

IT@CookBook

베이직 회로이론

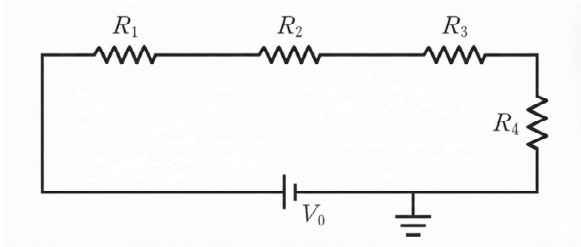
연습문제 정답

Chapter 01

번호	답
1.1	(a) [C] (b) 두 위치에서의 전위의 차이 (c) power (d) Watt (e) 단위 시간당 에너지, $P = VI$
1.2	12 [J]
1.3	(a) $V_{AB} = 3[V]$ (b) $V_{AC} = 5[V]$ (c) $V_{BD} = 3[V]$
1.4	$R = 5[\Omega]$, $G = 0.2[S]$
1.5	$I = 8[A]$
1.6	$P = 12[W]$, $P = 12[W]$
1.7	③
1.8	⑤
1.9	(a) 0.035 [mA] (b) 25 [μA] (c) 38.4 [kV] (d) 66 [kV] (e) 2.7 [μW]
1.10	$i(t) = 6t [A]$, $t = 2$ 일 때의 전류 $I = 12 [A]$
1.11	$t = 1$ 일 때의 전력 $P = -e^{0.5} [W]$
1.12	$R = 1,000[\Omega]$
1.13	$R = 5 [k\Omega]$
1.14	$I = 0.2 [mA]$
1.15	$P = 6.25 [mW]$
1.16	$R = 200 [\Omega]$
1.17	①
1.18	④
1.19	④

Chapter 02

번호	답
2.1	$R_t = 10 [\text{k}\Omega]$
2.2	$R_t = 10 [\text{k}\Omega]$
2.3	$R_t = 1,000 [\Omega]$
2.4	$R_t = 40 [\text{k}\Omega]$
2.5	$R_t = 45 [\text{k}\Omega]$
2.6	$R_t = 400 [\Omega]$
2.7	(a) $V_2 = 6 [\text{V}]$ (b) $V_2 = 8 [\text{V}]$ (c) $V_2 = 9.8 [\text{V}]$
2.8	(a) $I_2 = 10 [\text{A}]$ (b) $I_2 = 15 [\text{A}]$
2.9	(a) $I_1 = 72 [\text{A}]$ (b) $I_1 = 44 [\text{A}]$ (c) $I_1 = 33 [\text{A}]$
2.10	(a) $R_t = 2 [\Omega]$ (b) $I_t = 15 [\text{A}]$ (c) $I_1 = 10 [\text{A}]$, $I_2 = 5 [\text{A}]$
2.11	(a) $R_t = \frac{33}{7} [\text{k}\Omega]$ (b) $I_1 = \frac{140}{33} [\text{mA}]$ (c) $I_2 = \frac{80}{33} [\text{mA}]$, $I_3 = \frac{20}{11} [\text{mA}]$ (d) $V_1 = \frac{140}{11} [\text{V}]$, $V_2 = \frac{80}{11} [\text{V}]$, $V_3 = \frac{80}{11} [\text{V}]$
2.12	$V_1 = 6 [\text{V}]$, $V_2 = 6 [\text{V}]$, $V_3 = 8 [\text{V}]$ $I_1 = I_2 = I_3 = 2 [\text{mA}]$
2.13	$V_1 = 40 [\text{V}]$, $I_1 = \frac{10}{9} [\text{mA}]$, $I_2 = \frac{5}{9} [\text{mA}]$, $I_3 = \frac{10}{3} [\text{mA}]$
2.14	$R_t = 192 [\Omega]$
2.15	$I_t = 2 [\text{A}]$
2.16	(a) $I_t = 20 [\text{mA}]$ (b) $I_1 = 5 [\text{mA}]$, $I_2 = 5 [\text{mA}]$, $I_3 = 10 [\text{mA}]$, $I_4 = 16 [\text{mA}]$, $I_5 = 4 [\text{mA}]$ (c) $V_1 = V_2 = V_3 = V_4 = V_5 = 160 [\text{V}]$, $P_3 = 1.6 [\text{W}]$ (d) $P_1 = 0.8 [\text{W}]$, $P_2 = 0.8 [\text{W}]$, $P_4 = 2.56 [\text{W}]$, $P_5 = 0.64 [\text{W}]$ (e) $P = 6.4 [\text{W}]$
2.17	(a) $I_t = 0.12 [\text{A}]$ (b) $I_1 = 0.12 [\text{A}]$, $I_2 = 0.08 [\text{A}]$, $I_3 = I_4 = I_5 = 0.04 [\text{A}]$

