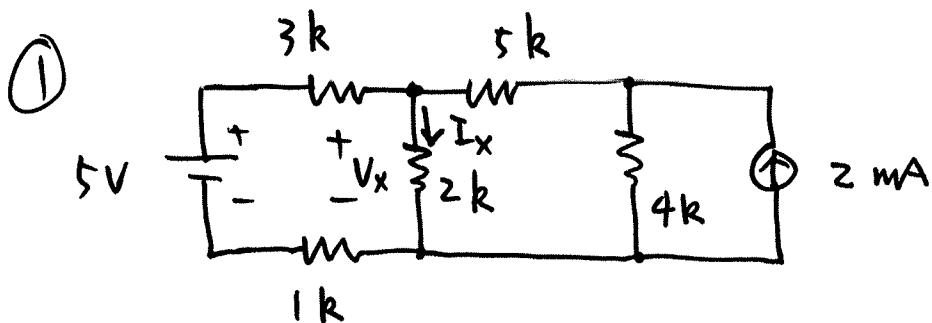
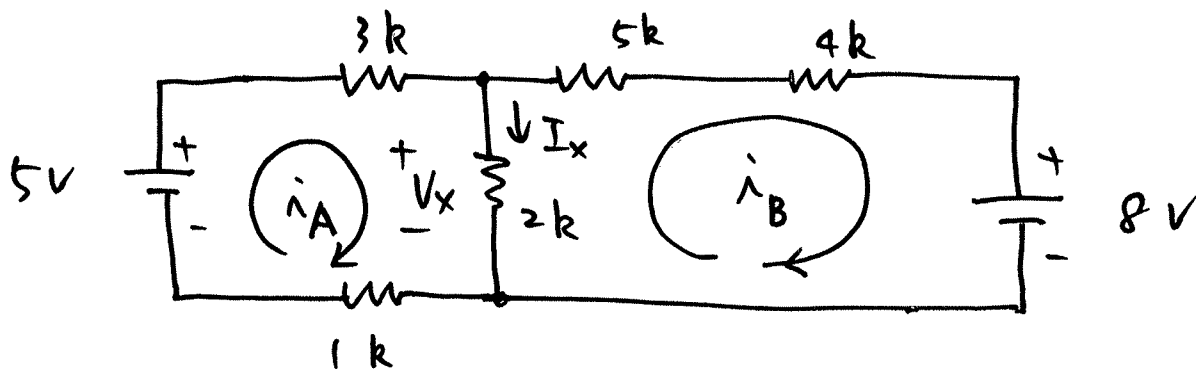


2014년 2학기 기출전사 해를 중간과사



Source transformation 을 이용해,



가 mesh 에서 KVL 을 이용해,

$$\begin{cases} 3\hat{i}_A + 2(\hat{i}_A - \hat{i}_B) + \hat{i}_A = 5 \\ 9\hat{i}_B - 2(\hat{i}_A - \hat{i}_B) = -8 \end{cases}$$

간단히 하면,

$$\begin{cases} 6\hat{i}_A - 2\hat{i}_B = 5 \\ -2\hat{i}_A + 11\hat{i}_B = -8 \end{cases}$$

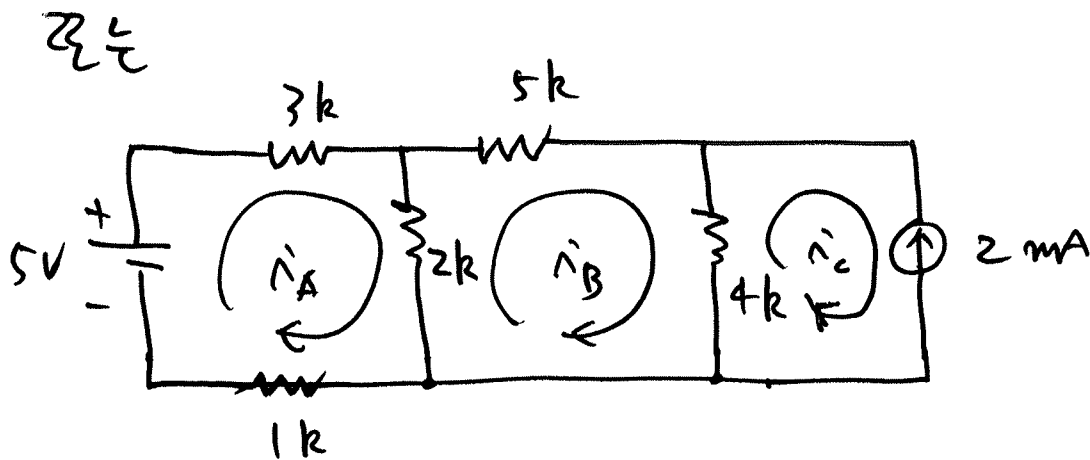
이 연립방정식을 풀면,

$$\begin{cases} \hat{i}_B = -0.613 \text{ mA} \\ \hat{i}_A = 0.629 \text{ mA} \end{cases}$$

$$I_x = \hat{i}_A - \hat{i}_B = 0.629 + 0.613$$

$$= 1.242 \text{ [mA]}$$

$$V_x = 2 \times 1.242 = 2.484 \text{ [V]}$$



$$\begin{cases} 3\hat{i}_A + 2(\hat{i}_A - \hat{i}_B) + \hat{i}_A = 5 \\ 5\hat{i}_B + 4(\hat{i}_B - \hat{i}_C) - 2(\hat{i}_A - \hat{i}_B) = 0 \\ \hat{i}_C = -2 \end{cases}$$

