台灣科技大學一百零六學年度上學期期中考

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：106 年 11 月 9 日　下午 13:20 至 15:10 (不可使用工程計算機)

1. (20%) Please find V_o in Fig. 1.

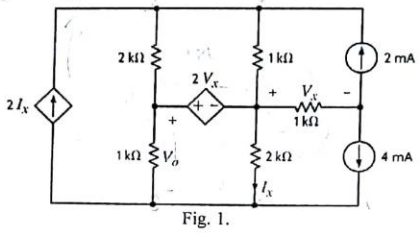


Fig. 1.

2. (15%) Please find V_o in Fig. 2.

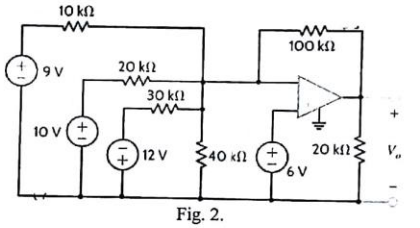


Fig. 2.

3. (15%) The current flowing through a 5μF capacitor is shown in Fig. 3. Please find the energy stored in the capacitor at t = 1.4ms, t = 3.3ms, t = 4.3ms, t = 6.7ms, and t = 8.5ms.

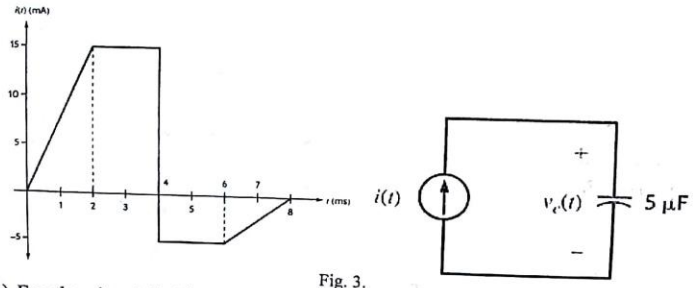


Fig. 3.

4. (15%) For the circuit in Fig. 4, $v_{s_1}(t)$ = 80cos324t V and $v_{s_2}(t)$ = 40cos324t V, please find $v_o(t)$.

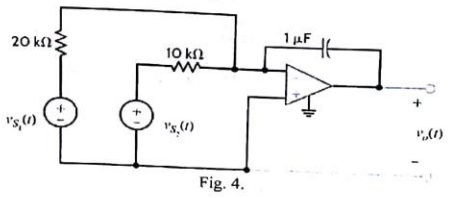


Fig. 4.

5. (20%) Please find R_L for maximum power transfer and the maximum power that can be transferred to the load R_L in Fig. 5.

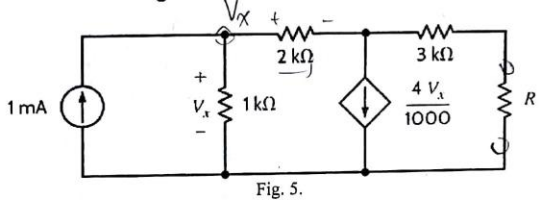


Fig. 5.

6. (15%) Please find V_o in Fig. 6 by using source transformation.

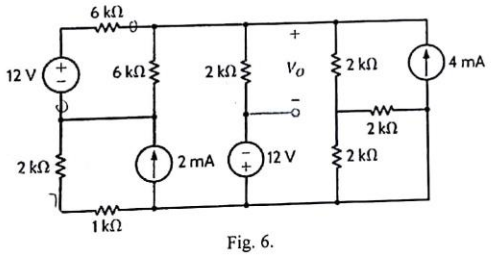
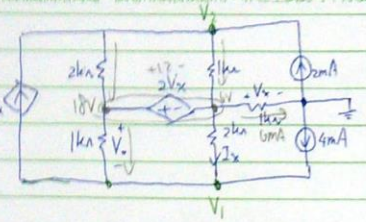


Fig. 6.

$V_2 = 18 - V_1$

1.



$V_x = 6m \times 1k = 6V$

$6 - V_1 = 2kI_x$ ——①

V_2 node:

$2mA + 2I_x = \frac{V_2-18}{2k} + \frac{V_2-6}{1k}$

$4 + 4kI_x = V_2 - 18 + 2V_2 - 12$

$3V_2 - 4kI_x = 34$ ——②

$2V_x$ node:

$\frac{V_2-18}{2k} + \frac{V_2-6}{1k} = 6mA + I_x + \frac{18-V_1}{1k}$

$V_2 - 18 + 2V_2 - 12 = 12 + 2kI_x + 36 - 2V_1$

$2V_1 + 3V_2 - 30 - 12 - 2kI_x - 36 = 0$

$2V_1 + 3V_2 - 2kI_x = 78$ ——③

+20

$V_1 \quad V_2 \quad I_x$

$\begin{cases} V_1 + 2kI_x = 6 \\ 3V_2 - 4kI_x = 34 \\ 2V_1 + 3V_2 - 2kI_x = 78 \end{cases}$

