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

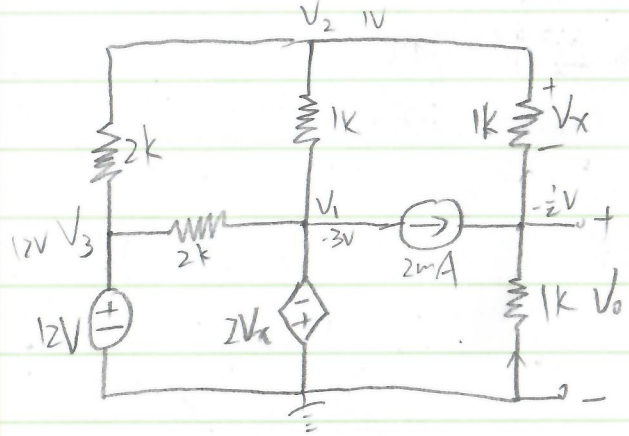
姓名/Name＿＿＿＿＿＿＿＿ 學號/Student ID＿＿＿＿＿＿＿＿ 班級/Class＿＿＿＿＿＿＿＿

科目/Course title＿＿＿＿＿＿＿＿ 日期/Date＿＿＿＿＿＿＿＿

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.



$V_2 - V_0 = V_x$, $V_1 = 2V_x$, $V_3 = 12$

$2V_0 - V_1 - 2V_2 = 0$ ①'

$\frac{V_2 - V_0}{1K} + 2m - \frac{V_0}{1K} = 0$

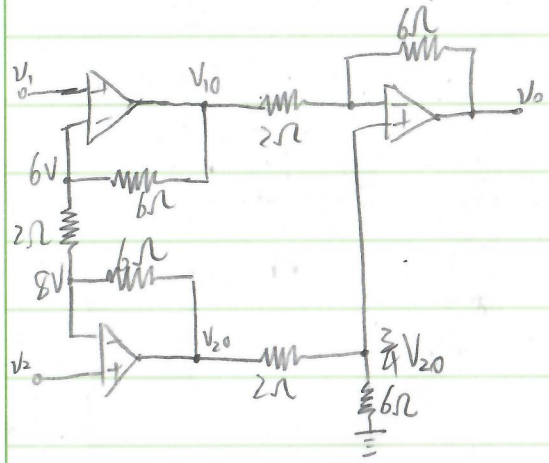
$2V_0 - V_2 = 2$ ②

$\frac{V_3 - V_2}{2K} + \frac{V_1 - V_2}{1K} + \frac{V_0 - V_2}{1K} = 0$

$V_0 + V_1 - \frac{5}{2}V_2 + 6 = 0$ ③

①,②③ $\Rightarrow V_0 = \frac{5}{2}V$ #, $V_1 = -1V$, $V_2 = 3V$

2.



$V_{10} = 6 + \frac{6-8}{2} \times 6 = 0V$

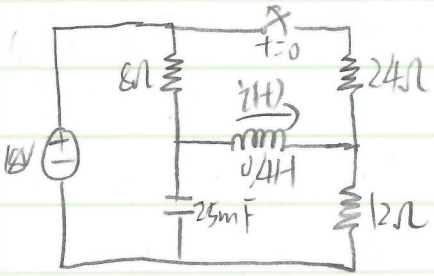
$V_{20} = 8 + \frac{8-6}{2} \times 6 = 14V$

$\frac{V_0 - \frac{2}{4}V_{20}}{6} = \frac{\frac{2}{4}V_{20} - V_{10}}{2}$

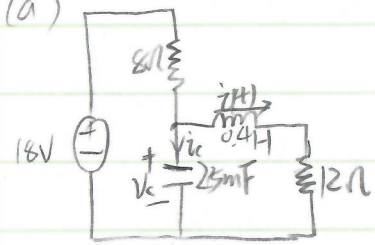
$\frac{V_0 - 10.5}{6} = \frac{10.5}{2}$

$V_0 = 42\ V$

3.



