2018년 2학기 기말

20181229 최효서

(회로이론1)

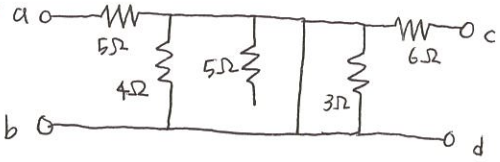
1

10×10^4 PF

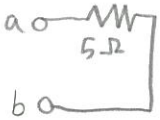
±5%

오차 ±5% ±10% ±20%
J K M

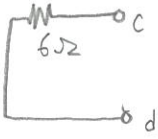
2.



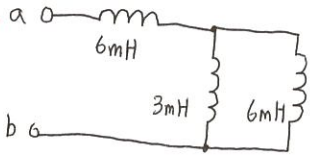
Rab = 5Ω



Rcd = 6Ω



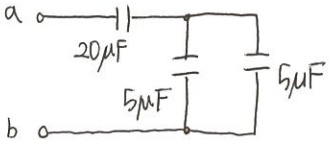
3.



병렬 연결 3mH, 6mH ⇒ $\frac{3\times6}{3+6} = 2\,mH$

$L_{eq} = 6+2 = 8mH$

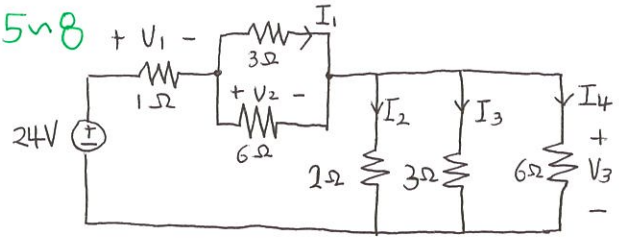
4.



병렬 연결 $5\mu F + 5\mu F = 10\mu F$

$C_{eq} = \frac{20\times10}{20+10} = \frac{20}{3}\mu F$

5~8



5. $3//6 = 2\Omega$ $\quad 2//3//6 = 1\Omega$

$$I_a = \frac{24}{1+2+1} = \frac{24}{4} = 6A$$

$$I_1 = I_a \times \frac{6}{3+6} = 6 \times \frac{2}{3} = 4A$$

$$I_2 = I_a \times \frac{\frac{1}{2}}{\frac{1}{2}+\frac{1}{3}+\frac{1}{6}} = 6 \times \frac{\frac{1}{2}}{1} = 3A$$

$$I_3 = I_a \times \frac{\frac{1}{3}}{\frac{1}{2}+\frac{1}{3}+\frac{1}{6}} = 6 \times \frac{\frac{1}{3}}{1} = 2A$$

$$I_4 = I_a \times \frac{\frac{1}{6}}{\frac{1}{2}+\frac{1}{3}+\frac{1}{6}} = 6 \times \frac{\frac{1}{6}}{1} = 1A$$

6. $V_1 = 1 \times I_a = 6V$

$V_2 = 3 \times I_1 = 12V$

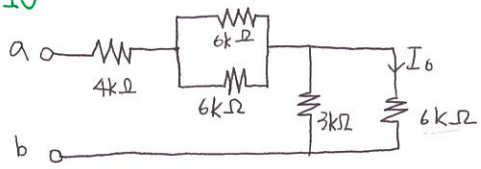
$V_3 = 2I_2 = 3I_3 = 6I_4 = 6V$

7. $P_{1\Omega} = V \cdot I = 6 \times 6 = 36$ watt/t

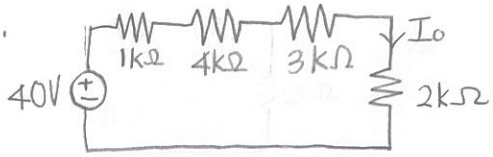
8. $W = \int_0^{10} P_{1\Omega}\, dt$

$= 36 \int_0^{10} dt = 360J$

9~10



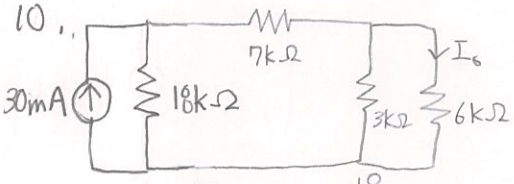
9.



$$I = \frac{40V}{10k\Omega} = 4mA$$

$$I_o = \frac{3}{3+6} \times 4 = \frac{1}{3} \times 4 = \frac{4}{3} mA$$

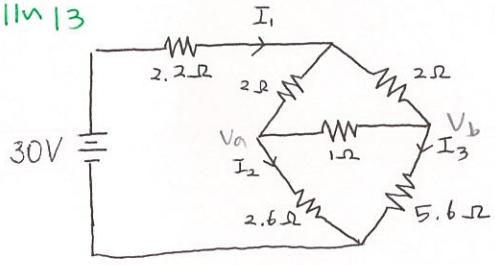
10.



