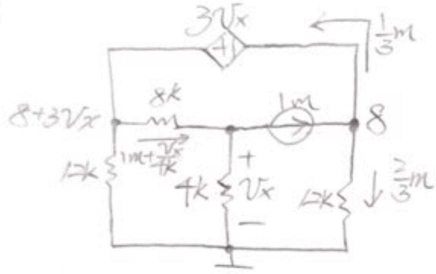
1.

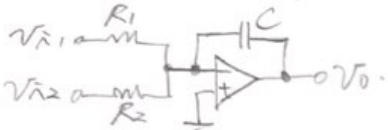


$\frac{1}{3}m = 1m + \frac{V_x}{4k} + \frac{8+3V_x}{12k} \Rightarrow V_x = -\frac{8}{3}$

$\therefore P_{3V_x} = -8 \times \frac{1}{3}m = \frac{-8}{3}m$

$\therefore P_{3V_x}$ absorbs $\frac{8}{3}m\,(\omega)$ #

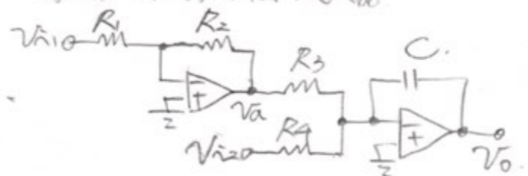
2. (a) ∵ ① V_o 為 V_i 之積分



∵ ② V_{i1} & V_{i2} 非同号

⇒ 多加 OPA 反相放大器

∴



$\Rightarrow V_o = -\frac{1}{C}\int\left(\frac{V_{i2}}{R_4} + \frac{V_a}{R_3}\right)dt$

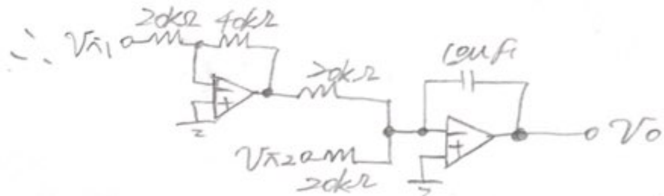
$= \frac{1}{C}\int\left(\frac{R_2}{R_1R_3}V_{i1} - \frac{1}{R_4}V_{i2}\right)dt$

$\frac{1}{R_4C} = 5,\ \frac{R_2}{R_1R_3C} = 10$

取 $C = 10\mu(F)$, $R_4 = 20k(\Omega)$

$R_1 = R_3 = 20k(\Omega)$, $R_2 = 40k(\Omega)$

∴

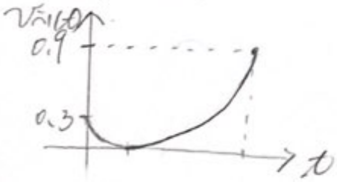


#

(b) $10V_{i1}(t) - 5V_{i2}(t) = V_o'(t) = 3t^2 - 6t + 6 + 0.5\pi\sin(0.5\pi t)$

$= 3(t-1)^2 + [3 + 0.5\pi\sin(0.5\pi t)]$

$\Rightarrow \begin{cases} V_{i1}(t) = 0.3(t-1)^2 \\ V_{i2}(t) = -0.6 - 0.1\sin(0.5\pi t) \end{cases}$



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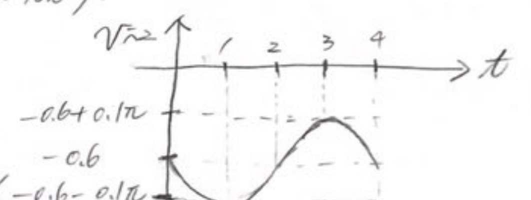
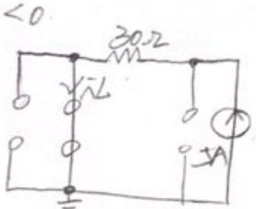


#

3.