간단히 하면,

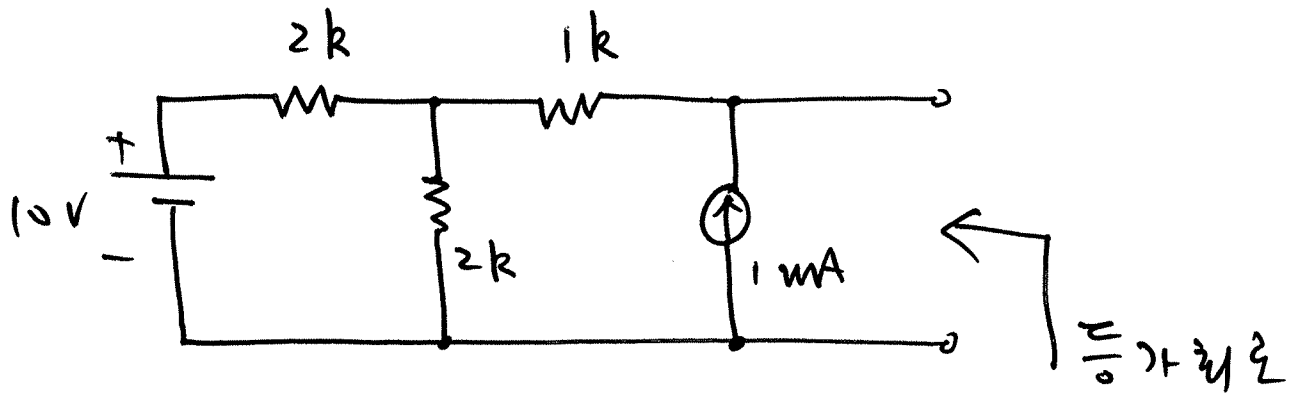
$$\begin{cases} 6\hat{i}_A - 2\hat{i}_B = 5 \\ -2\hat{i}_A + 11\hat{i}_B = -8 \end{cases}$$

$$\begin{cases} \hat{i}_B = -0.613 \text{ mA} \\ \hat{i}_A = 0.629 \text{ mA} \end{cases}$$

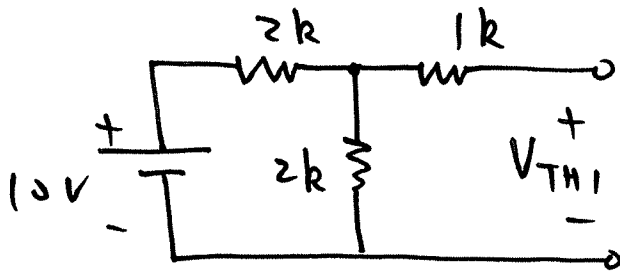
$$I_x = \hat{i}_A - \hat{i}_B = 1.242 \text{ mA}$$

$$V_x = 2 \times 1.242 = 2.484 \text{ V}$$

②

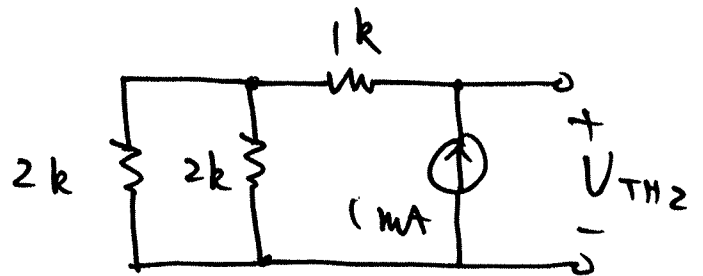


①  $\frac{2}{6}$  전압의 전압이 되게 하,



$$V_{TH1} = \frac{2}{2+2} \times 10$$

$$= 5 \text{ V}$$

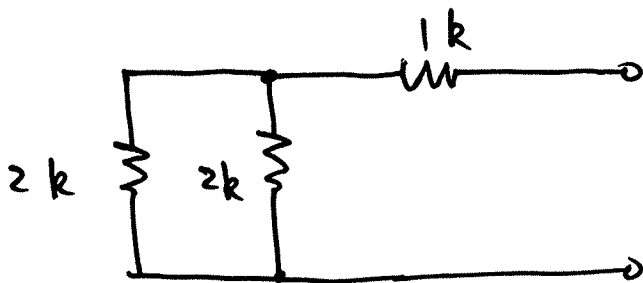


$$V_{TH2} = (2//2 + 1) \times 1$$

$$= 2 \text{ V}$$

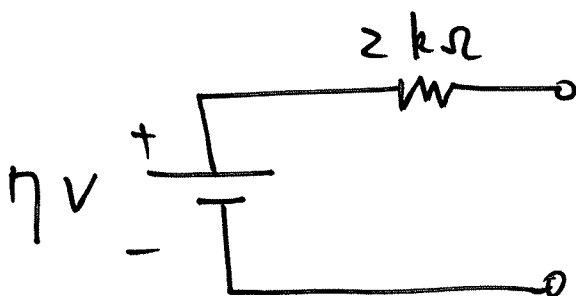
$$V_{TH} = V_{TH1} + V_{TH2} = 7 \text{ V}$$

신호원을 제거 하면,



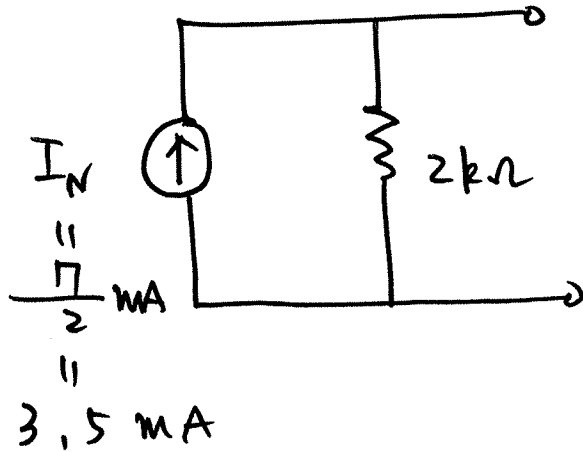
$$R_{TH} = (2//2) + 1$$

$$= 2 \text{ k}\Omega$$



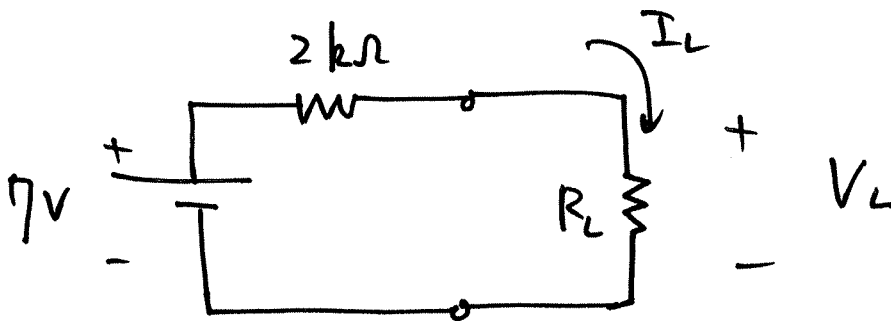
: Thevenin equivalent circuit

(b)