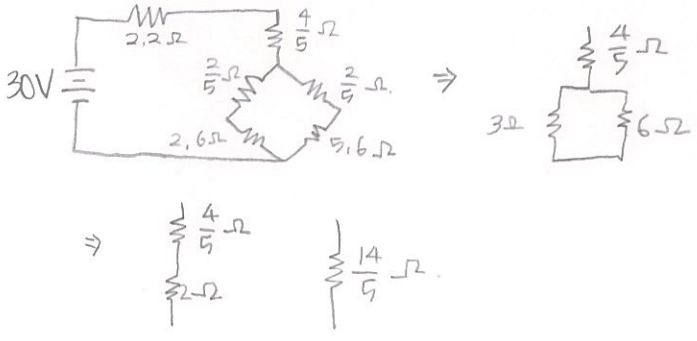
$$I = \frac{18}{18+7+2} \times 30 = 20mA$$

$$I_o = I \times \frac{3}{3+6} = 20 \times \frac{3}{9} = \frac{20}{3} mA$$

11~13



11. Req



$$Req = 2.2 + 2.8 = 5\Omega$$

12.

$$I_1 = \frac{30}{5} = 6[A]$$

$$I_2 = \frac{6}{3+6} \times I_1 = \frac{2}{3} \times 6 = 4A$$

$$I_3 = \frac{3}{3+6} \times I_1 = \frac{1}{3} \times 6 = 2A$$

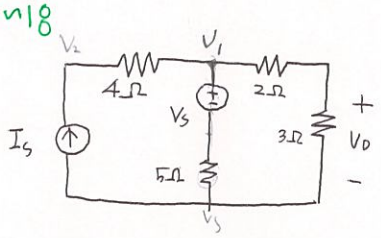
13.

$$V_a = 2.6 \times I_2 = 10.4V$$

$$V_b = 5.6 \times I_3 = 11.2V$$

$$I_4 = \frac{V_a - V_b}{1} = -0.8A$$

14~18



14.

$$\frac{V_o}{3} + \frac{V_o - V_1}{2} = 0$$

$$5V_o = 3V_1 \quad \cdots ①$$

V_1에서 KCL 적용

$$I_s = \frac{V_1 - V_s}{5} + \frac{V_1}{5}$$

$$5I_s = 2V_1 - V_s$$

$$5I_s + V_s = 2V_1$$

$$\frac{10}{3}V_o = 5I_s + V_s$$

$$V_o = \frac{3}{2}I_s + \frac{3}{10}V_s$$

15.

$5(I_1 - I_S) + 2I_1 + 3I_1 - V_S = 0$

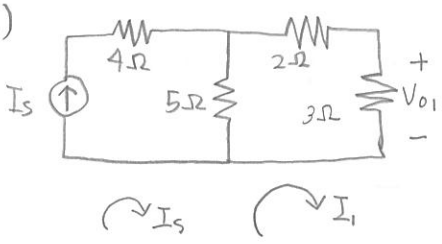
$V_S = 10I_1 - 5I_S$

$3I_1 = V_o$

$V_S = \frac{10}{3}V_o - 5I_S$.

$V_o = \frac{3}{10}V_S + \frac{3}{2}I_S$

16. 1)



$5(I_1 - I_S) + 2I_1 + 3I_1 = 0$

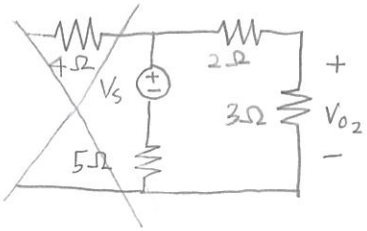
$10I_1 = 5I_S \cdots ①$

$V_{o1} = 3I_1$

$\frac{10}{3}V_{o1} = 5I_S$

$V_{o1} = \frac{3}{2}I_S$

2)

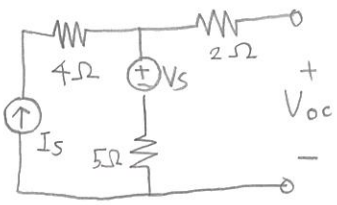


$V_{o2} = \frac{3}{10}V_S$

$V_o = V_{o1} + V_{o2} = \frac{3}{10}V_S + \frac{3}{2}I_S$

17.

$R_{TH} = 7\Omega$

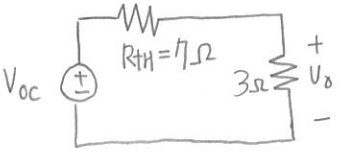


$I_S = \frac{V_{oc} - V_S}{5}$

$5I_S = V_{oc} - V_S$

$V_{oc} = V_S + 5I_S$

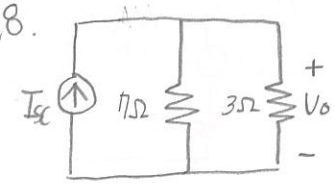
〈테브난 등가회로〉



$V_o = \frac{3}{10}V_{oc} = \frac{3}{10}(V_S + 5I_S)$

$= \frac{3}{10}V_S + \frac{3}{2}I_S$

18.



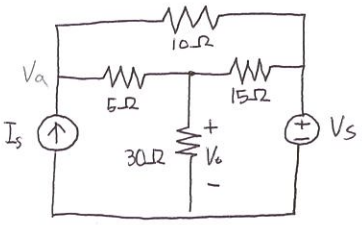
$I_{sc} = \frac{V_{oc}}{R_{TH}} = \frac{V_S + 5I_S}{7}$

$V_o = (7 /\!/ 3)I_{sc}$

$= \frac{21}{10}\left(\frac{1}{7}V_S + \frac{5}{7}I_S\right)$

$= \frac{3}{10}V_S + \frac{3}{2}I_S$

19번 23



19.