(a) ⇒ 串聯 RLC 2nd ODE

$t<0$



$i_L(0^-) = i_L(0^+) = 5\,(A)$

$\therefore i_{30\Omega}(0^+) = 0\,(A)$

$\therefore V_L(0^+) = V_C(0^+) = V_C(0^-)$

$= L\frac{di_L}{dt}\Big|_{t=0} = 150\,(V)$

$\alpha = \frac{R}{2L} = 5,\ \omega_0 = \frac{1}{\sqrt{LC}} = 3$

$S = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2} = -1$ or -9

$i_L(\infty) = 10\,(A)$

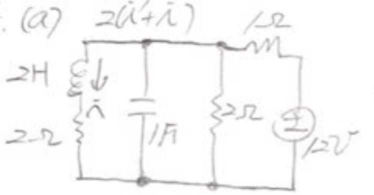
$\therefore i_L(t) = i_{Ls} + i_{Lh},\ i_{Ls} = 10,\ i_{Lh} = Ae^{-t} + Be^{-9t}$

$\Rightarrow \begin{cases} i_L(0^+) = 5 = 10 + A + B \\ i_L'(0^+) = 150 \Rightarrow (-A - 9B) \end{cases} \Rightarrow \begin{cases} A = \frac{5}{8} \\ B = \frac{-45}{8} \end{cases} \Rightarrow i_L(t) = 10 + \frac{5}{8}e^{-t} - \frac{45}{8}e^{-9t}\,(A)$ #

(b) 令 $\frac{di_L(t)}{dt}=0 \Rightarrow -\frac{5}{8}e^{-t}+\frac{405}{8}e^{-9t}=0 \Rightarrow e^{8t}=81 \Rightarrow t=\frac{\ln 81}{8}=0.549(s)$

$\therefore i_L(t)_{max}=10+\frac{5}{8}e^{-0.549}-\frac{45}{8}e^{-9\cdot 0.549}=10.32\ (A)$ ✻

4. (a)



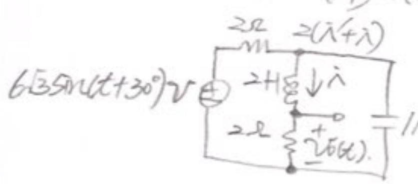
$i'=\frac{di}{dt}$

$\Rightarrow 12-2(i'+i)=\frac{2(i'+i)}{2}+1\cdot[2(i'+i)]'+i$

$\Rightarrow 2i''+5i'+4i=12$

$\therefore$ Characteristic eq: $s^2+2.5s+2=0$ ✻, $\omega_0=\sqrt{2}\ (rad/s)$ ✻

(b) $i(0^+)=i(0^-)=3(A)$; $v_C(0^+)=v_C(0^-)=6(V)$.



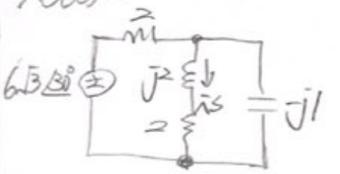
$v_o(t)=2i$

$\frac{6\sqrt{3}\sin(t+30°)-2(i'+i)}{2}=i+1\cdot[2(i'+i)]'$

$\Rightarrow 2i''+3i'+2i=3\sqrt{3}\sin(t+30°)$

$\Rightarrow i(t)=i_s(t)+i_h(t)$

$i_s(t)$:



$i_s=\sqrt{3}\angle -60°$

$i_h(t)$:

$s=\frac{-3\pm\sqrt{3^2-4\cdot2\cdot2}}{2\cdot2}=\frac{-3\pm\sqrt{7}}{4}$

$\therefore i_h(t)=e^{-\frac{3}{4}t}[A\cos(\frac{\sqrt{7}}{4}t)+B\sin(\frac{\sqrt{7}}{4}t)]\ (A)$

$\therefore i_s(t)=\sqrt{3}\sin(t-60°)\ (A)$

$\Rightarrow \begin{cases} i(0^+)=3=-\frac{3}{2}+A \Rightarrow A=\frac{9}{2} \\ v_C(0^+)=6=2[i'(0^+)+i(0^+)] \end{cases}$

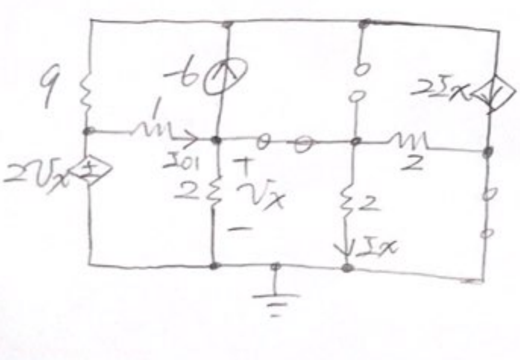
$=2\{\{\sqrt{3}\cos(t-60°)-\frac{3}{4}e^{-\frac{3}{4}t}[A\cos(\frac{\sqrt{7}}{4}t)+B\sin(\frac{\sqrt{7}}{4}t)]+e^{-\frac{3}{4}t}\{-\frac{\sqrt{7}}{4}A\sin(\frac{\sqrt{7}}{4}t)+\frac{\sqrt{7}}{4}B\cos(\frac{\sqrt{7}}{4}t)]\}\Big|_{t=0}+3\}$

