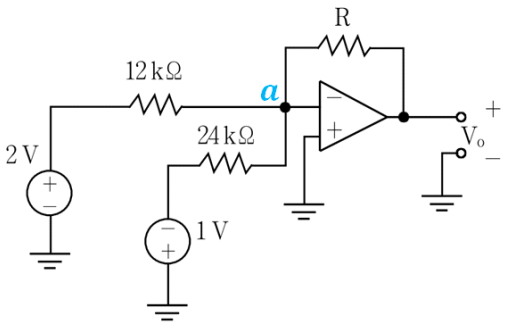
2012년 국가직 7급 회로이론 인책형 해설

01. ④	02. ②	03. ④	04. ①	05. ①	06. ①	07. ③	08. ②	09. ④	10. ④
11. ①	12. ②	13. ②	14. ④	15. ①	16. ①	17. ①	18. ③	19. ③	20. ④

1.【정답】④



$V_a = 0\,[\mathrm{V}]$

Node a : $\dfrac{2-0}{12}+\dfrac{-1-0}{24}=\dfrac{0-(-6)}{R}$

$\dfrac{1}{8}=\dfrac{6}{\mathrm{R}}$, $\mathrm{R}=48\,[\Omega]$

2.【정답】②

$R_{eq}=5\,[\mathrm{k}\Omega]$ 이므로 $\tau=R_{eq}C=5\times10^{3}\times2\times10^{-6}=10^{-2}[\mathrm{sec}]=10^{3}\,[\mathrm{msec}]$

3.【정답】④

부하에서 소비되는 전력이 최대일 때이므로

$\mathrm{Z_L}=\overline{\mathrm{Z_t}}=10-\mathrm{j}10$

$\mathrm{P_{max}}=\dfrac{\mathrm{V_t^2}}{4\mathrm{R}}=\dfrac{50^2}{10}=250\,[\mathrm{W}]$

4.【정답】①

$$H(s)=\frac{10^4(s+1)}{(s+10)(s+100)}=\frac{10^4(s+1)}{10^3\left(\frac{s}{10}+1\right)\left(\frac{s}{100}+1\right)}=\frac{10(s+1)}{\left(\frac{s}{10}+1\right)\left(\frac{s}{100}+1\right)}$$

$\omega<1$일 때 기울기 0이고 $20\log|H(j\omega)|=20\log10=20\,[\mathrm{dB}]$

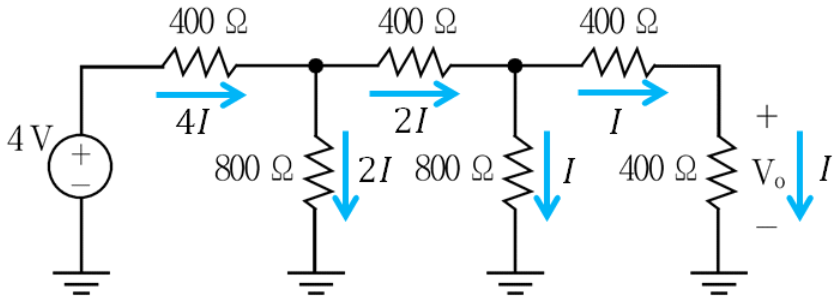
$1\le\omega<10$일 때 기울기 $+20$

$10\le\omega<100$일 때 기울기 $+20-20=0$

$\omega\ge100$일 때 기울기 $+20-20-20=-20$

따라서 보드 선도의 크기로 가장 적절한 것은 ①번이다.

5. 【정답】 ①



$$I = \frac{4}{400\times 4 + 800\times 2} = \frac{4}{3200} = \frac{1}{800}\,[\mathrm{A}]$$

$$\mathrm{V_o} = 400\times\frac{1}{800} = 0.5\,[\mathrm{V}]$$

6. 【정답】 ①

$$Y_{eq} = 0.1j\omega + \frac{1}{10} + \frac{1}{2j\omega+2} = 0.1 + 0.1j\omega + \frac{1-j\omega}{2(\omega^2+1)}$$