: Norton  
 $\frac{C}{V}$ 가 최대

(c)



$$V_L = \frac{R_L}{2 + R_L} \times 7 \quad [V]$$

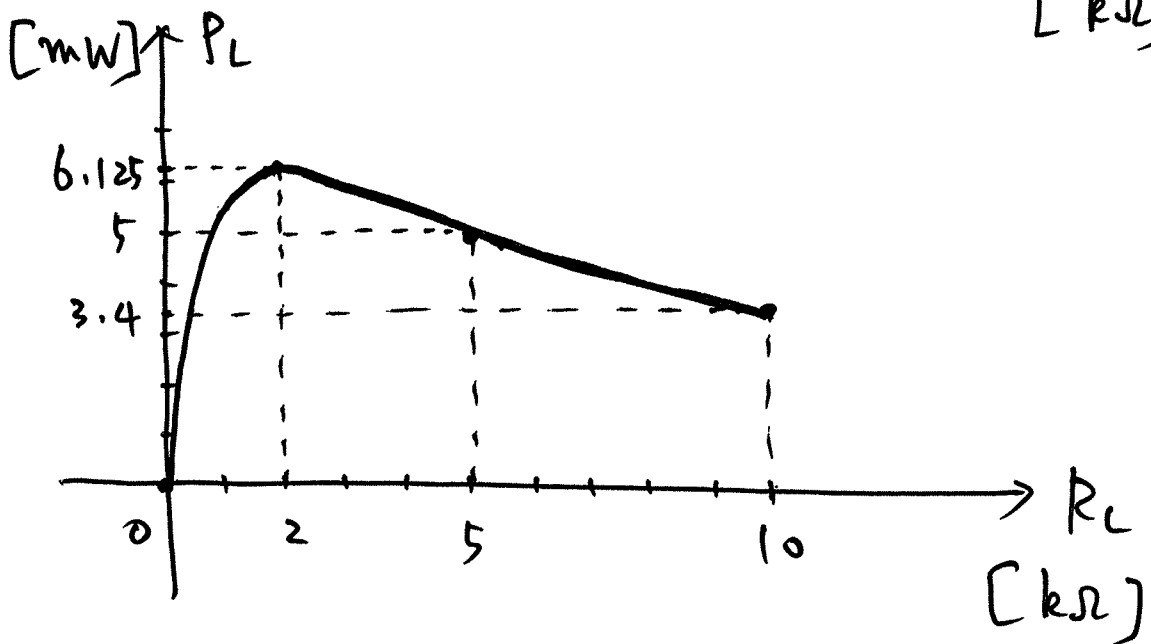
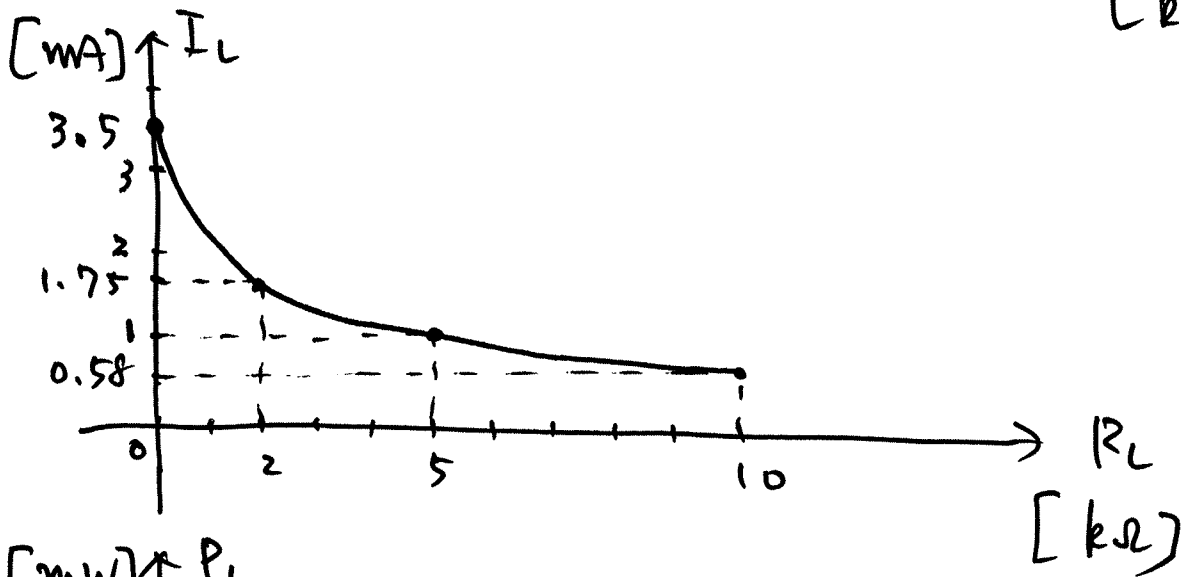
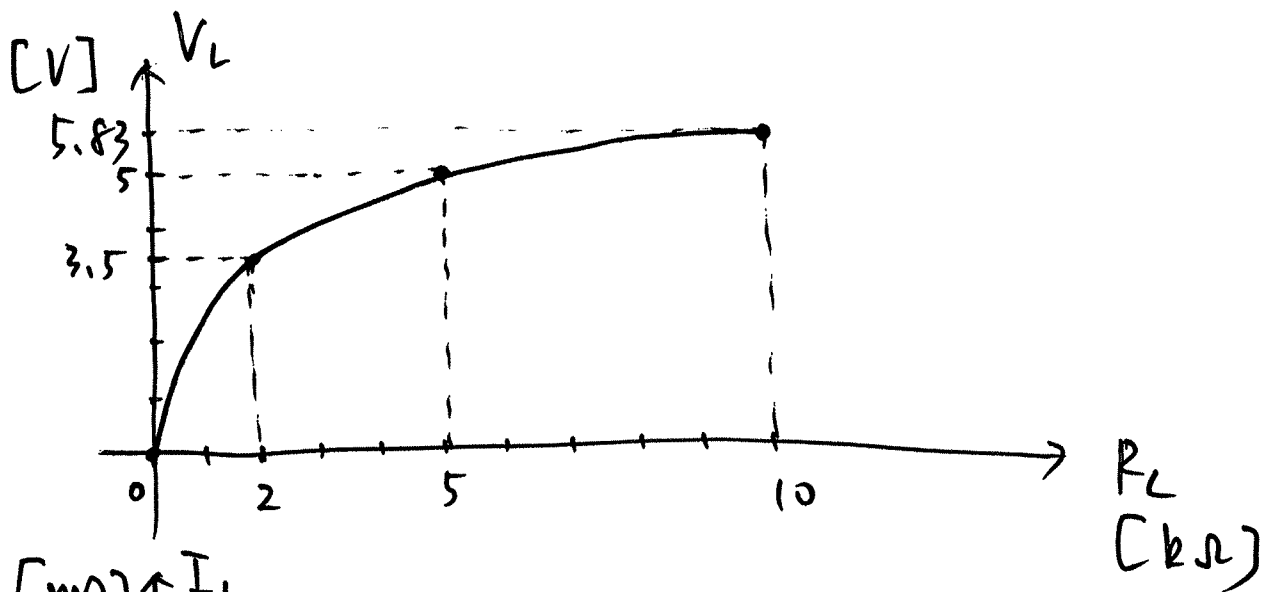
$$I_L = \frac{7}{2 + R_L} \quad [mA]$$