$=2(\frac{\sqrt{3}}{2}-\frac{3}{4}A+\frac{\sqrt{7}}{4}B+3)$

$\Rightarrow A=\frac{9}{2}=4.5,\ B=\frac{-4\sqrt{21}+27\sqrt{7}}{14}=3.793$

$\therefore v_o(t)=2i(t)=2\sqrt{3}\sin(t-60°)+e^{-\frac{3}{4}t}[9\cos(\frac{\sqrt{7}}{4}t)+\frac{-4\sqrt{21}+27\sqrt{7}}{7}\sin(\frac{\sqrt{7}}{4}t)]\ (V)$ ✻

5. ① $-6\ (A)$



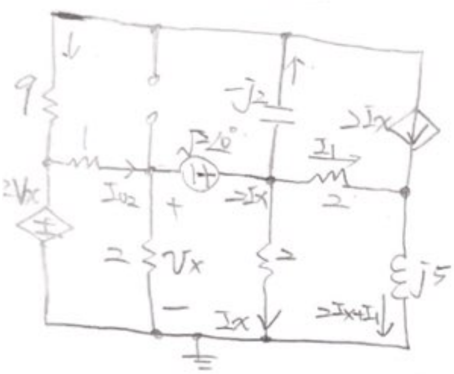
$V_x=2I_x,\ I_0=\frac{2V_x-V_x}{1}=V_x$

$I_{01}=-6+\frac{V_x}{2}+I_x+\frac{2I_x}{2}$

$\Rightarrow V_x=12$

$\therefore I_{01}=12\ (A)$

② [illegible] $\Rightarrow \sqrt{2}\angle 0^\circ$



$2I_x - V_x = \sqrt{2}\angle 0^\circ$, $I_{02} = V_x$

$2I_x - 2I_1 = j5(2I_x + I_1) \Rightarrow I_1 = \frac{2-j10}{2+j5} I_x$

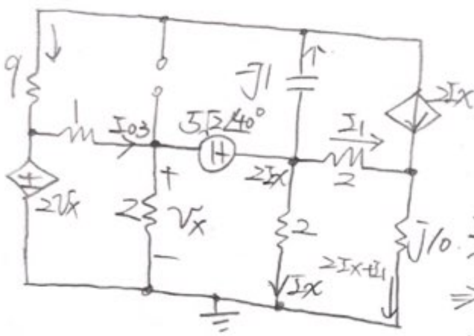
$\frac{V_x}{2} = I_x + I_1 + I_{-j2} \Rightarrow I_{-j2} = -\frac{\sqrt{2}}{2}\angle 0^\circ - I_1$

$I_9 = I_{-j2} - 2I_x$

$\Rightarrow 2V_x + 9I_9 = 2I_x - (-j2)I_{-j2} \Rightarrow I_x = 1.513\angle -95.531^\circ$

$\therefore I_{02} = V_x = 2I_x - \sqrt{2}\angle 0^\circ = 3.461\angle -119.528^\circ$ (A)

③ $5\sqrt{2}\cos(2t + 40^\circ) \Rightarrow 5\sqrt{2}\angle 40^\circ$



$2I_x - V_x = 5\sqrt{2}\angle 40^\circ$, $I_{03} = V_x$

$2I_x - 2I_1 = j10(2I_x + I_1) \Rightarrow I_1 = \frac{1-j10}{1+j5} I_x$

$\frac{V_x}{2} = I_x + I_1 + I_{-j1} \Rightarrow I_{-j1} = -\frac{5\sqrt{2}}{2}\angle 40^\circ - I_1$

$I_9 = I_{-j1} - 2I_x$

$\Rightarrow 2V_x + 9I_9 = 2I_x - (-j1)I_{-j1} \Rightarrow I_x = 12.637\angle -29.455^\circ$

$\therefore I_{03} = V_x = 2I_x - 5\sqrt{2}\angle 40^\circ = 27.734\angle -45.654^\circ$ (A)