	(c) $V_1 = 6[\text{V}]$, $V_2 = 24[\text{V}]$, $V_3 = 12[\text{V}]$, $V_4 = 8[\text{V}]$, $V_5 = 4[\text{V}]$ (d) $P_1 = 0.72[\text{W}]$, $P_2 = 1.92[\text{W}]$, $P_3 = 0.48[\text{W}]$, $P_4 = 0.32[\text{W}]$, $P_5 = 0.16[\text{W}]$ (e) $P = 3.6[\text{W}]$
2.18	(a) $I_0 = 3[\text{mA}]$ (b) $I_1 = 1.5[\text{mA}]$
2.19	(a) $I_t = 30[\text{mA}]$ (b) $V_1 = 320[\text{V}]$ (c) $P_1 = 3.2[\text{W}]$ (d) $P_5 = 0[\text{W}]$
2.20	$R_4 = 10[\text{k}\Omega]$
2.21	$V_{R_1} = 3[\text{V}]$, $V_{R_2} = 5[\text{V}]$, $V_{R_3} = 2[\text{V}]$
2.22	(a) 47Ω (b) $V_{R_1} = 6[\text{V}]$, $V_{R_2} = 6[\text{V}]$, $V_{R_3} = 5[\text{V}]$, $V_{R_4} = 3[\text{V}]$ (c) $R_1 : R_2 : R_3 : R_4 = 6 : 6 : 5 : 3$ (d) $R_1 = 3[\text{k}\Omega]$, $R_2 = 3[\text{k}\Omega]$, $R_3 = 2.5[\text{k}\Omega]$, $R_4 = 1.5[\text{k}\Omega]$ 
2.23	(a) $R_1 : R_2 : R_3 = 3 : 2 : 1$ (b) $R_1 = 30[\text{k}\Omega]$, $R_2 = 20[\text{k}\Omega]$, $R_3 = 10[\text{k}\Omega]$
2.24	③
2.25	②
2.26	②
2.27	②

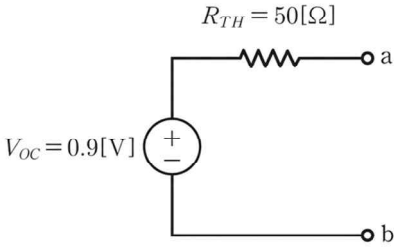
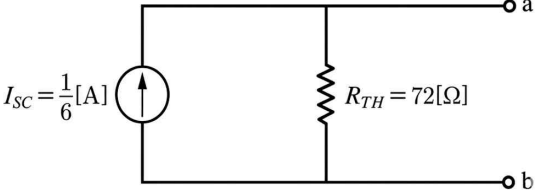
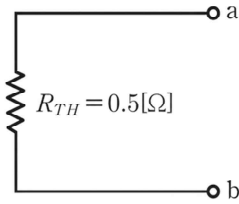
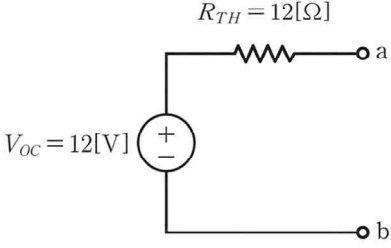
Chapter 03