① $\frac{V_s - V_o}{15} + \frac{V_a - V_o}{5} = \frac{V_o}{30}$

$2V_s - 2V_o + 6V_a - 6V_o = V_o$

$9V_o = 2V_s + 6V_a$

② $I_s = \frac{V_a - V_o}{5} + \frac{V_a - V_s}{10}$

$10I_s = 2V_a - 2V_o + V_a - V_s$

$2V_o = -10I_s + 3V_a - V_s$

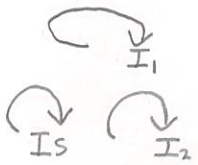
$\Rightarrow 9V_o = 2V_s + 6V_a$

$-\ \underline{4V_o = -2V_s + 6V_a - 20I_s}$

$5V_o = 4V_s + 20I_s$

$V_o = \frac{4}{5}V_s + 4I_s$

20.



I_1에서 KVL $\Rightarrow$ ① $10I_1 + 5(I_1 - I_s) + 15(I_1 - I_2) = 0$

$30I_1 - 15I_2 = 5I_s \cdots ①$

I_2에서 KVL $\Rightarrow$ ② $V_s + 15(I_2 - I_1) + 30(I_2 - I_s) = 0$

$V_s + 45I_2 - 15I_1 - 30I_s = 0$

$-15I_1 + 45I_2 = -V_s + 30I_s \cdots ②$

✱ $V_o = 30(I_s - I_2)$

$\Rightarrow$ ①+②×2 $\quad 30I_1 - 15I_2 = 5I_s$

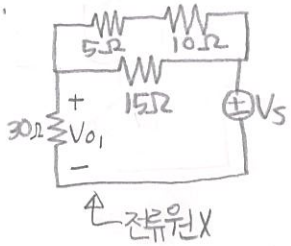
$+\ \underline{-30I_1 + 90I_2 = 60I_s - 2V_s}$

$75I_2 = -2V_s + 65I_s$

$I_2 = -\frac{2}{75}V_s + \frac{13}{15}I_s$

$\Rightarrow V_o = 4I_s + \frac{4}{5}V_s$

21.

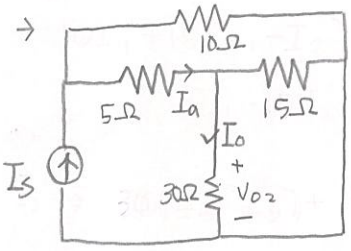


↑ 전류원X

$\rightarrow \quad V_{o1} = V_s \times \frac{30}{30 + \frac{15}{2}}$

$V_{o1} = \frac{4}{5}V_s$

$\rightarrow$



✱ $V_{o2} = 30I_o$

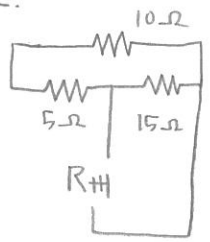
$I_a = I_s \times \frac{10}{10 + (5 + 30 // 15)} = \frac{2}{5}I_s$

$I_o = I_a \times \frac{15}{30 + 15} = \frac{2}{5}I_s \times \frac{1}{3} = \frac{2}{15}I_s$

$V_{o2} = 30 \cdot \frac{2}{15}I_s = 4I_s$

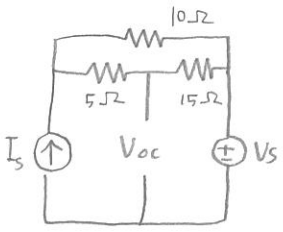
$V_o = V_{o1} + V_{o2} = \frac{4}{5}V_s + 4I_s$

22.



$R_{TH} = (10+5) /\!/ 15$

$= 7.5\,\Omega$



중첩의 원리

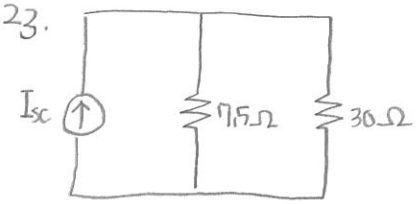
$V_{oc} = V_s + 5I_s$

⇒

$V_o = (V_s + 5I_s) \times \frac{30}{30+7.5}$

$= \frac{4}{5}V_s + 4I_s$

23.