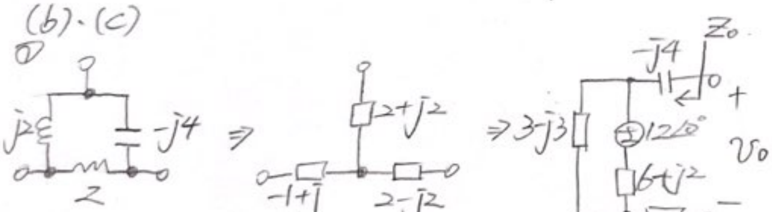
$\therefore P_{1\Omega} = I_{01}^2 \times 1 + \frac{1}{2} \times I_{02}^2 \times 1 + \frac{1}{2} I_{03}^2 \times 1 = 431.641$ (W) #

6. (a). $\because R - jX_C$ is line impedance ② No reactive power $\rightarrow X_C = X_L = 10 = 2\pi f \cdot 5$

$\therefore$ ① No loss $\rightarrow R = 0\,(\Omega)$ # $\Rightarrow 2\pi f = 2$ $\therefore \frac{1}{2\pi f C} = 10 \Rightarrow C = 0.05$ (F) #

(b).(c)

①

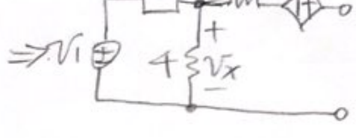


$Z_0 = -j4 + [(3-j3)//(6+j2)] + 2 - j2$

$= 8.497\angle -55.263^\circ\,(\Omega)$

$V_0 = \frac{12\angle 0^\circ}{3-j3+6+j2} \times (3-j3) = 5.62\angle -38.66^\circ$ (V)

$\Rightarrow Z_1 = Z_0 + j1 = 7.691\angle -51.568^\circ\,(\Omega)$, $V_1 = V_0 + 4 \times Z_0 = 39.394\angle -57.358^\circ$ (V)



$\pm V_{oc} = 3V_x$

$\frac{V_1 - V_x}{Z_1} = \frac{V_x}{4}$

$\Rightarrow V_x = 14.798\angle -18.902^\circ$

$\therefore V_{oc} = 44.393\angle -18.902^\circ$ (V)

外加 1V 求 Z_{th}

$\frac{1 - 2V_x - V_x}{4} = \frac{V_x}{4} + \frac{V_x}{Z_1}$

$\Rightarrow V_x = 0.237\angle -5.383^\circ$

$\therefore Z_{th} = 12.254 - j2.534\,(\Omega)$

(b) Choose $jX_L = j10\,(\Omega)$ $\therefore R_L = |12.254 + j(-2.534 + 10)| = 14.349\,(\Omega)$

$\therefore P_{L,max} = \frac{1}{2} \cdot \left|\frac{V_{oc}}{Z_{th} + 14.349 + j10}\right|^2 \times 14.349 = 18.52$ (W) #

(c) Choose $R_L = |Z_{th}| = 12.513\,(\Omega)$

$\therefore P_{Z_L,max} = \frac{1}{2} \cdot \left| \frac{V_{oc}}{Z_{th} + 12.513} \right|^2 \times 12.513 = 19.897\,(W)$ #

7. (a) $S_{4kw} = 4k + j1.937k\,(VA) \Rightarrow I_1 = \left(\frac{S_{4kw}}{220\angle 0^\circ}\right)^* = 20.202\angle -25.842^\circ\,(A_{rms})$

$V_1 + 220\angle 0^\circ = \frac{S_{2kw}}{I_1^*} + 220\angle 0^\circ = 71.390\angle 59.532^\circ + 220\angle 0^\circ = 267.484\angle 13.505^\circ\,(V_{rms})$

$I_2 = \left(\frac{S_{15kw}}{267.484\angle 13.505}\right)^* + I_1 = 85.736\angle 13.089^\circ\,(A_{rms})$

$V_2 = 267.484\angle 13.505 + (0.3 + j0.15) I_2 = 281.668\angle 8.818^\circ\,(V_{rms})$

$I_S = \left(\frac{S_{10kw}}{281.668\angle 8.818^\circ}\right)^* + I_2 = 115.995\angle 1.491^\circ\,(A_{rms})$

$V_S = V_2 + (0.02 + j0.8) I_S = 287.372\angle 19.924^\circ\,(V_{rms})$

$S = V_S I_S^* = 33.334k\angle 11.415^\circ\,(VA)$ # $P.F. = \cos(11.415) = 0.980$, lagging #

(b) $S = P + jQ = 32.675k + j6.597k\,(VA)$

$Q_{new} = 32.675k \tan[\cos^{-1}(0.99)] = 4.656k$

$|jQ_{new} - jQ| = 2\pi \cdot 60 \cdot C \cdot |V_S|^2 \Rightarrow C = 62.346\,\mu(F)$ #