(a)



$i_c(t)=C\frac{dV_c(t)}{dt}=0.025\frac{dV_c(t)}{dt}$

$V_c(t)=L\frac{di(t)}{dt}+12i(t)=0.4\frac{di(t)}{dt}+12i(t)$

$i_c(t)=CL\frac{d^2i(t)}{dt^2}+12C\frac{di(t)}{dt}=0.01\frac{d^2i(t)}{dt^2}+0.3\frac{di(t)}{dt}$

$18=V_c(t)+8[i(t)+i_c(t)]$

$18=0.4\frac{di(t)}{dt}+12i(t)+8[0.01\frac{d^2i(t)}{dt^2}+0.3\frac{di(t)}{dt}+i(t)]$

$\Rightarrow 0.08\frac{d^2i(t)}{dt^2}+2.8\frac{di(t)}{dt}+20i(t)=18$

$\frac{d^2i(t)}{dt}+35\frac{di(t)}{dt}+250i(t)=225$

特徵方程：$s^2+35s+250=0$

$i_p(t)=\frac{225}{250}=0.9$

(b) $s^2+2\zeta\omega_n s+\omega_n^2=0$

$\omega_n=\sqrt{250}=5\sqrt{10}$

(c) $2\zeta\omega_n=35$, $\omega_n=5\sqrt{10}$

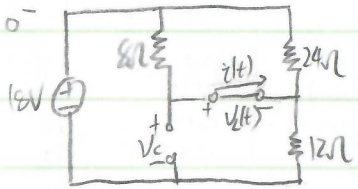
$\therefore \zeta=\frac{35}{10\sqrt{10}}=1.107$

$\zeta>1$, $\therefore$ 為過阻尼系統

(d) 由特徵方程：$s^2+35s+250=0$

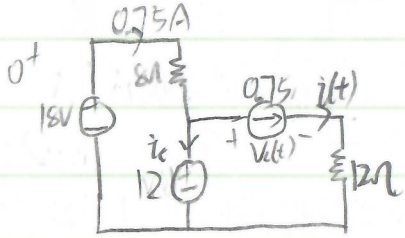
$s_1=-10$, $s_2=-25$

$i(t)=0.9+K_1e^{-10t}+K_2e^{-25t}$



$V_c(0_-)=18\times\frac{12}{12+8//24}=12V$

$i(0_-)=\frac{18-12}{8}=0.75A$



$V_L(0_+)=12-0.75\times12=3V$

$i(0_+)=i(0_-)=0.75A$

$i_c(0_+)=\frac{18-12}{8}-0.75=0A$

$i(0)=0.9+K_1e^{-10t}+K_2e^{-25t}|_{t=0}=0.75$

$\Rightarrow K_1+K_2=-0.15$ ①

$V_L(0_+)=L\frac{di(t)}{dt}|_{t=0}=-4K_1e^{-10t}-10K_2e^{-25t}=3$

$\Rightarrow 4K_1+10K_2=-3$ ②

①, ② $\Rightarrow K_1=0.25$, $K_2=-0.4$

$\therefore i(t)=0.9+0.25e^{-10t}-0.4e^{-25t}$

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

姓名/Name_____ 學號/Student ID_____ 班級/Class_____

科目/Course title_____ 日期/Date_____

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.

4.

$\dot{V}_2-\dot{V}_1=2\angle 0°$, $\dot{V}_5-\dot{V}_6=\dot{V}_x$, $\dot{V}_3=2\dot{V}_x$

$\Rightarrow -\dot{V}_3+2\dot{V}_5-2\dot{V}_6=0$ ①

$-\dot{V}_3-\dot{V}_5+(2+j1)\dot{V}_6=0$ ②

$-\dot{V}_1+2\dot{V}_4-\dot{V}_5=2\dot{V}_x$, $\dot{V}_x=\dot{V}_4-\dot{V}_5$

$\Rightarrow -\dot{V}_1+\dot{V}_5=0$ ③

12回圈. $10\dot{V}_1-j\dot{V}_2+j\dot{V}_3-\dot{V}_4=-12\angle 0° \Rightarrow (10-j)\dot{V}_1+j\dot{V}_3-\dot{V}_4=-12+j12$ ④