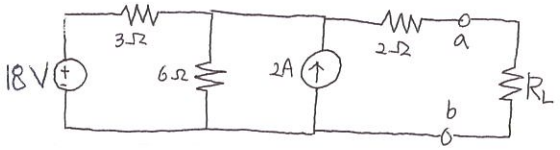
$I_{sc} = \frac{V_{oc}}{R_{TH}} = \frac{V_s + 5I_s}{7.5} = \frac{2}{15}V_s + \frac{2}{3}I_s$

$V_o = (7.5 /\!/ 30) I_{sc}$

$= 6 I_{sc}$

$V_o = 6\left(\frac{2}{15}V_s + \frac{2}{3}I_s\right) = \frac{4}{5}V_s + 4I_s$

24 ~ 25



24. $R_{eq} = 2 + (3 /\!/ 6) = 4\,\Omega$

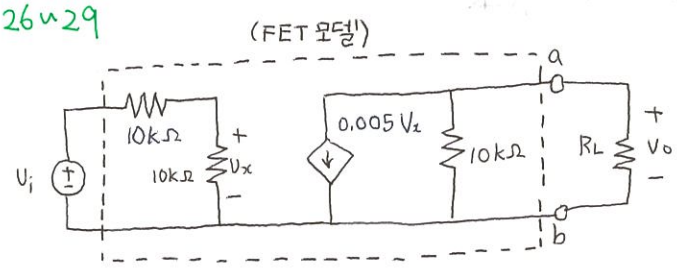
$V_{oc} = 18 \times \frac{6}{3+6} + 6 \times 2 \times \frac{3}{3+6} = 16\,V$

$R_L = R_{eq} = 4$

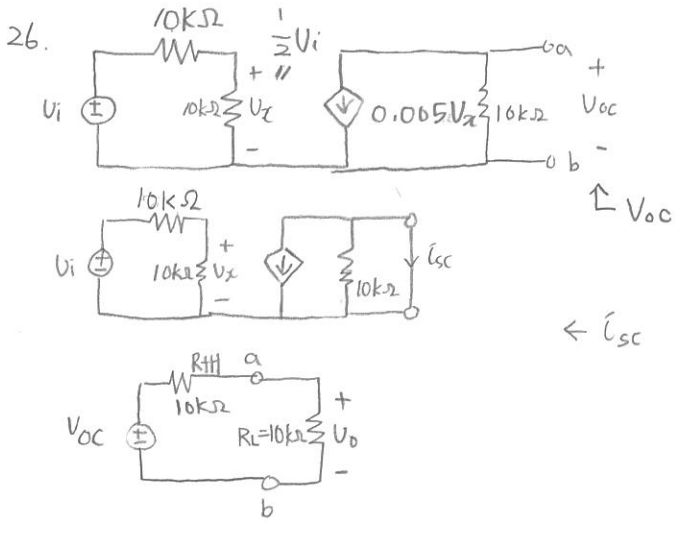
25. $P_{L,max} = R_{eq} \times \left(\frac{V_{oc}}{2R_{eq}}\right)^2 = \frac{V_{oc}^2}{4R_{eq}}$

$= \frac{16 \cdot 16}{4 \cdot 4} = 16W$

26 ~ 29



26.



$V_{oc} = -10 \times 10^3 \times 0.005 V_x = -50 V_x$

$V_x = \frac{1}{2}V_i$

$V_{oc} = -25 V_i$

$I_{sc} = -0.005 V_x$

$= -0.0025 V_i$

$R_{eq} = \frac{V_{oc}}{I_{sc}} = \frac{-25V_i}{-0.0025V_i} = 10\,k\Omega$

27 $R_{eq} = R_L$ ⇐ 최대

$R_{eq} = 10k\Omega$

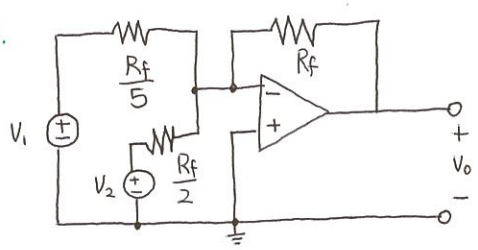
28 $P_{L,max} = \frac{V_{oc}^2}{4R_{eq}} = \frac{(-25V_i)^2}{4 \cdot 10} = \frac{625V_i^2}{40}$

$= 15.6\, V_i^2\ [mW]$

29. $V_o = \frac{10}{10+10} V_{oc} = \frac{1}{2} V_{oc} = -\frac{25}{2} V_i$

전압이득 $\frac{V_o}{V_i} = -\frac{25}{2}$

30.

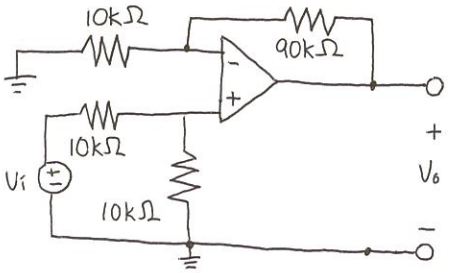


$\frac{V_1-0}{R_f/5} + \frac{V_2-0}{R_f/2} + \frac{V_o-0}{R_f} = 0$

$5V_1 + 2V_2 + V_o = 0$

$V_o = -(5V_1 + 2V_2)$

31.