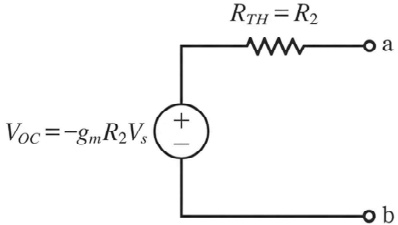
번호	답
3.1	4개
3.2	7개
3.3	③
3.4	④
3.5	②
3.6	$R_T = 900[\Omega]$
3.7	$I_3 = 2[\text{A}]$
3.8	$V_2 = 5[\text{V}]$
3.9	$V_2 = -6[\text{V}]$
3.10	$V_R = 4[\text{V}]$
3.11	$V_R = 10[\text{V}]$
3.12	5개
3.13	$V_{R2} = -3[\text{V}], V_{R3} = -4[\text{V}]$
3.14	(a) $I_1 = 20[\text{A}]$ (b) $V_1 = 2[\text{kV}]$ (c) $P_1 = 40[\text{kW}]$ (d) $P_3 = 35[\text{kW}]$
3.15	$V_4 = 2[\text{V}], V_5 = 6[\text{V}], V_7 = 9[\text{V}]$
3.16	$I_1 = 10[\text{A}], I_3 = 7[\text{A}], I_4 = 5[\text{A}], I_5 = 8[\text{A}], I_7 = 10[\text{A}]$
3.17	(a) $I_1 = I_2 = 0.2[\text{mA}]$ (b) $I_1 = I_2 = 0[\text{A}]$
3.18	③
3.19	②
3.20	④
3.21	③
3.22	④

Chapter 04

번호	답
4.1	(a) $I_1 = 3.2[\text{A}]$, $I_2 = 1.4[\text{A}]$ (b) $I_1 = 3.2[\text{A}]$, $I_2 = 1.4[\text{A}]$
4.2	(a) $I_3 = \frac{2}{7}[\text{A}]$, $I_4 = \frac{44}{21}[\text{A}]$ (b) $I_3 = \frac{2}{7}[\text{A}]$, $I_4 = \frac{44}{21}[\text{A}]$
4.3	$I_1 = 3[\text{A}]$, $V_2 = 3[\text{V}]$
4.4	$R_3 = 2[\Omega]$
4.5	$I_1 = \frac{16}{7}[\text{A}]$
4.6	$I_1 = 2[\text{A}]$, $V_2 = 4[\text{V}]$
4.7	$P = 2[\text{W}]$
4.8	$I_A = 2[\text{A}]$
4.9	$V_3 = 15[\text{V}]$
4.10	$V_2 = -2[\text{mV}]$
4.11	$I_y = 4[\text{A}]$
4.12	$V_a = 2[\text{V}]$, $i_x = 5[\text{A}]$
4.13	②
4.14	①
4.15	②
4.16	②
4.17	③
4.18	②
4.19	③
4.20	②
4.21	③
4.22	④
4.23	④
4.24	②
4.25	②

Chapter 05

번호	답
5.1	(a) $I_2 = 6[\text{A}]$ (b) $I_2 = 2[\text{A}]$ (c) $I_2 = 8[\text{A}]$
5.2	(a) $I_4 = 1[\text{A}]$, $V_2 = 6[\text{V}]$ (b) $I_4 = 2[\text{A}]$, $V_2 = 4[\text{V}]$ (c) $I_4 = 3[\text{A}]$, $V_2 = 6[\text{V}]$
5.3	
5.4	
5.5	(a) $R_{TH} = 20[\Omega]$ (b) $V_{OC} = 24[\text{V}]$ (c) $P_{L,\max} = 7.2[\text{W}]$
5.6	$R_3 = 8[\Omega]$
5.7	(a) $R_{TH} = 1.5625[\Omega]$ (b) $V_{OC} = 15[\text{V}]$ (c) $P_{L,\max} = 36[\text{W}]$
5.8	
5.9	$V_{TH} = 12[\text{V}]$, $R_{TH} = 1[\text{k}\Omega]$
5.10	

