$V_x=\frac{\begin{vmatrix}-1.5+j & 0.5 & 12\\ 0.5 & -2.5-j & 12+j12\\ -j & 0 & 14\end{vmatrix}}{\begin{vmatrix}-1.5+j & 0.5 & -1\\ 0.5 & -2.5-j & j\\ -j & 0 & 2\end{vmatrix}}$$

$1-j2.5$　$j0.5$　$4.75-j$

$$=\frac{12(-(-j)(-2.5-j))-(12+j12)(-1+j0.5)+14((-1.5+j)(-2.5-j)-0.25)}{-1(j(-2.5-j))-j(j0.5)+2(4.5-j)}\doteq 11.18\angle -35.05^\circ$$

$\Rightarrow$ $I_o=\frac{V_x-12}{1}\doteq \boxed{7.024\angle -113.7^\circ A}$ #3

4.

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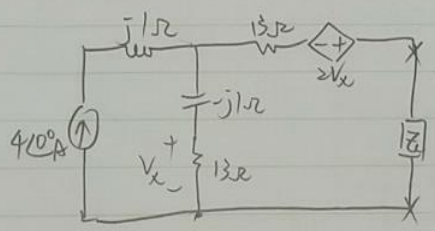

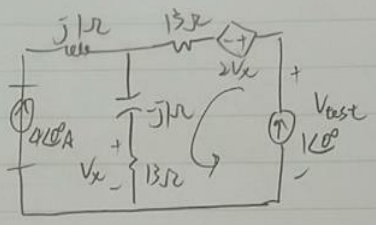

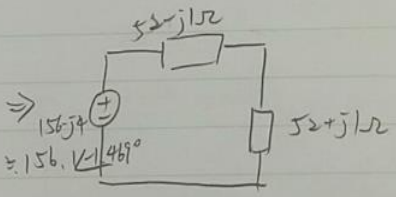

$\Rightarrow 156\angle 0^\circ \doteq 156.1\angle -1.46^\circ$

$V_{th}=4(13-j1)+2\cdot 4\cdot 13=156-j4$

$V_{test}=(13-j1+13)+2\cdot 13=52-j \Rightarrow Z_{th}=52-j1\Omega$

For the maximum power transfer, $\boxed{Z_L=52+j1\Omega\doteq 52.01\angle 1.102^\circ\Omega}$ #4(1)

$\boxed{P_{max}=\left(\frac{\frac{156.1}{\sqrt{2}}}{2}\right)^2\cdot\frac{1}{52}\doteq 58.58\,W}$ #4(2)

記分欄 轉頁從此開始寫起。

5.

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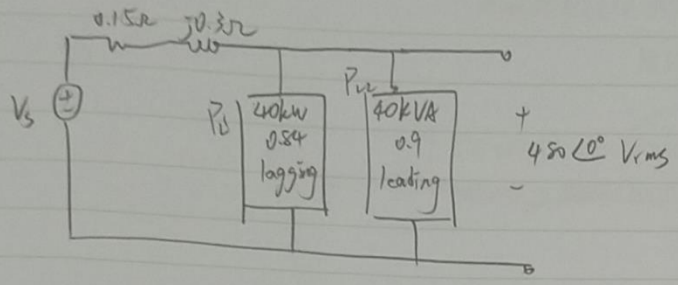

$P_{L1} = 450 \cdot I_{rms_1} \cdot \cancel{\cos\theta}^{0.84} = 40k \Rightarrow I_{rms_1} \doteq 99.21\angle -\cos^{-1}(0.84) \doteq 99.21\angle -32.86°$

$P_{L2} = 450 \cdot I_{rms_2} \cdot \cancel{0.9} = 40k \cdot \cancel{0.9} \Rightarrow I_{rms_2} \doteq 83.33\angle \cos^{-1}(0.9) \doteq 83.33\angle -25.84°$

$\Rightarrow I_{rms_1} + I_{rms_2} \doteq 159.3\angle -6.311°$

$\therefore V_s = 480\angle 0° + (0.15+j0.3)(I_{rms_1} + I_{rms_2}) \doteq 511.0\angle 5.038°$ Vrms

$\boxed{pf} = \cos(\theta_v - \theta_i) = \cos(5.038 - (-6.311)) \doteq \boxed{0.9804, \text{ lagging}}$ #5

$\boxed{v_s(t)} \doteq 511\sqrt{2}\cos(120\pi t + 5.038°)$

$\doteq \boxed{722.7\cos(377.0t + 5.038°)\ V}$ #5

$\boxed{S} = V_{rms} I_{rms}^* \doteq 79.81 + j16.02$ kVA $\doteq \boxed{81.40\angle 11.35° \text{ kVA}}$ #5