반전단자 ⇒ KCL 적용

$\frac{0-V_-}{10k} + \frac{V_o-V_-}{90k} = 0$

$-9V_- + V_o - V_- = 0$

$V_- = \frac{1}{10} V_o$

비반전단자 ⇒ KCL 적용

$\frac{V_i-V_+}{10} + \frac{0-V_+}{10} = 0$

$V_i - V_+ - V_+ = 0$

$V_+ = \frac{1}{2} V_i$

$V_- = V_+$

$\frac{1}{10} V_o = \frac{1}{2} V_i \qquad V_o = 5V_i$

전압이득 ⇒ $\frac{V_o}{V_i} = \frac{5V_i}{V_i} = 5$

32~36 2차 미분방정식의 해 $x(t)$, $t \geq 0$ 라플라스 변환

32. $\frac{d^2v(t)}{dt^2} + 3\frac{dv(t)}{dt} + 2v(t) = 8,\ v(0)=2,\ \dot{v}=0$

$\{s^2V(s) - sv(0) - \dot{v}(0)\} + 3\{sV(s) - v(0)\} + 2V(s) = \frac{8}{s}$

$(s^2+3s+2)V(s) - sv(0) - 3v(0) - \dot{v}(0) = \frac{8}{s}$

$V(s) = \frac{8}{s(s+1)(s+2)} + \frac{2(s+3)}{(s+1)(s+2)}$

$= \frac{2(s^2+3s+4)}{s(s+1)(s+2)} = \frac{2s^2+6s+8}{s(s+1)(s+2)}$

$k_1 = \{V(s)s\}|_{s=0}$

$= \frac{2s^2+6s+8}{(s+1)(s+2)}\Big|_{s=0} = \frac{8}{2} = 4$

$k_2 = \{V(s)(s+1)\}|_{s=-1}$

$= \frac{2s^2+6s+8}{s(s+2)}\Big|_{s=-1} = \frac{2-6+8}{-1} = -4$

$k_3 = \{V(s)(s+2)\}|_{s=-2}$

$= \frac{2s^2+6s+8}{s(s+3)}\Big|_{s=-2} = \frac{8-12+8}{2} = \frac{4}{2} = 2$

$V(s) = \frac{4}{s} + \frac{-4}{s+1} + \frac{2}{s+2}$

$v(t) = 4 - 4e^{-t} + 2e^{-2t}$

33. $\frac{d^2v(t)}{dt^2} + 5\frac{dv(t)}{dt} + 6v(t) = 24\cos 3t$

$\{s^2V(s) - sv(0) - \dot{v}(0)\} + 5\{sV(s) - v(0)\} + 6V(s) = \frac{24s}{s^2+9}$

$(s^2+5s+6)V(s) = \frac{24s}{s^2+9}$

$V(s) = \frac{24s}{(s^2+9)(s+3)(s+2)}$

$= \frac{C_1s+C_2}{s^2+9} + \frac{K_1}{s+3} + \frac{K_2}{s+2}$

$K_1 = (s+2)V(s)\big|_{s=-2}$

$= \frac{24s}{(s+3)(s^2+9)}\Big|_{s=-2}$

$= -\frac{48}{13}$

$K_2 = (s+3)V(s)\big|_{s=-3}$

$= \frac{24s}{(s+2)(s^2+9)}\Big|_{s=-3}$

$= \frac{8}{2} = 4$

$24s = -\frac{48}{13}(s+3)(s^2+9) + 4(s+2)(s^2+9) + (C_1s+C_2)(s+2)(s+3)$

$= \left(-\frac{48}{13}+4+C_1\right)s^3 + \left(-\frac{48}{13}+3+8+5C_1+C_2\right)s^2 + \left(-\frac{48}{13}\times 9 + 36 + 6C_1 + 5C_2\right)s + \left(-\frac{48}{13}\times 27 + 4\times 18 + 6C_2\right)$

$-\frac{48}{13}+4+C_1 = 0 \qquad C_1 = -\frac{4}{13}$

$-\frac{48}{13}\times 3 + 8 + 5C_1 + C_2 = 0 \qquad C_2 = \frac{60}{13}$

$V(s) = \frac{-\frac{4}{13}s + \frac{60}{13}}{s^2+9} + \frac{4}{s+3} + \frac{-\frac{48}{13}}{s+2}$

$V(t) = -\frac{48}{13}e^{-2t} + 4e^{-3t} - \frac{4}{13}\cos 3t + \frac{20}{13}\sin 3t$

34 $\frac{d^2v(t)}{dt^2} + 2\frac{dv(t)}{dt} + v(t) = 8, \quad v(0) = \dot{v}(0) = 0$