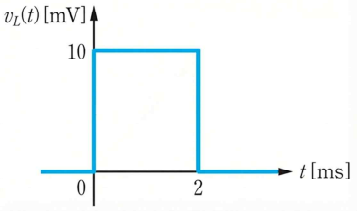
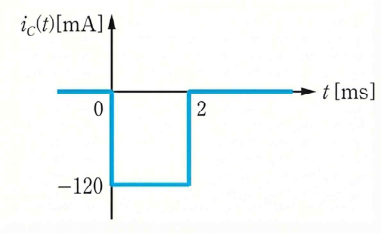
5.11	(a) $V_{OC} = -g_m R_2 V_S$ (b) $I_{SC} = -g_m V_S$ (c) $R_{TH} = R_2$ 
5.12	①
5.13	③
5.14	③
5.15	④
5.16	②
5.17	④
5.18	①
5.19	④
5.20	③

Chapter 06

번호	답
6.1	$C_t = 25[\mu\text{F}]$
6.2	$C_t = 450[\mu\text{F}]$
6.3	$C_t = 75[\mu\text{F}]$
6.4	$C_t = \frac{840}{89}[\mu\text{F}]$
6.5	$C_0 = 20[\mu\text{F}]$
6.6	$L_t = 28[\text{mH}]$
6.7	$L_t = 3[\text{mH}]$
6.8	$L_t = \frac{205}{3}[\text{mH}]$
6.9	$L_t = \frac{100}{7}[\text{mH}]$
6.10	$L_0 = 20[\mu\text{H}]$
6.11	(a) $I_{R1} = 3[\text{mA}]$ (b) $V_{R2} = 9[\text{V}]$
6.12	(a) $I_{R1} = 0[\text{A}]$ (b) $V_{R2} = 10[\text{V}]$, $I_{R2} = 2[\text{mA}]$ (c) $I_{L1} = 2[\text{mA}]$
6.13	$W_{C(t)} = 162[\mu\text{J}]$
6.14	$W_{L(t)} = 4[\text{nJ}]$
6.15	(a) $V_{C2} = 6[\text{V}]$ (b) $Q_2 = 120[\mu\text{C}]$
6.16	$i_C(t) = 3C[\mu\text{A}]$
6.17	$v_L(t) = 6L\cos(3t)[\text{mV}]$
6.18	(a) $V_{R3} = 2[\text{V}]$ (b) $I_{L1} = \frac{1}{3}[\text{mA}]$ (c) $W_{C3} = 4[\mu\text{J}]$ (d) $W_{L2} = \frac{1}{9}[\text{nJ}]$
6.19	(a) $C_2 = 10[\text{nF}]$ (b) $W_{C4} = 360[\text{nJ}]$
6.20	$L_2 = 20[\text{mH}]$
6.21	②
6.22	③
6.23	④
6.24	①
6.25	③

