電路學 (一)　期中考

1.

$$V_y = V_1 \times (-\frac{80k}{10k}) = -8V_1 \quad , \quad V_z = V_2 \times (1 + \frac{30k}{10k}) = 4V_2$$

(a)

$$V_0 = (-8V_1) \times (-\frac{10k}{10k}) + (4V_2) \times (-\frac{10k}{10k}) = 8V_1 - 4V_2 \quad \#$$

(b)　$1V \le V_1 \le 2V$　　　　$V_0 = 0V \,,\, -4V \,,\, 8V \,,\, 4V$
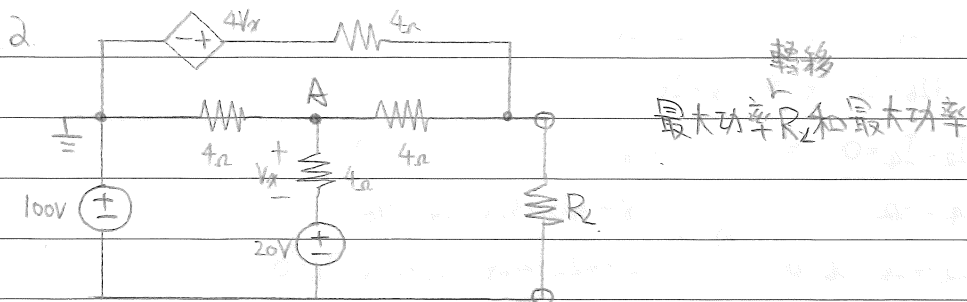
$2V \le V_2 \le 3V$

$$-4V \le V_0 \le 8V \quad \#$$

(c)　$V_y = -8V_1 \,,\, -10V \le V_y \le -8V$

$V_z = 4V_2 \,,\, 8V \le V_z \le 10V$
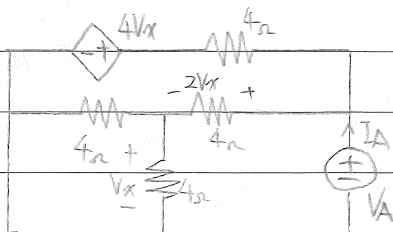
$$-2V \le V_0 \le 2V \quad \#$$

2.

轉移

最大功率 R_L 和最大功率

$$\frac{A - 4V_x}{8} + \frac{A}{4} + \frac{A + 80}{4} = 0 \Rightarrow 5A - 4V_x = -160$$

$$\frac{A + 80}{4} \times 4 = V_x \Rightarrow A = V_x - 80 \quad , \quad V_x = 240V \,,\, A = 160V$$

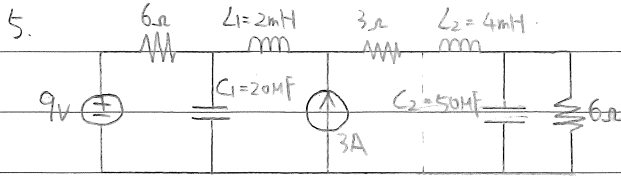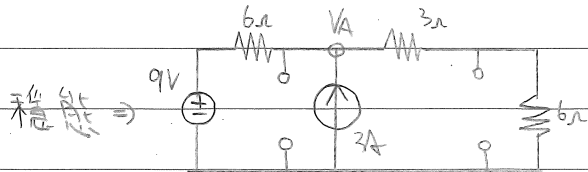$$(\frac{-160 - 960}{8} \times 4) + 240 + 20 = 660V = V_{th}$$

$V_A = 3V$　　$I_A = \frac{3-4}{4} + \frac{3}{6} = \frac{-1}{4} + \frac{1}{2} = \frac{1}{4}$

$V_x = 1V$

$$\frac{V_A}{I_A} = 12 \,\Omega \quad \#$$

$$P_{MAX} = \frac{1}{4}(660)^2 / 12 = 9075 \, W \quad \#$$

3.

find I_0

$2I_x = I_3 = 2I_5 - 2I_6$

$2I_x = I_3$, $I_x = I_5 - I_6$, $V_x = -I_1$

$V_x = 2I_1 - I_2 - I_4 \Rightarrow 3I_1 - I_2 - I_4 = 0$

$-6 = 2I_2 - I_1 - I_5 \Rightarrow I_1 - 2I_2 + I_5 = -6 \Rightarrow I_1 = -6 + 2I_2 - I_5$