$\{s^2V(s) - sv(0) - \dot{v}(0)\} + 2\{sV(s) - v(0)\} + V(s) = \frac{8}{s}$

$(s^2+2s+1)V(s) = \frac{8}{s}$

$V(s) = \frac{8}{s(s+1)^2}$

$= \frac{k_1}{s} + \frac{k_2}{(s+1)^2} + \frac{k_3}{s+1}$

$k_1 = \{V(s)s\}\big|_{s=0}$

$= \frac{8}{(s+1)^2}\Big|_{s=0} = 8$

$k_2 = \{V(s)(s+1)^2\}\big|_{s=-1}$

$= \frac{8}{s}\Big|_{s=-1} = -8$

$k_3 = \left[\frac{d}{ds}\{V(s)(s+1)^2\}\right]\Big|_{s=-1}$

$= \frac{-8}{s^2}\Big|_{s=-1} = -8$

$V(s) = \frac{8}{s} + \frac{-8}{(s+1)^2} + \frac{-8}{s+1}$

$V(t) = 8 - 8te^{-t} - 8e^{-t}$

35. $\frac{d^2v(t)}{dt^2} + 4v(t) = 16$, $v(0) = \dot{v}(0) = 0$

$\{s^2V(s) - sv(0) - \dot{v}(0)\} + 4V(s) = \frac{16}{s}$

$(s^2+4)V(s) = \frac{16}{s}$

$V(s) = \frac{16}{s(s^2+4)}$

$= \frac{k_1}{s} + \frac{c_1 s + c_2}{s^2+4}$

$(k_1 + c_1)s^2 = 0$

$c_2 s = 0$

$4k_1 = 16 \quad \Rightarrow k_1 = 4$

$c_1 = -4$

$V(s) = \frac{4}{s} + \frac{-4s}{s^2+4}$

$v(t) = 4 - 4\cos 2t \quad , t \geq 0$

36. $\frac{d^2v(t)}{dt^2} + 2\frac{dv(t)}{dt} + 2v(t) = 8u_s(t)$, $v(0) = \dot{v}(0) = 0$

$\{s^2V(s) - sv(0) - \dot{v}(0)\} + 2\{sV(s) - v(0)\} + 2V(s) = \frac{8}{s}$

$(s^2+2s+2)V(s) = \frac{8}{s}$

$V(s) = \frac{8}{s(s^2+2s+2)}$

$= \frac{k_1}{s} + \frac{c_1 s + c_2}{s^2+2s+2}$

$(k_1 + c_1)s^2 = 0$

$(2k_1 + c_2)s = 0$

$2k_1 = 8 \quad \Rightarrow k_1 = 4$

$c_1 = -4$

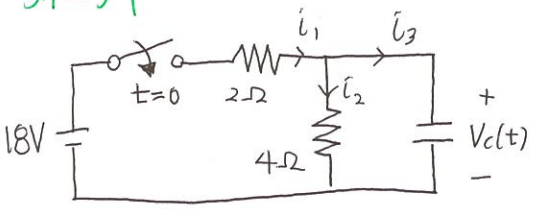
$c_2 = -8$

$V(s) = \frac{4}{s} + \frac{-4s-8}{s^2+2s+2} = \frac{4}{s} + \frac{-4(s+1)-4}{(s+1)^2+1^2}$

$v(t) = 4 - 4e^{-t}\cos t - 4e^{-t}\sin t$

$= 4 - 4e^{-t}(\cos t + \sin t) \quad , t \geq 0$

37~39

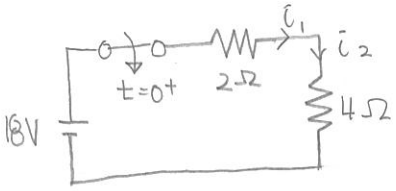


37. $t=0^-$ 에서의 v_c, i_1, i_2, i_3

$i_1(0^-) = i_2(0^-) = i_3(0^-) = 0$ [A]

$V(0^-) = 0$ [V]

38. $t=0^+$ 에서의 v_c, i_1, i_2, i_3



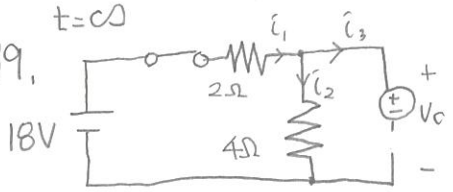
$V_c(0^+) = V_c(0^-) = 0$ [V]

$i_2(0^+) = \frac{V_c(0^+)}{4} = 0$ [A]

$i_1(0^+) = \frac{18-0}{2} = 9$ [A]

$i_3 = i_1 = 9$ [A]

39.

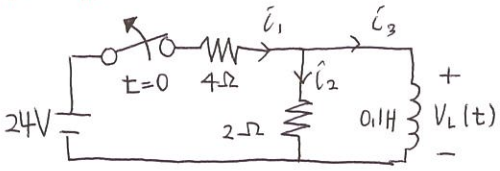


$V_c(\infty) = 18 \times \frac{4}{2+4} = 12$[V]

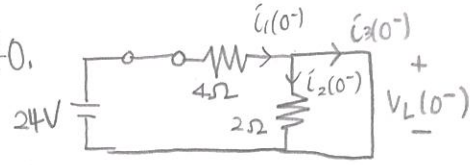
$i_1(\infty) = i_2(\infty) = \frac{18}{6} = 3$ [A]

$i_3(\infty) = 0$ [A]

40~42



40.



$t=0^-$

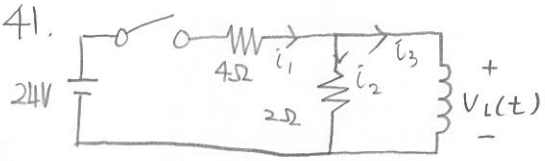
$V_L(0^-) = 0\,[V]$ ← 일정한 전류 흘러서

$i_1(0^-) = \frac{24}{4} = 6\,[A]$

$i_3(0^-) = i_1(0^-) = 6\,[A]$

$i_2(0^-) = 0A$

41.