$$P_L = V_L I_L = \frac{49 R_L}{(2 + R_L)^2} \quad [mW]$$

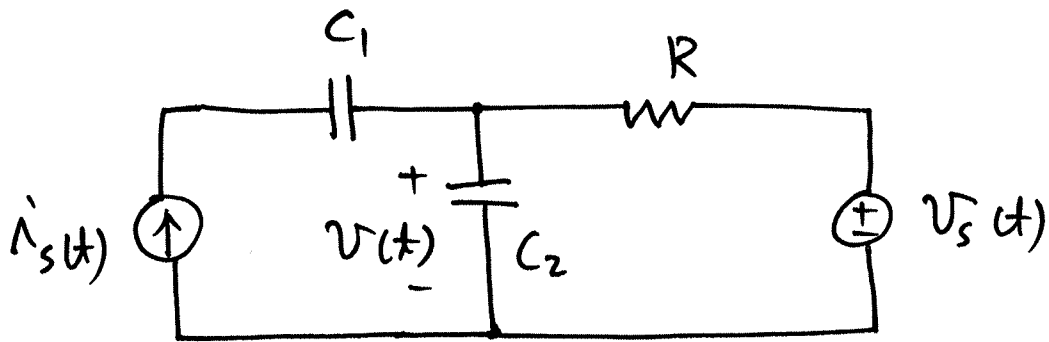
$$\frac{dP_L}{dR_L} = \frac{49 (2 + R_L)^2 - 49 R_L \times 2 \times (2 + R_L)}{(2 + R_L)^4}$$

$$= \frac{49 (2 - R_L)}{(2 + R_L)^3} = 0 \quad \text{일 때}$$

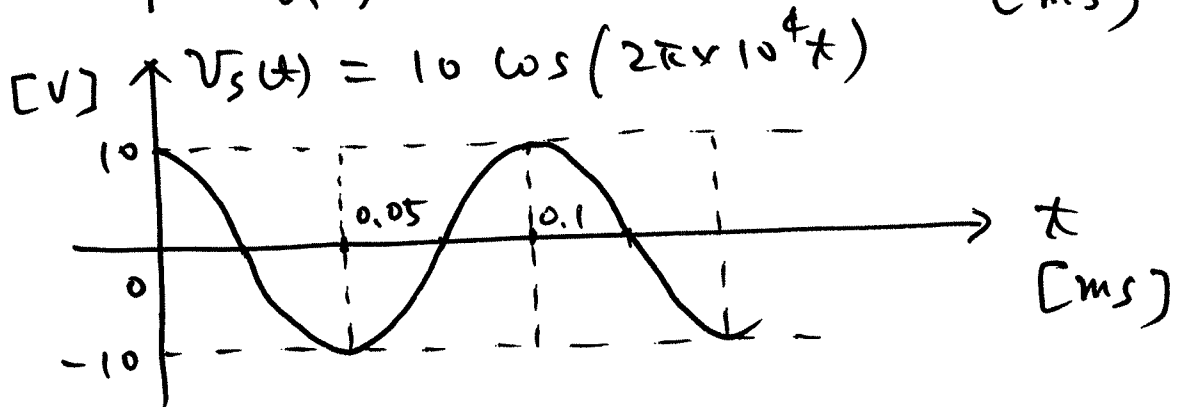
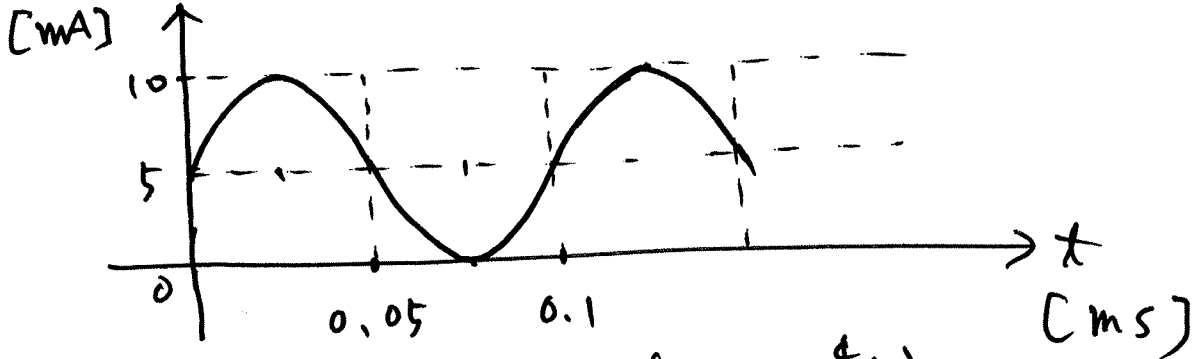
$R_L = 2 \text{ k}\Omega$  일 때  $P_L$ 이 최대