6.26	④
6.27	④
6.28	④
6.29	②
6.30	②
6.31	①

Chapter 07

번호	답
7.1	(a) $i_L(0) = 2.5[\text{A}]$ (b) $\frac{di_L(t)}{dt} + i_L(t) = 2.5$ (c) $i_{L,T}(t) = Ae^{-t}[\text{A}]$ (d) $i_{L,SS}(t) = 2.5[\text{A}]$ (e) $i_L(t) = 2.5[\text{A}]$
7.2	(a) $v_C(0) = V_0 = 12[\text{V}]$ (b) $\frac{dv_C(t)}{dt} + v_C(t) = 4$ (c) $v_{C,T}(t) = Ae^{-t}[\text{V}]$ (d) $v_{C,SS}(t) = 4[\text{V}]$ (e) $v_C(t) = 8e^{-t} + 4[\text{V}]$
7.3	
7.4	
7.5	(a) $i_L(0) = 0.5[\text{A}]$ (b) $\frac{di_L(t)}{dt} + 3.5i_L(t) = 2.25$ (c) $i_{L,T}(t) = Ae^{-3.5t}[\text{A}]$ (d) $i_{L,SS}(t) = \frac{9}{14}[\text{A}]$ (e) $i_L(t) = -\frac{1}{7}e^{-3.5t} + \frac{9}{14}[\text{A}]$
7.6	(a) $v_C(0) = 5[\text{V}]$ (b) $\frac{dv_C(t)}{dt} + \frac{1}{28}v_C(t) = \frac{5}{14}$ (c) $v_{C,T}(t) = Ae^{-\frac{t}{28}}[\text{V}]$, $\tau = 28[\text{s}]$ (d) $v_{C,SS}(t) = 10[\text{V}]$ (e) $v_C(t) = -5e^{-\frac{t}{28}} + 10[\text{V}]$
7.7	(a) $i_L(0) = 0[\text{A}]$ (b) $i_L(\infty) = 4[\text{mA}]$
7.8	(a) $v_C(0) = 5[\text{V}]$ (b) $v_C(\infty) = 7[\text{V}]$ (c) $i_{R3}(\infty) = \frac{2}{3}[\text{A}]$
7.9	(a) $v_C(0) = 10[\text{V}]$ (b) $\frac{dv_C(t)}{dt} + 2v_C(t) = 18$

	(c) $v_{C,T}(t) = Ae^{-2t} [\text{V}]$ (d) $v_{C,SS}(t) = 9[\text{V}], \tau = 0.5[\text{s}]$ (e) $v_C(t) = e^{-2t} + 9[\text{V}]$ (f) $v_{R3}(t) = \frac{1}{3}e^{-2t} + 9[\text{V}]$
7.10	(a) $v_C(0) = -8[\text{V}]$ (b) $\frac{d^2v_C(t)}{dt^2} + 3\frac{dv_C(t)}{dt} + 2v_C(t) = -96e^{-3t}$ (c) $v_{C,T}(t) = A_1e^{-t} + A_2e^{-2t} [\text{V}], \tau = 1[\text{s}]$ 또는 $\tau = 0.5[\text{s}]$ (d) $v_{C,SS}(t) = -48e^{-3t} [\text{V}]$ (e) $v_C(t) = -32e^{-t} + 72e^{-2t} - 48e^{-3t} [\text{V}]$
7.11	(a) $v_C(0) = 8[\text{V}]$ (b) $\frac{d^2v_C(t)}{dt^2} + \frac{13}{3}\frac{dv_C(t)}{dt} + 8v_C(t) = 0$ (c) $\tau = \frac{6}{13}[\text{s}], v_{C,T}(t) = e^{-\frac{13}{6}t} [A_1\cos(\frac{\sqrt{119}}{6}t) + A_2\sin(\frac{\sqrt{119}}{6}t)][\text{V}]$ (d) $v_{C,SS}(t) = 0[\text{V}]$ (e) $v_C(t) = e^{-\frac{13}{6}t} [A_1\cos(\frac{\sqrt{119}}{6}t) + A_2\sin(\frac{\sqrt{119}}{6}t)][\text{V}]$ (f) $i_L(t) = e^{-\frac{13}{6}t} [B_1\cos(\frac{\sqrt{119}}{6}t) + B_2\sin(\frac{\sqrt{119}}{6}t)][\text{A}]$ (g) $i_L(t) = e^{-\frac{13}{6}t} [2\cos(\frac{\sqrt{119}}{6}t) + \frac{26}{\sqrt{119}}\sin(\frac{\sqrt{119}}{6}t)][\text{A}]$
7.12	②
7.13	④
7.14	③
7.15	②
7.16	④
7.17	③
7.18	②
7.19	④
7.20	④
7.21	③
7.22	④
7.23	①