$i_3(0^+) = i_3(0^-) = 6\,[A]$

$i_2 = -i_3(0^+) = -6\,[A]$

$i_1(0^+) = 0\,[A]$

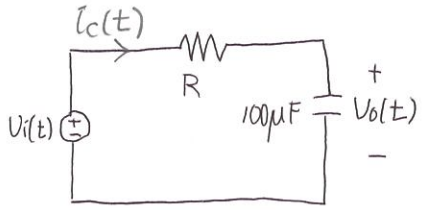
$V_L(0^+) = 2 \times i_2(0^+) = -12\,[V]$

42. 시간이 지남에 따라 0J

$V_L(t) = 0\,[V]$

$i_1(\infty) = i_2(\infty) = i_3(\infty) = 0\,[A]$

43~47



43. $V_i(t) = i_C(t)R + V_o(t)$

$i_C(t) = 100\mu F \cdot \frac{dV_o(t)}{dt}$

$V_i(t) = 100\mu F \cdot R \cdot \frac{dV_o(t)}{dt} + V_o(t)$

44. 1) 입력이 $\partial V_i(t)$ 일때,

$\partial V_i(t) = \partial\left(100\mu F \cdot R \cdot \frac{dV_o(t)}{dt} + V_o(t)\right)$

$= 100\mu F R \cdot \frac{d}{dt}\partial V_o(t) + \partial V_o(t)$

출력 $\partial V_o(t)$ 성립 ← 비례성 만족

2) 입력 $V_{i1}(t) + V_{i2}(t)$ 일때,

$V_{i1}(t) = 100\mu F \cdot R \cdot \frac{d}{dt}V_{o1}(t) + V_{o1}(t)$

$V_{i2}(t) = 100\mu F \cdot R \cdot \frac{d}{dt}V_{o2}(t) + V_{o2}(t)$

$V_{i1}(t) + V_{i2}(t) = 100\mu F \cdot R \cdot \frac{d}{dt}(V_{o1}(t) + V_{o2}(t))$

$+ (V_{o1}(t) + V_{o2}(t))$

출력 $V_{o1}(t) + V_{o2}(t)$ 성립 ← 중첩성 만족

⇒ 비례성, 중첩성을 만족시키므로 선형이다

45. $\tau = RC$

$= R \times 100 \times 10^{-6} = R \times 10^{-4}\,[s]$

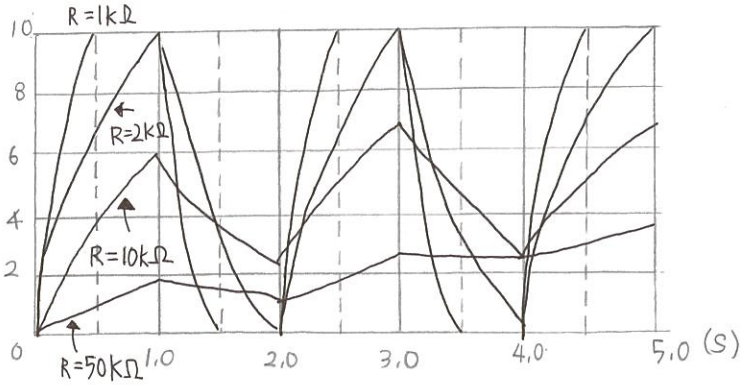
46~47

$R=1k\Omega \longrightarrow \tau = 0.1$초

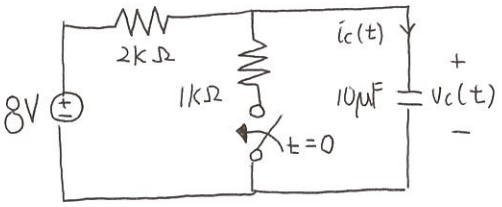
$R=2k\Omega \longrightarrow \tau = 0.2$초