3



(a)  $i_s(t) = 5 \sin(2\pi \times 10^4 t) + 5 \text{ [mA]}$



(b)  $i_{s, \max} = 10 \text{ mA}$

$i_{s, \min} = 0 \text{ mA}$

$i_{s, pp} = 10 \text{ mA}$

$$i_{s, \text{avg}} = \frac{1}{0.1} \int_0^{0.1} \{5 \sin(2\pi \times 10^4 t) + 5\} dt$$

$$= 5 \text{ mA}$$

$$i_{s, \text{rms}} = \sqrt{\frac{1}{0.1} \int_0^{0.1} \{5 \sin(2\pi \times 10^4 t) + 5\}^2 dt}$$

$$= \sqrt{\frac{25}{2} + 25} = 6.12 \text{ mA}$$

$$V_{s, \max} = 10 \text{ V}$$

$$V_{s, \min} = -10 \text{ V}$$

$$V_{s, \text{pp}} = 20 \text{ V}$$

$$V_{s, \text{avg}} = \frac{1}{0.1} \int_0^{0.1} 10 \cos(2\pi \times 10^4 t) dt = 0 \text{ V}$$

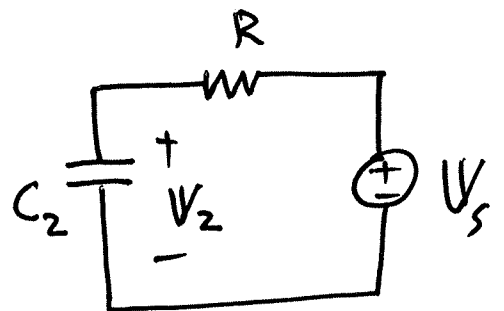
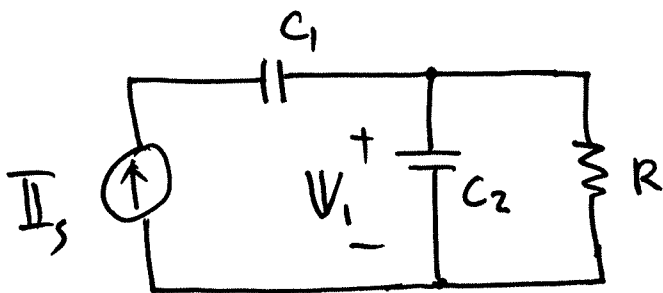
$$V_{s, \text{rms}} = \sqrt{\frac{1}{0.1} \int_0^{0.1} 100 \cos^2(2\pi \times 10^4 t) dt}$$

$$= \sqrt{\frac{100}{2}} \doteq 7.07 \text{ V}$$

③ Capacitor 는 dc 나 대해 open 이므로  
 $i_s(t)$  의 dc 성분  $5 \text{ mA}$  는 무시하고  
 phasor 를 사용하면,

$$\mathbf{I}_s = 5 \times 10^{-3} \angle -\frac{\pi}{2}, \quad \mathbf{V}_s = 10 \angle 0$$

중첩의 원리를 사용하면,



$$V_1 = \frac{R \cdot \frac{1}{j\omega C_2}}{R + \frac{1}{j\omega C_2}} \quad \overline{I}_s = \frac{R}{1 + j\omega RC_2} \overline{I}_s$$

$$= \frac{2 \times 10^3}{1 + j 2\pi \times 10^4 \times 2 \times 10^3 \times 10^{-8}} \times 5 \times 10^{-3} \angle -\frac{\pi}{2}$$

$$= \frac{1}{1 + j \frac{4\pi}{10}} \times 10 \angle -\frac{\pi}{2}$$

$$\therefore 6.23 \angle -2.47 = -4.88 - j3.88$$

$$V_2 = \frac{\frac{1}{j\omega C_2}}{R + \frac{1}{j\omega C_2}} \quad V_s = \frac{1}{1 + j\omega RC_2} V_s$$