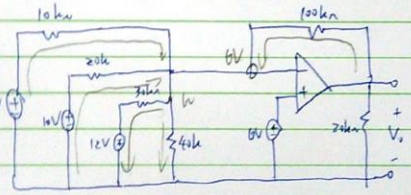
$\Delta = \begin{vmatrix} 1 & 0 & 2 \\ 0 & 3 & -4 \\ 2 & 3 & -2 \end{vmatrix} = -6 - 12 + 12 = -6$

$\Delta V_1 = \begin{vmatrix} 6 & 0 & 2 \\ 34 & 3 & -4 \\ 78 & 3 & -2 \end{vmatrix} = 2\begin{vmatrix} 3 & 0 & 1 \\ 17 & 3 & -2 \\ 39 & 3 & -1 \end{vmatrix} = 4(-9 + 51 - 117 + 78) = -57 \times 4$

$V_1 = \frac{-57 \times 4}{-6} = 38V$

$V_0 = 18 - 38 = -20V$ #

2.



+15

$\frac{9-6}{10k} + \frac{10-6}{20k} + \frac{V_0-6}{100k} = \frac{6+12}{30k} + \frac{6}{40k}$

$\frac{3}{10k} + \frac{1}{5k} + \frac{V_0-6}{100k} = \frac{3}{5k} + \frac{3}{20k}$

$30 + 20 + V_0 - 6 = 60 + 15$

$44 + V_0 = 75 \Rightarrow V_0 = 31V$ #

3.

$i(t) = \begin{cases} 0 \le t \le 2ms, & i(t) = 7.5t \text{ A} \\ 2ms < t \le 4ms, & i(t) = 15mA \\ 4ms < t \le 6ms, & i(t) = -5mA \\ 6ms < t \le 8ms, & i(t) = -5m + 2.5(t-6m) = 2.5t - 20m \\ t > 8ms, & i(t) = 0A \end{cases}$

$C = 5\mu F$

$i(t) = C\frac{dV(t)}{dt}$

$\int_{t_0}^{t} dV(t) = \frac{1}{C}\int_{t_0}^{t} i(t)\,dt$

$V(t) = V(t_0) + \frac{1}{5\mu}\int_{t_0}^{t} i(t)\,dt$

$V(0) = 0V$

+13

$0 \le t \le 2ms$

$V(t) = \frac{1}{5\mu}\int_0^t 7.5t\,dt = \frac{1}{5\mu} \times \frac{7.5t^2}{2} = 0.75t^2 = 750kt^2$, $\Rightarrow V(2ms) = 3V$

$2ms < t \le 4ms$

$V(t) = 3 + \frac{1}{5\mu}\int_{2ms}^{t} 15m\,dt = 3 + \frac{1}{5\mu}15mt\Big|_{2m}^{t} = 3 + 3kt - 6 = 3kt - 3V$ $\Rightarrow V(4ms) = 9V$

$4ms < t \le 6ms$

$V(t) = 9 + \frac{1}{5\mu}\int_{4ms}^{t} -5m\,dt = 9 - 1kt\Big|_{4m}^{t} = 9 - 1kt + 4 = 13 - 1kt\ V$ $\Rightarrow V(6ms) = 7V$

$6ms < t \le 8ms$

$V(t) = 7 + \frac{1}{5\mu}\int_{6ms}^{t} (2.5t - 20m)\,dt = 7 + \frac{1}{5\mu}\left[1.25t^2 - 20mt\right]_{6m}^{t} = 7 + \frac{1}{5\mu}\left[1.25t^2 - 20mt + 75\mu\right]$

$= 7 + 250kt^2 - 4kt + 15 = 250kt^2 - 4kt + 22\ V$ $\Rightarrow V(8ms) = 16 - 32 + 22 = 6V$

$t > 8ms$ $V = V(8ms) = 6V$

$W = \frac{1}{2}CV^2$

$W(1.4ms) = \frac{1}{2}$

$V(1.4ms) = 0.75M t^2 = 1.47V \Rightarrow W(1.4ms) = \frac{1}{2} \times 5\mu \times (1.47)^2 = 5.4\mu J$ #

$V(3.3ms) = 3kt - 5 = 6.9V \Rightarrow W(3.3ms) = \frac{1}{2} \times 5\mu \times (6.9)^2 \doteq 119.025\mu J$ #

$V(4.7ms) = 13 - 1kt = 13 - 4.7 = 8.3V \Rightarrow W(4.7ms) = \frac{1}{2} \times 5\mu \times (8.3)^2 = 189.225\mu J$ #