Chapter 08

번호	답
8.1	(a) $\frac{V_1 I}{Z} = 16 \angle -45^\circ$ (b) $V_1 + V_2 \simeq 26.15 \angle 36.59^\circ$
8.2	$Z_T = 10 - j\frac{40}{3}[\Omega]$
8.3	$R = 5.5\sqrt{2}[\Omega], X = -5.5\sqrt{6}[\Omega]$
8.4	(a) $Z_C = -j[\Omega]$ (b) $i_S(t) = 10\sqrt{5}\cos(10t + 63.43^\circ)[A]$ (c) $i_R(t) = 10\cos(10t)[A]$
8.5	(a) $V = 110 \angle 0^\circ [V], I = 5\sqrt{2} \angle 60^\circ [A]$ (b) $S = 550\sqrt{2} \angle -60^\circ [VA]$ (c) $ S = 550\sqrt{2}[VA], P = 275\sqrt{2}[W], Q = -275\sqrt{6}[VAR]$
8.6	(a) $ S = 500[VA]$ (b) $Q = 300[VAR]$ (c) $4:3$ (d) $L = 1.5[H]$
8.7	(a) $P_{av} = \frac{25}{24}[W]$ (b) $P_{av} = \frac{17}{24}[W]$
8.8	(a) $Z_T = \frac{100}{89} + j\frac{196}{89}[\Omega]$ (b) $I_S = \frac{25}{17} - j\frac{49}{17}[A], i_S(t) = \frac{\sqrt{3026}}{17}\cos(2t - 62.97^\circ)[A]$ (c) $I_R = -\frac{15}{17} - j\frac{25}{17}[A], i_R(t) = \frac{\sqrt{850}}{17}\cos(2t - 120.96^\circ)[A]$ (d) $S = \frac{100}{17} + j\frac{196}{17}[VA]$ (e) $P_R = \frac{100}{17}[W], Q_R = 0[VAR]$ (f) $P_C = 0[W], Q_C = -\frac{160}{17}[VAR]$
8.9	(a) $pf = 0.8$ (b) $pf = \frac{\sqrt{5}}{3}$
8.10	$L = 0.2[H]$
8.11	$Z_{Load} = 4000 - j0.04[\Omega], P_{Load, \max} = 12.5[W]$

8.12	$f_0 \simeq 0.0331[\text{Hz}]$
8.13	$P_{R2} = 100[\text{W}]$
8.14	(a) 테브난 등가 회로는 $\frac{2-j}{\sqrt{2}}[\text{V}]$ 전압원과 $0.4 - j0.2[\Omega]$ 임피던스가 직렬로 연결된 형태 (b) $Z_{Load} = Z_{th}^* = 0.4 + j0.2[\Omega]$ $P_{Load, \max} = \frac{ V_{th} ^2}{4R_{th}} = \frac{ \frac{2-j}{\sqrt{2}} ^2}{4 \times 0.4} = \frac{2.5}{1.6} = 1.5625[\text{W}]$
8.15	①
8.16	③
8.17	①
8.18	①
8.19	①
8.20	①
8.21	①
8.22	④
8.23	③
8.24	①
8.25	①
8.26	①
8.27	④