$R=10k\Omega \longrightarrow \tau = 1$초

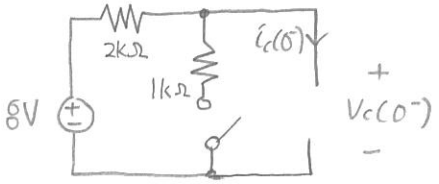
$R=50k\Omega \longrightarrow \tau = 5$초



48~53



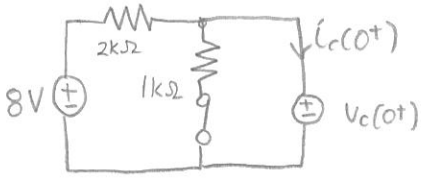
48. $t=0^-$



$i_c(0^-) = 0[A]$

$v_c(0^-) = 8[V]$

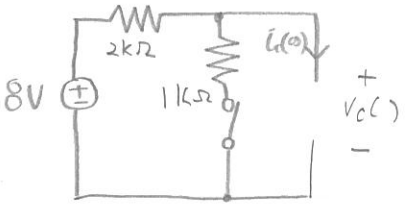
49. $t=0^+$



$v_c(0^+) = v_c(0^-) = 8[V]$

$i_c(0^+) = \frac{8 - v_c(0^+)}{2k} - \frac{v_c(0^+)}{1k} = -8[mA]$

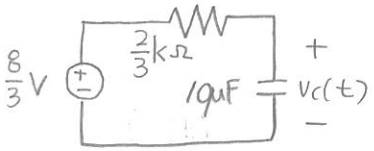
50. $t=\infty$



$v_c(\infty) = 8 \times \frac{1}{2+1} = \frac{8}{3}[V]$

$i_c(\infty) = 0[A]$

51. $t \geq 0 \Rightarrow$ KVL



$\frac{8}{3} = \frac{2}{3} \times 10^3 i_c(t) + v_c(t)$

$i_c(t) = 10 \times 10^{-6} \frac{dv_c(t)}{dt}$

$\Rightarrow 400 = 150 v_c(t) + \frac{dv_c(t)}{dt}$

커패시터는 연속 $v_c(0^+) = v_c(0^-) = 8[V]$

라플라스 $\Rightarrow sV(s) - 8 + 150V(s) = \frac{400}{s}$

$V(s) = \frac{8}{s+150} + \frac{400}{s(s+150)}$

$= \frac{8}{s+150} + \frac{8}{3}\left(\frac{1}{s} - \frac{1}{s+150}\right)$

$= \frac{\frac{16}{3}}{s+150} + \frac{\frac{8}{3}}{s}$

$v_c(t) = \frac{8}{3} + \frac{16}{3} e^{-150t}[V], \ t>0$

$i_c(t) = 10 \times 10^{-6} \times \frac{dv_c(t)}{dt}$

$= 10 \times 10^{-6} \times \frac{16}{3} \times (-150) e^{-150t}$

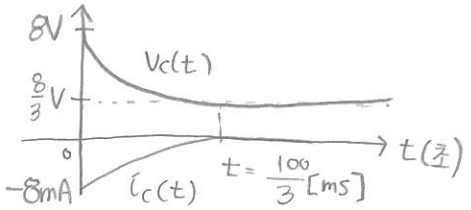
$= -8e^{-150t}[mA] \quad t>0$

52 $\tau = \frac{1}{150}$ 초

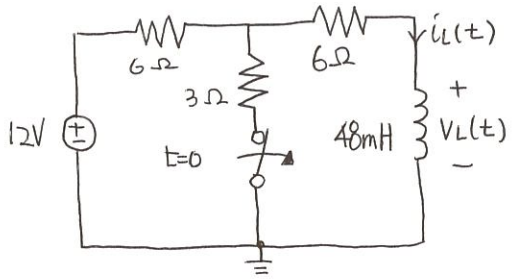
$5\tau = \frac{1}{30}$ 초 후 정상 도달

53 $v_C(t) = \frac{8}{3} + \frac{16}{3}e^{-150t}$ [V], $t \geq 0$

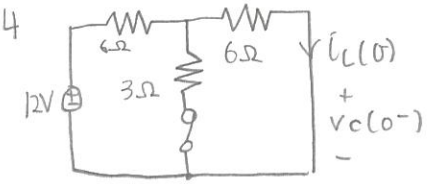
$$i_C(t) = \begin{cases} 0, & t = 0^- \\ -8e^{-150t}, & t > 0 \end{cases} \text{ [mA]}$$



54 ~ 57



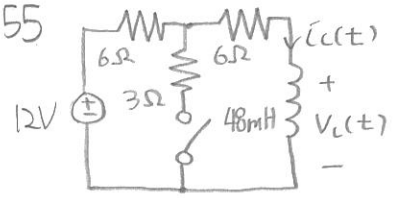
54



$i_L(0^-) = \frac{12}{6+2} \times \frac{3}{3+6} = \frac{1}{2}$ [A]

$v_C(0^-) = 0$ [V]

55



KVL ⇒ $12 = 12\, i_C(t) + 48\times10^{-3} \frac{di_L(t)}{dt}$

$$\frac{di_L(t)}{dt} + 250 i_L(t) = 250$$

$i_L(0^+) = i_L(0^-) = \frac{1}{2}$ [A]

라플라스 ⇒ $sI_L(s) - \frac{1}{2} + 250 I_L(s) = \frac{250}{s}$

$$I_L(s) = \frac{250}{s(s+250)} + \frac{1}{2}\left(\frac{1}{s+250}\right)$$

$$= \frac{1}{s} - \frac{1}{2}\left(\frac{1}{s+250}\right)$$

$$\begin{cases} I_L(t) = 1 - \frac{1}{2}e^{-250t} \text{ [A]}, & t > 0 \\ v_C(t) = 48\times10^{-3} \frac{di(t)}{dt} \end{cases}$$

$= 48\times10^{-3} \times \frac{1}{2} \times 250\, e^{-250t}$

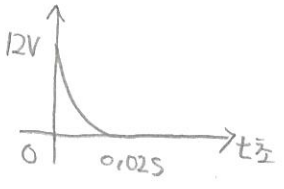
$= 6e^{-250t}$ [V], $t > 0$

56. 시정수 $\tau = \frac{48\times10^{-3}}{12} = 0.004$ [s]

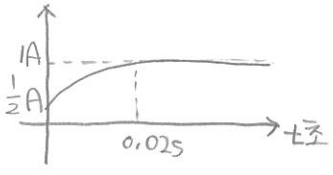
$5\tau = 0.02$ [s] 후 정상 도달

57. $i_L(t) = 1 - \frac{1}{2}e^{-250t}$ [A], $t \geq 0$

$$v_L(t) = \begin{cases} 0 & , t = 0^- \\ 6e^{-250t} & , t > 0 \end{cases} \text{ [V]}, \quad t > 0$$



$v_L(t)$ 그래프



$i_L(t)$ 그래프