어드미턴스의 허수부가 없어야 하므로

$$0.1\omega = \frac{\omega}{2(\omega^2+1)},\ 0.2(\omega^2+1) = 1$$

$$\omega = 2\,[\mathrm{rad/s}]$$

7. 【정답】 ③

$$\frac{\mathrm{v_1}-\mathrm{v_2}}{2} = \mathrm{v_2} + \frac{\mathrm{dv_2}}{\mathrm{dt}},\ \text{라플라스 변환하면}\ \mathrm{V_1}-\mathrm{V_2} = 2\mathrm{V_2} + 2\mathrm{sV_2}$$

$$\frac{\mathrm{v_1}-\mathrm{v_2}}{2} = -\frac{\mathrm{dv_1}}{\mathrm{dt}},\ \text{라플라스 변환하면}\ \mathrm{V_1}-\mathrm{V_2} = -2(\mathrm{sV_1}-1)$$

$$\mathrm{V_1} = (2\mathrm{s}+3)\mathrm{V_2},\ (2\mathrm{s}+1)\mathrm{V_1} = \mathrm{V_2}+2$$

$$\mathrm{V_2(s)} = \frac{2}{(2\mathrm{s}+3)(2\mathrm{s}+1)-1} = \frac{2}{4\mathrm{s}^2+8\mathrm{s}+2} = \frac{1}{2\mathrm{s}^2+4\mathrm{s}+1}$$

8. 【정답】 ②

$$\mathrm{V_1} = \frac{100}{\sqrt{2}}\angle 0^\circ,\ \mathrm{V_2} = \frac{40}{\sqrt{2}}\angle 0^\circ,\ \mathrm{V_3} = \frac{30}{\sqrt{2}}\angle 90^\circ$$

$$\mathrm{I_1} = \frac{10}{\sqrt{2}}\angle -60^\circ,\ \mathrm{I_2} = 0,\ \mathrm{I_3} = \frac{2}{\sqrt{2}}\angle 30^\circ$$

$$\mathrm{P} = \left(\frac{100}{\sqrt{2}}\right)\left(\frac{10}{\sqrt{2}}\right)\cos 60^\circ + \left(\frac{30}{\sqrt{2}}\right)\left(\frac{2}{\sqrt{2}}\right)\cos 60^\circ = 250+15 = 265\,[\mathrm{W}]$$

9. **【정답】** ④

$2+1+I=0,\ I=-3\,[A]$

$V_1=3I-2I=I=-3\,[V]$

10. **【정답】** ④

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

$$I(s)=\frac{V(s)}{Z(s)}=\frac{\frac{1}{s^2}}{0.5s+1+\frac{1}{s}}=\frac{1}{0.5s^3+s^2+s}=\frac{2}{s(s^2+2s+2)}$$

11. **【정답】** ①

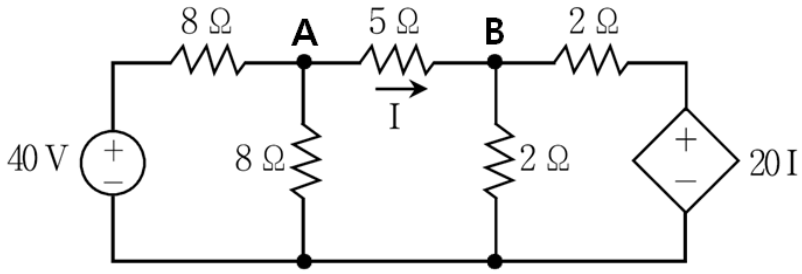
$$i_1(0+)=\frac{V}{R_1},\ i_2(0+)=0$$

$$i_1(0+)+i_2(0+)=\frac{V}{R_1}$$

12. **【정답】** ②

$$z_{11}=\left.\frac{V_1}{I_1}\right|_{I_2=0}=\frac{I_1+\frac{2}{s}I_1}{I_1}=1+\frac{2}{s}$$

13. **【정답】** ②



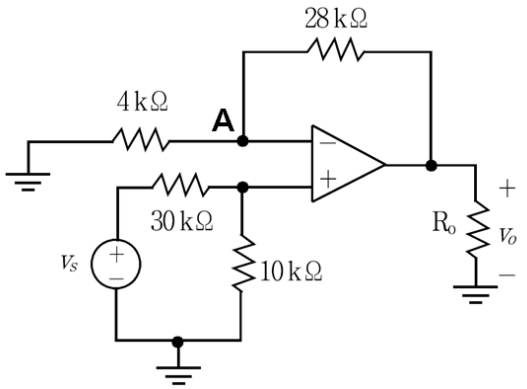
노드A : $\frac{40-V_A}{8}=\frac{V_A}{8}+I,\ V_A=20-4I$