Chapter 09

번호	답
9.1	$(a) A + B = \begin{pmatrix} 6 & 3 \\ 4 & 6 \end{pmatrix} \quad (b) A - B = \begin{pmatrix} 2 & 3 \\ 2 & 2 \end{pmatrix}$ $(c) AB = \begin{pmatrix} 11 & 6 \\ 10 & 8 \end{pmatrix} \quad (d) A^{-1} = \begin{pmatrix} \frac{4}{7} & -\frac{3}{7} \\ -\frac{3}{7} & \frac{4}{7} \end{pmatrix}$
9.2	$BA + 2A + BE + A^{-1}B = \begin{pmatrix} 9 & -13 \\ -17.5 & 8 \end{pmatrix}$
9.3	$(a) Z = \begin{pmatrix} 3 & 2 \\ 2 & 2 \end{pmatrix} \quad (b) Y = \begin{pmatrix} 1 & -1 \\ -1 & \frac{3}{2} \end{pmatrix} \quad (c) T = \begin{pmatrix} \frac{3}{2} & 1 \\ \frac{1}{2} & 1 \end{pmatrix}$
9.4	$(a) Z = \begin{pmatrix} 1 & 1 \\ 1 & 1+j \end{pmatrix} \quad (b) Y = \begin{pmatrix} \frac{1+j}{j} & -\frac{1}{j} \\ -\frac{1}{j} & \frac{1}{j} \end{pmatrix} \quad (c) T = \begin{pmatrix} 1 & j \\ 1 & 1+j \end{pmatrix}$
9.5	$(a) Z_a = \begin{pmatrix} 2+3j & 3j \\ 3j & 3j \end{pmatrix} \quad (b) Z_b = \begin{pmatrix} 4+6j & 6j \\ 6j & 6j \end{pmatrix} \quad (c) Z_T = \begin{pmatrix} 6+9j & 9j \\ 9j & 9j \end{pmatrix}$
9.6	$(a) Y_a = \begin{pmatrix} -j & j \\ j & 1-j \end{pmatrix} \quad (b) Y_b = \begin{pmatrix} -\frac{j}{3} & \frac{j}{3} \\ \frac{j}{3} & \frac{1}{3} - \frac{j}{3} \end{pmatrix} \quad (c) Y_T = \begin{pmatrix} -\frac{4j}{3} & \frac{4j}{3} \\ \frac{4j}{3} & \frac{4}{3} - \frac{4j}{3} \end{pmatrix}$
9.7	$(a) T_a = \begin{pmatrix} 1+j & -1+2j \\ 1 & 1+j \end{pmatrix} \quad (b) T_b = \begin{pmatrix} 1+j & -2+4j \\ \frac{1}{2} & 1+j \end{pmatrix}$ $(c) T_T = \begin{pmatrix} -\frac{1}{2}+3j & -9+3j \\ \frac{3+3j}{2} & -2+6j \end{pmatrix}$
9.8	$T = \begin{pmatrix} 1-j & 20+10j \\ \frac{1}{10} & 1+2j \end{pmatrix}$
9.9	$h = \begin{pmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{pmatrix} = \begin{pmatrix} \frac{4}{3} & \frac{2}{3} \\ -\frac{2}{3} & \frac{2}{3} \end{pmatrix}$
9.10	$P = \frac{5}{32} [\text{W}]$

9.11	②
9.12	①
9.13	④
9.14	④
9.15	②
9.16	②

Chapter 10

번호	답
10.1	$V_{out} = -5[\text{V}]$
10.2	$I_3 = 1.2[\text{mA}]$
10.3	$R_4 = 30[\text{k}\Omega]$
10.4	(a) $V_{out} = 1.8[\text{V}]$ (b) $V_{out} = 1.8[\text{V}]$
10.5	$(V_{out} =) V_{out3} = 1.5[\text{V}]$
10.6	$V_{out} = -0.9[\text{V}]$
10.7	$V_{out} = 0.54[\text{V}]$
10.8	$V_{Oa} = \left(-\frac{R_4}{R_1}\right)V_1 + \left(-\frac{R_4}{R_2}\right)V_2 + \left(-\frac{R_4}{R_3}\right)V_3,$ $V_{Ob} = V_{Oa} = -1.3[\text{V}], \quad V_{Oc} = -5.2[\text{V}]$
10.9	(a) $Z_C = -j[\Omega]$ (b) $V_{out} = 5 \angle 90^\circ$ (c) $v_{out} = 5\cos(2t + 90^\circ)[\text{V}]$
10.10	②
10.11	④
10.12	③
10.13	④