$$= \frac{1}{1 + j \frac{4\pi}{10}} \times 10 \angle 0$$

$$\therefore 6.23 \angle -0.9 = 3.87 - j4.88$$

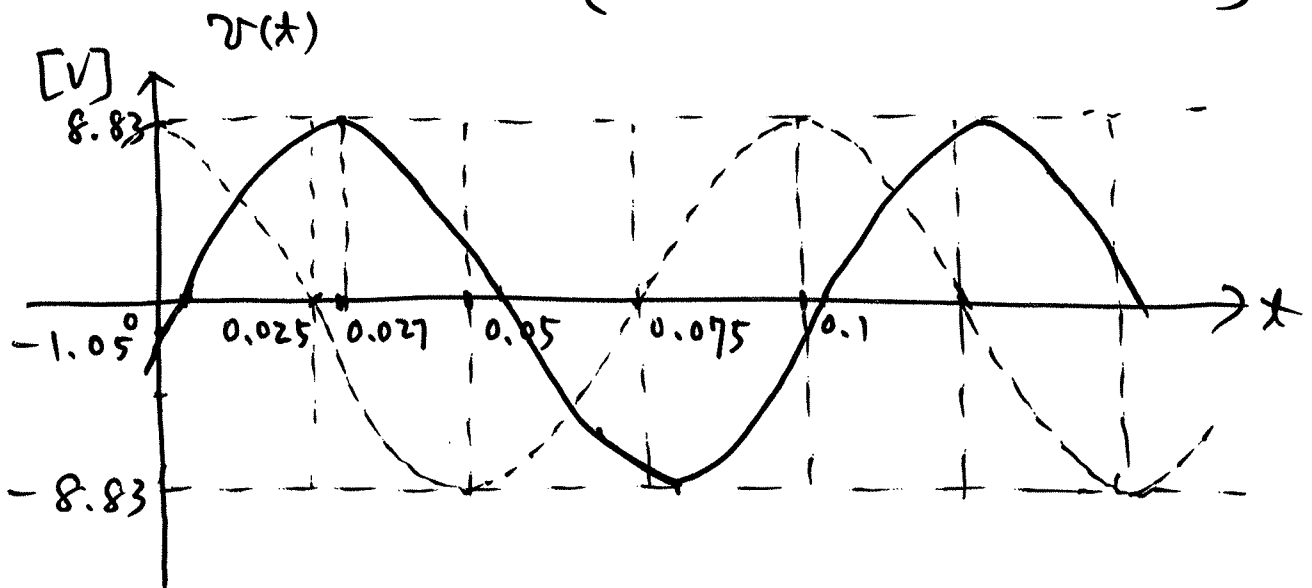
$$V = V_1 + V_2 = -1.1 - j8.76$$

$$= 8.83 \angle 4.59 \quad \approx 8.83 \angle -1.69$$



$$v(t) = 8.83 \cos(2\pi \times 10^4 t - 1.69) \text{ [V]}$$

$$= 8.83 \cos\left[2\pi \times 10^4 \left(t - 2.7 \times 10^{-5}\right)\right] \text{ [V]}$$



④

$$V_{\max} = 8.83 \text{ V}$$

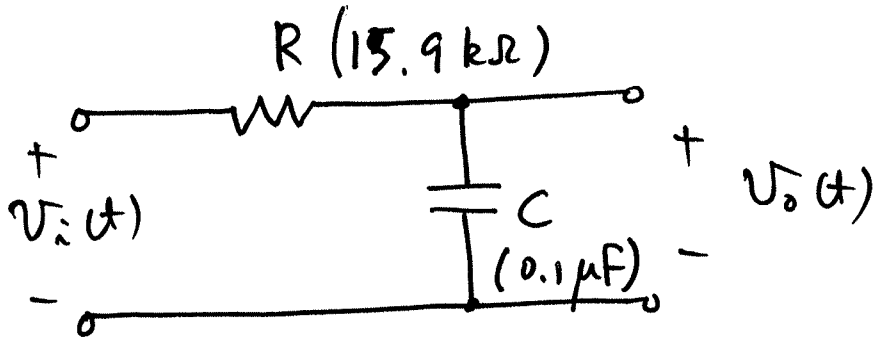
$$V_{\min} = -8.83 \text{ V}$$

$$V_{pp} = 17.66 \text{ V}$$

$$V_{\text{avg}} = 0 \text{ V}$$

$$V_{\text{rms}} = \frac{8.83}{\sqrt{2}} \doteq 6.24 \text{ V}$$

④



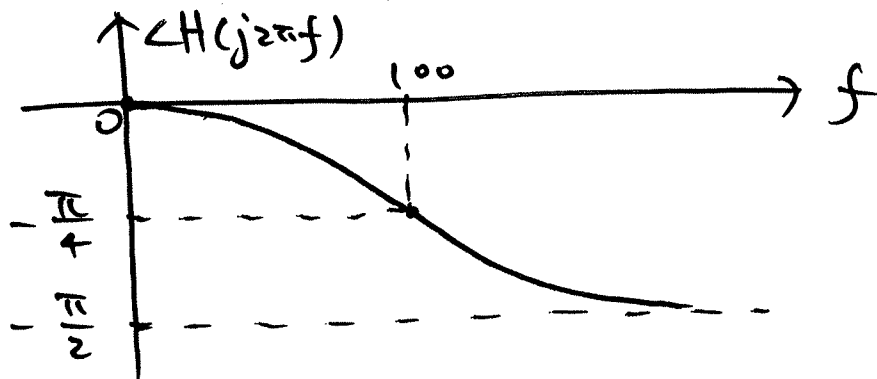
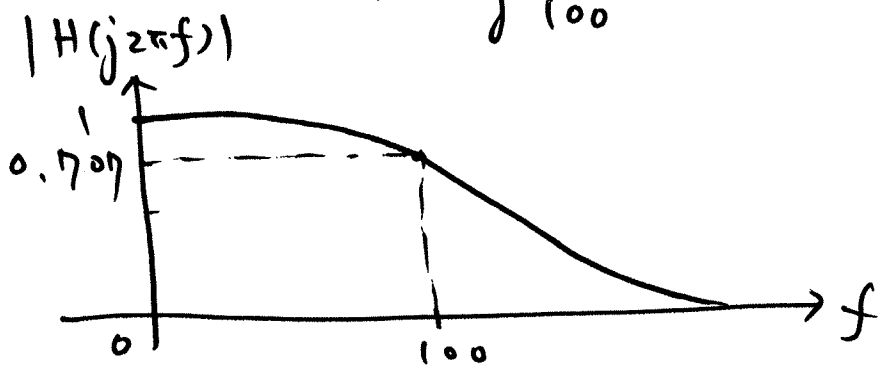
①

$$H(j\omega) = \frac{V_o(j\omega)}{V_i(j\omega)} = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}}$$