$12 = I_4 - I_1 + 2V_x \Rightarrow 3I_1 - I_4 = -12$

$2V_x = 2I_5 - I_2 - I_6 \Rightarrow 2I_1 - I_2 + 2I_5 - I_6 = 0$

$0 = 3I_6 - I_3 - I_5 \Rightarrow I_3 + I_5 - 3I_6 = 0$

$\begin{cases} 3I_1 - I_2 - I_4 = 0 \\ 3I_1 - I_4 = -12 \\ 2I_1 - I_2 + 2I_5 - I_6 = 0 \\ I_3 + I_5 - 3I_6 = 0 \end{cases}$
$\Rightarrow$
$\begin{cases} -18 + 6I_2 - 3I_5 - I_2 - I_4 = 0 \\ -18 + 6I_2 - 3I_5 - I_4 = -12 \\ -12 + 4I_2 + 2I_5 - I_2 + 2I_5 - I_6 = 0 \\ I_3 + I_5 - 3I_6 = 0 \end{cases}$

$\Rightarrow$
$\begin{cases} 5I_2 - I_4 - 3I_5 = -18 \\ 6I_2 - I_4 - 3I_5 = -6 \\ 3I_2 - I_6 = -12 \\ I_3 + I_5 - 3I_6 = 0 \end{cases}$

$I_2 = -12mA$, $I_6 = -48mA$ #

4.

$V_x = 1kI_A$, $V_A = 8V_x$

$\dfrac{V_A}{I_A} = \dfrac{8V_x}{\frac{V_x}{1k}} = 8k\Omega$

$V_{th} = -8V$

$V_0 = -8 \times \dfrac{1k}{9k} = \dfrac{-8}{9} V$ #

5.

Find total energy

$$\frac{9-V_A}{6} + 3 = \frac{V_A}{9} \Rightarrow 27 - 3V_A + 54 = 2V_A$$

$$\Rightarrow 5V_A = 81 \Rightarrow V_A = 16.2V$$

$I_{L_1} = (9-16.2)/6 = -1.2A$
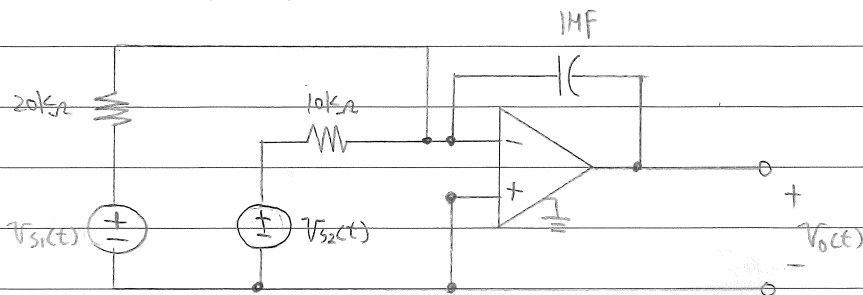
$I_{L_2} = 1.8A$

$V_{C_1} = 6 \times 1.2 + 9 = 16.2V$

$V_{C_2} = 16.2 - 1.8 \times 3 = 10.8V$

$$E = \frac{1}{2}(1.2^2 \times 2m + 1.8^2 \times 4m + 16.2^2 \times 20M + 10.8^2 \times 50M)$$

$$= 13.46mJ \qquad \#$$

6.

(a) $\dfrac{V_{S_1}(t)}{20k} + \dfrac{V_{S_2}(t)}{10k} = C\dfrac{dV}{dt} \Rightarrow V_{S_1}(t) + 2V_{S_2}(t) = -20m\dfrac{dV_0(t)}{dt}$

$\Rightarrow \displaystyle\int (V_{S_1}(t) + 2V_{S_2}(t))dt = -20m\int \dfrac{dV_0(t)}{dt}dt$

$\Rightarrow V_0(t) = -50\displaystyle\int (V_{S_1}(t) + 2V_{S_2}(t))dt$

(b) $V_0(t) = -50\displaystyle\int 160\cos 377t \, dt$

$= -50 \times 160 \times \dfrac{1}{377}(\sin 377t) = -21.22\sin 377t \ (V)$ $\#$