$-\dot{V}_4+2\dot{V}_5-\dot{V}_6=12$ ⑤

③,④,⑤ $\Rightarrow j\dot{V}_2+(8-j)\dot{V}_3+\dot{V}_6=-24+j12$ ⑥

①,②,⑥ $\Rightarrow$

$$\begin{cases} -\dot{V}_3+2\dot{V}_5-2\dot{V}_6=0 \\ -\dot{V}_3-\dot{V}_5+(2+j1)\dot{V}_6=0 \\ j\dot{V}_2+(8-j)\dot{V}_3+\dot{V}_6=-24+j12 \end{cases}$$

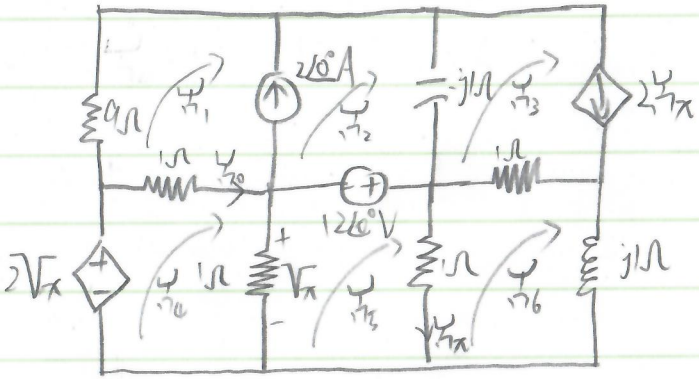
$\dot{V}_3=-1.704-j0.992$, $\dot{V}_5=-2.875+j0.038$

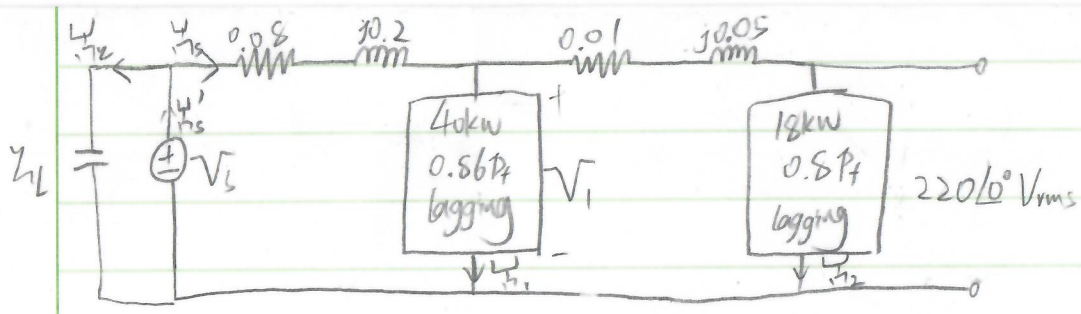
$\dot{V}_6=-2.023+j0.534$

$\dot{V}_1=\dot{V}_5=-2.875+j0.038$

$\dot{V}_4=2\dot{V}_5-\dot{V}_6-12=-15.727-j0.458$

$\dot{V}_0=\dot{V}_4-\dot{V}_1=-12.852-j0.496$ #





(a) $\cos(\theta_{2V}-\theta_{2i})=0.8$

lagging $\Rightarrow$ $\theta_{2i}=\theta_{2V}-36.87°$

$=-36.87°$

$I_{2rms}=\frac{18k}{220\times 0.8}=102.273$ A_{rms}

$\underline{I}_2=102.273\angle -36.87°$ A_{rms}

$\underline{V}_1=(0.01+j0.03)\times 102.273\angle -36.87°+220\angle 0°$

$=223.886+j3.477=223.913\angle 0.89°$

$I_{1rms}=\frac{40000}{223.913\times 0.86}=207.722$

$\cos(\theta_{1V}-\theta_{1i})=0.86$

lagging $\Rightarrow$ $\theta_{1i}=\theta_{1V}-30.683°$

$=-29.793°$

$\underline{I}_1=207.722\angle -29.793°$

$\underline{V}_s=223.913\angle 0.714°+(0.08+j0.2)\times(207.722\angle -29.793°+102.273\angle -36.87°)$