노드B : $I=\frac{V_B}{2}+\frac{V_B-20I}{2},\ V_B=11I$

$20-4I-11I=5I,\ I=1\,[A]$

$P=1^2\cdot 5=5\,[W]$

14. 【정답】 ④



$$\frac{v_o - v_A}{28} = \frac{v_A}{4},\ v_o = 8v_A$$

$$\frac{v_s - v_A}{30} = \frac{v_A}{10},\ v_s = 4v_A$$

$$\frac{v_o}{v_s} = \frac{8v_A}{4v_A} = 2,\ v_o = 2v_s\,[\mathrm{A}]$$

위상이 변하지 않으므로 비반전증폭기이며 $v_o = 2v_s\,[\mathrm{A}]$이다.

15. 【정답】 ①

① 공진 각주파수 ω_0는 어드미턴스의 허수부가 0일 때 발생한다.

16. 【정답】 ①

$$H(s) = \frac{I_o(s)}{V_i(s)} = \frac{\frac{1}{0.25s}}{4 + \frac{1}{0.25s}} \frac{1}{1 + 2s + \frac{\frac{4}{0.25s}}{4 + \frac{1}{0.25s}}} = \frac{1}{s+1} \frac{1}{1 + 2s + \frac{4}{s+1}}$$

$$H(s) = \frac{1}{s+1} \frac{s+1}{(1+2s)(s+1)+4} = \frac{1}{2s^2 + 3s + 5}$$

17. 【정답】 ①

$$h_{11} = \left.\frac{V_1}{I_1}\right|_{V_2 = 0} = \frac{(R_1 + R_2)I_1}{I_1} = R_1 + R_2$$

$$h_{12} = \left.\frac{V_1}{V_2}\right|_{I_1 = 0} = \frac{0}{V_2}$$

$V_2 = 0$일 때 $V_2 = AV_s + I_2R_3 = 0$, $I_2 = -A\dfrac{V_s}{R_3} = -A\dfrac{I_1R_2}{R_3}$

$$h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0} = \frac{-A\dfrac{I_1R_2}{R_3}}{I_1} = -A\frac{R_2}{R_3}$$

$$h_{22} = \left.\frac{I_2}{V_2}\right|_{I_1=0} = \frac{I_2}{I_2R_3} = \frac{1}{R_3}$$

18.【정답】③

내전압이 작은 쪽이 먼저 파괴되므로 작은 쪽을 기준으로 한다.

$C_2 + C_3 = 10 + 6 = 16\,[\mathrm{mF}]$

$C_1 : (C_2 + C_3) = 20 : 16 = 5 : 4$이므로 $V_1 : V_2 = 4 : 5$

$$V_2 = \frac{5}{4}V_1 = \frac{5}{4} \times 50 = 62.5\,[\mathrm{V}]$$

따라서 최대 전압은 $50 + 62.5 = 112.5\,[\mathrm{V}]$

19.【정답】③

$N_1 : N_2 = 2 : 1$이므로 $V_1 : V_2 = 2 : 1$, $I_1 : I_2 = 1 : 2$이다.

$$120\angle 0^\circ = \left(4 + \frac{1}{j0.25}\right)I_1 + V_1$$

$$V_1 = 2V_2 = 2(2+j)I_2 = 4(2+j)I_1$$

$$120\angle 0^\circ = (4 - j4)I_1 + (8 + j4)I_1 = 12I_1$$

$$I_1 = \frac{120\angle 0^\circ}{12} = 10\angle 0^\circ$$

20.【정답】④

$R_{Th} = \dfrac{2 \times 2}{2+2} + 4 = 5\,[\Omega]$이므로 $\tau = R_{Th}C = 5 \times 0.4 = 2\,[\mathrm{sec}]$

$v_0(0-) = 2\,[\mathrm{V}]$, $v_0(\infty) = 5\,[\mathrm{V}]$이므로

$$v_o(t) = 5 + (2-5)e^{-t/2} = 5 - 3e^{-0.5t}\,[\mathrm{V}]$$