$$= \frac{1}{1 + j\omega RC}$$

$$= \frac{1}{1 + j 2\pi f \times 10^{-7} \times 15.9 \times 10^3}$$

$$= \frac{1}{1 + j \frac{f}{100}}$$

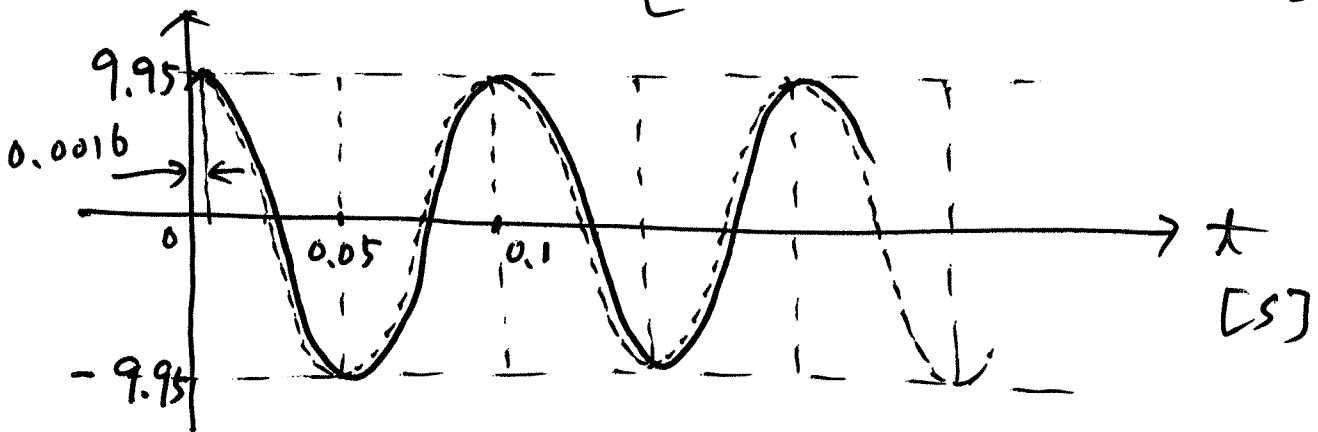


$$\textcircled{b} v_i(t) = 10 \cos(2\pi \times 10t) \Rightarrow f = 10 \text{ Hz}$$

$$H(j2\pi \times 10) = \frac{1}{1+j0.1} \doteq 0.995 \angle -0.1$$

$$V_i = 10 \angle 0 \quad \text{or } \frac{10}{\sqrt{2}} \quad V_o = 9.95 \angle -0.1$$

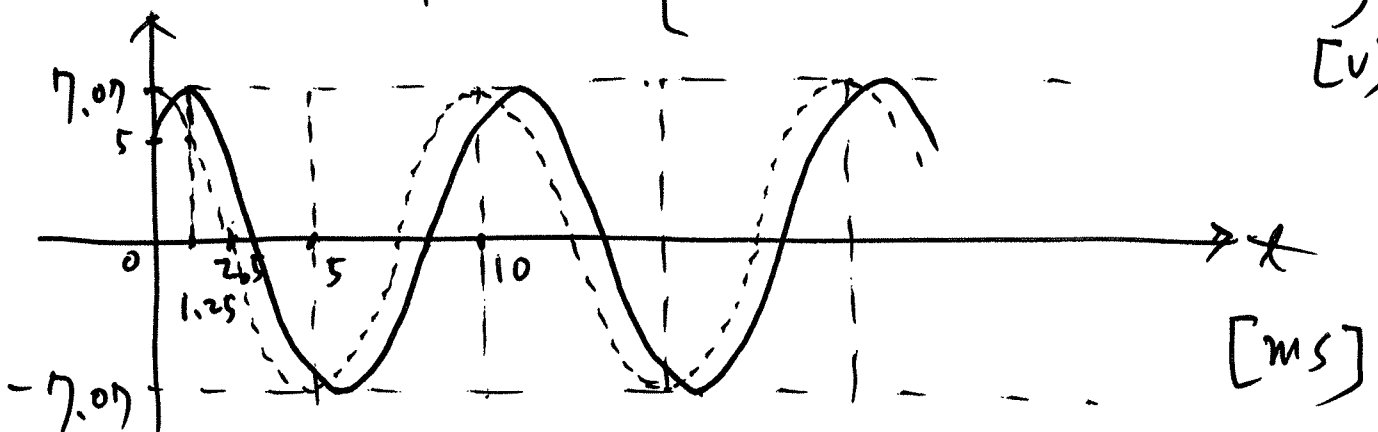
$$\begin{aligned} v_o(t) &= 9.95 \cos(2\pi \times 10t - 0.1) \\ &= 9.95 \cos\left[2\pi \times 10\left(t - 1.6 \times 10^{-3}\right)\right] \text{ [V]} \end{aligned}$$



$$\textcircled{c} v_i(t) = 10 \cos(2\pi \times 100t) \Rightarrow f = 100 \text{ Hz}$$

$$H(j2\pi \times 100) = \frac{1}{1+j} \doteq 0.707 \angle -\frac{\pi}{4}$$

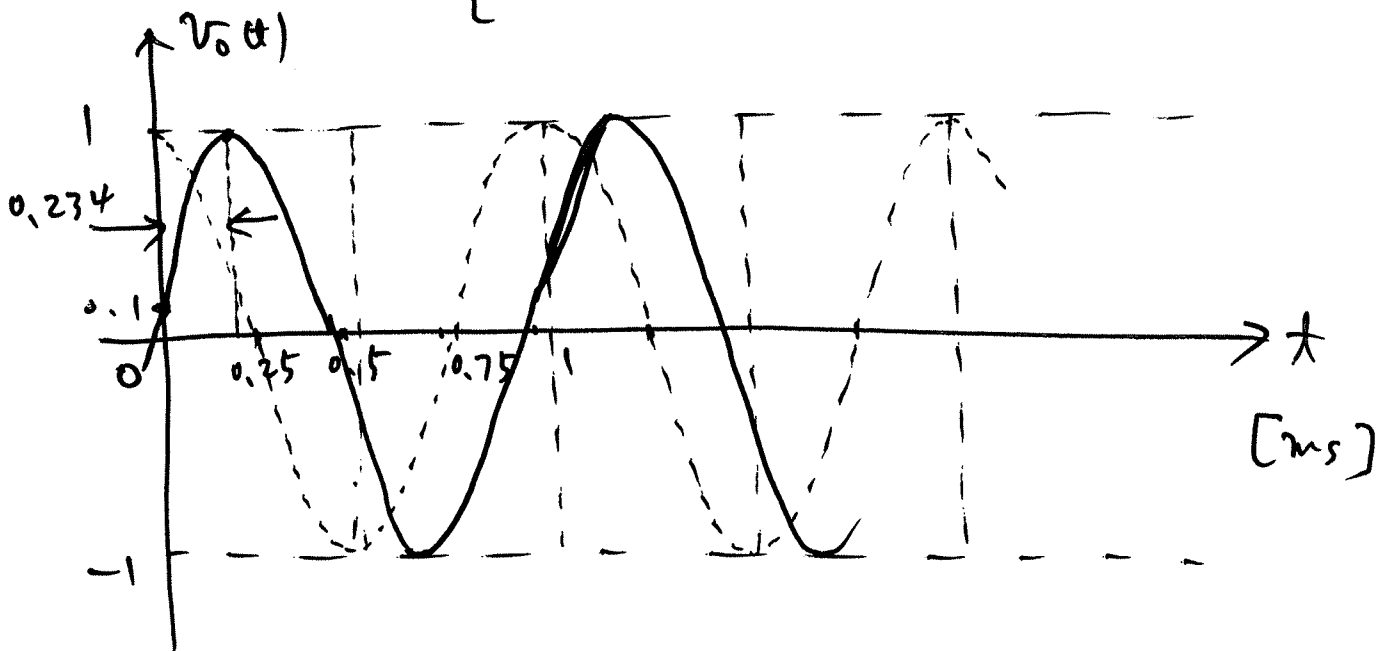
$$\begin{aligned} v_o(t) &= 7.07 \cos\left(2\pi \times 100t - \frac{\pi}{4}\right) \\ &= 7.07 \cos\left[2\pi \times 100\left(t - 1.25 \times 10^{-3}\right)\right] \text{ [V]} \end{aligned}$$