$=277.777+j42.041=280.94\angle 8.606°$ #

(b) $\underline{I}_s=102.273\angle -36.87°+207.722\angle -29.793=262.085-j164.574$

$=309.473\angle -32.126°$

$P_f=\cos(8.606°+32.126°)=0.76$ #

(c) $S=\underline{V}_s\underline{I}_s^*=86942\angle 40.732°=65882+j56731$ V·A #

(d) $\theta_v-\theta_i=\cos^{-1}(0.97)=14.07°$

$S'=65882+j65682\tan 14.07°$

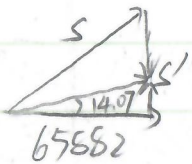
$=65682+j16512$

$S_c=S'-S=+j40219$

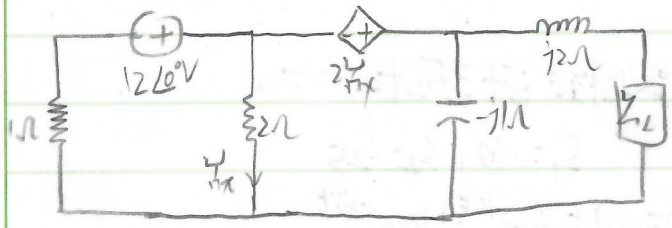
$\underline{I}_c^*=\frac{S_c}{\underline{V}_s}=143.16\angle -98.606°$

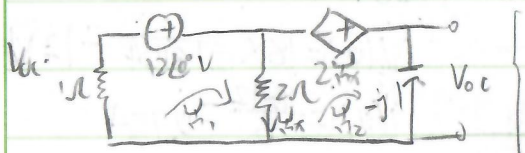
$Z_c=\frac{\underline{V}_s}{\underline{I}_s}=\frac{280.94\angle 8.606°}{143.16\angle 98.606°}=j1.96$

$C=\frac{1}{\omega Z_c}=\frac{1}{50\times 2\times 70\times 1.96}=1.62$ mF #



5.





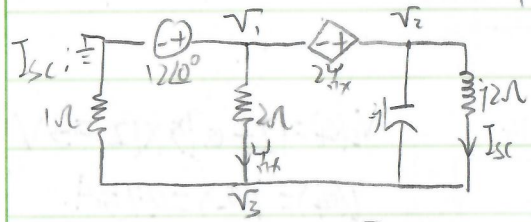
$3I_1-2I_2=12\angle 0°$

$-2I_1+(2-j1)I_2=2V_x$

$V_x=I_1-I_2$

$I_2=\frac{48}{4-j3}=7.68+j5.76$

$\Rightarrow V_{oc}=-jI_2=5.76-j7.68$

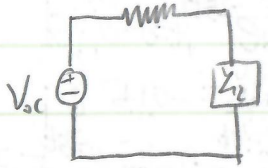


$V_1=12$, $V_x=\frac{V_1-V_3}{2}\Rightarrow V_2=V_1+2V_x=24-V_3$ ①

KVL@V_3, $-V_3+\frac{12-V_3}{2}+\frac{V_2-V_3}{(-j1)//(j2)}=0\Rightarrow V_2=(1-3j)V_3+j12$ ②

①②$\Rightarrow V_3=\frac{84}{13}+j\frac{48}{13}$, $V_2=\frac{228}{13}-j\frac{48}{13}$, $I_{sc}=\frac{V_2-V_3}{j2}=-\frac{48}{13}-j\frac{72}{13}$

$Z_{th}=\frac{V_{oc}}{I_{sc}}=0.48+j1.36=1.442\angle 70.56°$



(a) $Z_L=0.48-j1.36=1.442\angle -70.56°$ (b) $Z_L=1.442$

$I_L=\frac{V_{oc}}{Z_L+Z_{th}}=6-j8=10\angle -53.13°$ $I_L=\frac{V_{oc}}{Z_L+Z_{th}}=0.113-j4.076=4.078\angle -88.412°$

$P_{av}=\frac{1}{2}\times(10)^2\times 1.442\times\cos(70.56°)=24W$ $P_{av}=\frac{1}{2}\times(4.078)^2\times 1.442=11.99\ W$