$V(6.7ms) = 250kt^2 - 4kt + 22 = 11.22 - 26.8 + 22 = 6.42V \Rightarrow W(6.7ms) = \frac{1}{2} \times 5\mu \times (6.42)^2 = 98.04\mu J$

$V(8.5ms) = 6V \Rightarrow W(8.5ms) = \frac{1}{2} \times 5\mu \times 6^2 = 90\mu J$ #

$\Rightarrow$

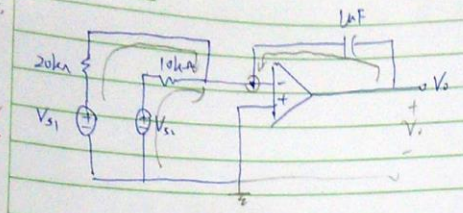
$V_{S1}(t) = 8\cos 324t$

$V_{S2}(t) = 4\cos 324t$

記分欄

轉頁從此開始寫起。

4.



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$i_c = C\frac{dV_o}{dt}$ $\Rightarrow \int dV_o = \frac{1}{C}\int i_c dt$ $\Rightarrow V_o = \frac{1}{C}\int i_c dt$

$i_c + \frac{V_{S1}}{20k} + \frac{V_{S2}}{10k} = 0$

$i_c + 4m\cos 324t + 4m\cos 324t = 0$

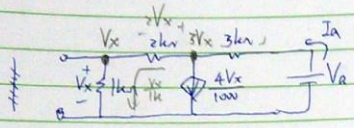
$i_c = -4m\cos 324t - 4m\cos 324t = -8m\cos 324t$

$\int i_c dt = -\frac{8m\sin 324t}{324}$

$V_o = \frac{1}{1\mu} \times \frac{-2m\sin 324t}{81} = -\frac{2k}{81}\sin 324t$

$= -\frac{2000}{81}\sin 324t$ V #

5.



$I_A = \frac{4V_x}{1000} + \frac{V_x}{1k}$

$1kI_A = 4V_x + V_x = 5V_x$ $\Rightarrow 5V_x = 1kI_A$

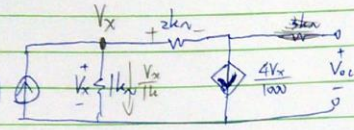
$V_x = \frac{1kI_A}{5}$ ①

$V_A = 3kI_A + 3V_x = 3kI_A + \frac{3kI_A}{5}$

$5V_A = 15kI_A + 3kI_A = 18kI_A$

$R_{th} = \frac{V_A}{I_A} = \frac{18k}{5} = \frac{18}{5}k\Omega$ $\Rightarrow R_L = \frac{18}{5}k\Omega$ #

+20



$1mA = \frac{V_x}{1k} + \frac{4V_x}{1k}$

$1 = 5V_x$

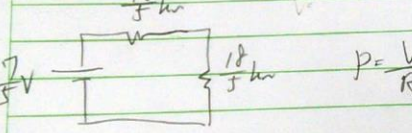
$V_x = \frac{1}{5}V$

$\frac{4V_x}{1k} = \frac{4}{5}mA$

$V_{oc} = V_x - 2k \times \frac{4V_x}{1k}$

$= V_x - 8V_x = -7V_x$

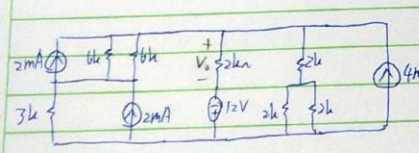
$= -\frac{7}{5}V$

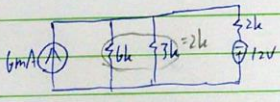


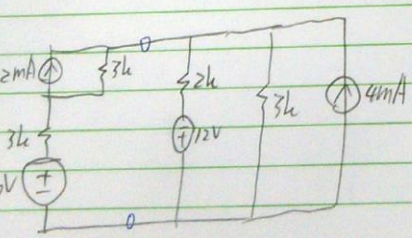
$P = \frac{V^2}{R_L} = \frac{(-\frac{7}{10})^2}{\frac{18}{5}k} = \frac{49}{100} \times \frac{5}{18k} = \frac{49}{360}mW$

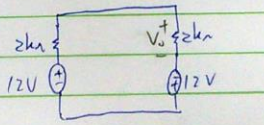
$\Rightarrow P_{max} = \frac{49}{360}mW$ #

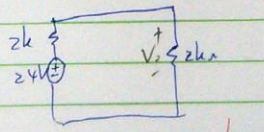
6.

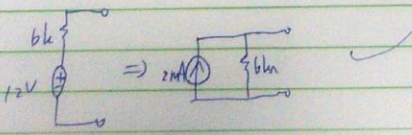












$V_o = 24 \times \frac{1}{2} = 12V$ #