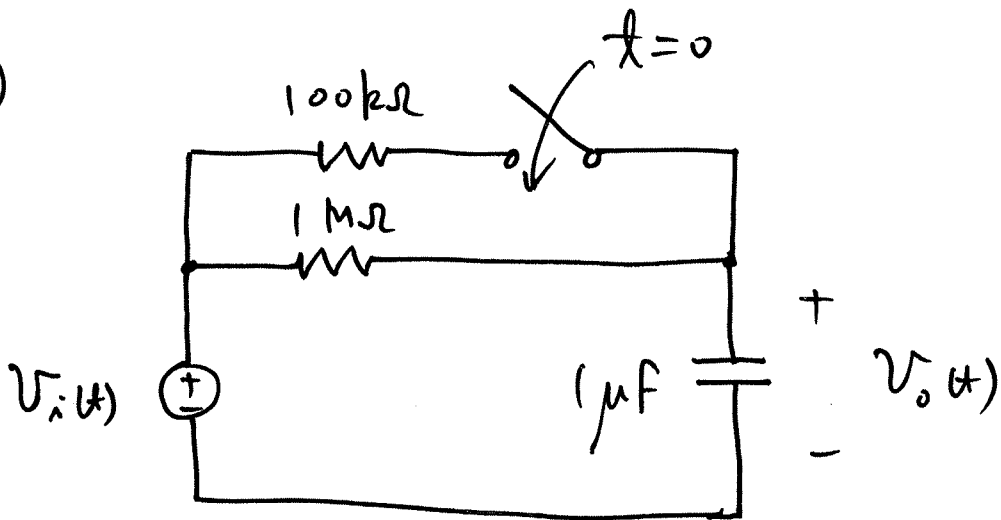
$$\textcircled{d} \quad v_i(t) = 10 \cos(2\pi \times 1000t) \Rightarrow f = 1000 \text{ Hz}$$

$$H(j2\pi \times 1000) = \frac{1}{1+j10} \doteq 0.1 \angle -1.47$$

$$\begin{aligned} v_o(t) &= \cos(2\pi \times 1000t - 1.47) \\ &= \cos\left[2\pi \times 1000\left(t - 2.34 \times 10^{-4}\right)\right] \text{ [V]} \end{aligned}$$

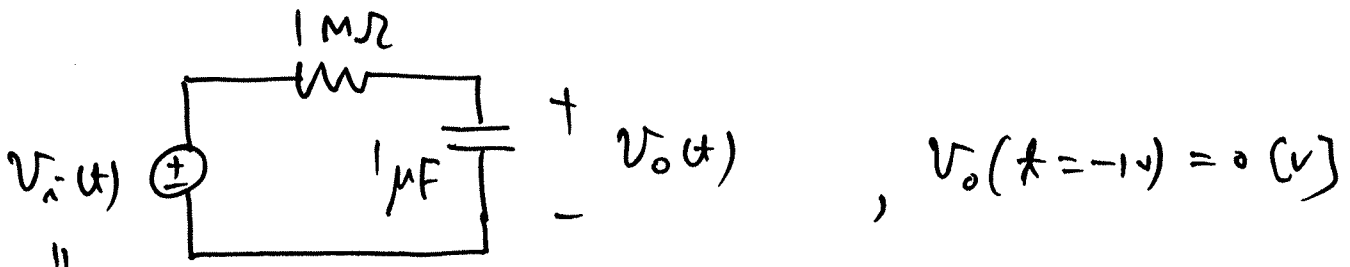


5



$V_o(t = -10) = 0 \text{ (v)}$

(!)  $t < 0 \text{ m s}^{-1}$

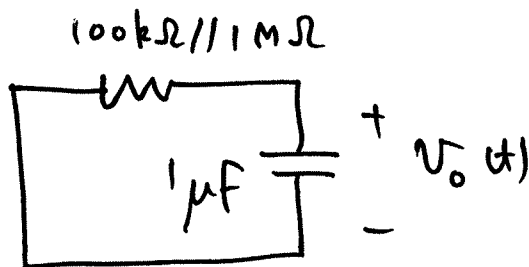


$V_o(t = -10) = 0 \text{ (v)}$

$5u(t+10)$

$\tau = RC = 10^6 \times 10^{-6} = 1 \text{ [s]}$

(!!)  $t \geq 0 \text{ m s}^{-1}$



$V_o(t = 0) = 5 \text{ (v)}$

$\tau \doteq 0.1 \text{ [s]}$

