九十八學年四技二專第四次聯合模擬考試
電機與電子群　專業科目（一）　詳解

98-4-03-4
98-4-04-4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
B	D	A	A	C	D	D	D	B	B	C	C	B	A	D	A	C	B	C	B	B	C	A	A	D
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	C	D	C	C	C	D	D	A	C	B	A	C	A	C	A	D	B	D	C	D	B	D	B	D

第一部份：基本電學

1. (B) $\overline{Z}=2+3+\dfrac{45^2(1+j)(1-j)}{45(1+j+1-j)}=50\,\Omega$

$\bar{I}=\dfrac{\overline{V}}{\overline{Z}}=\dfrac{100\angle 60^\circ}{50\angle 0^\circ}=2\angle 60^\circ$ A

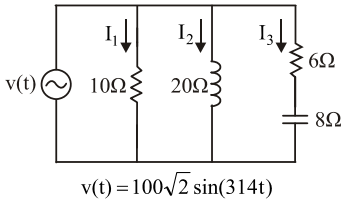
2. $\left|\overline{I_1}\right|=\dfrac{100}{10}=10$ A ，$\left|\overline{I_2}\right|=\dfrac{100}{20}=5$ A

$\left|\overline{I_3}\right|=\dfrac{100}{\sqrt{6^2+8^2}}=10$ A

$P_T=I_1^2\times 10+I_3^2\times 6=10^2\times 10+10^2\times 6=1600$ W

$Q_T=I_2^2\times 20-I_3^2\times 8=5^2\times 20-10^2\times 8=300$ VAR (電容性)，當 $Q_L=Q_C$ 時，電路呈純電阻性

$\dfrac{100^2}{X_L}=800\Rightarrow X_L=\dfrac{10000}{800}=12.5\,\Omega$



$v(t)=100\sqrt{2}\sin(314t)$

3. (1) $\left|\bar{I}\right|=\left|\dfrac{\overline{V_{R1}}}{12}\right|=\dfrac{24}{12}=2$ A

$\Rightarrow\left|\overline{Z}\right|=\left|\dfrac{\overline{V}}{\bar{I}}\right|=\dfrac{96\sqrt{2}}{2}=48\sqrt{2}\,\Omega$

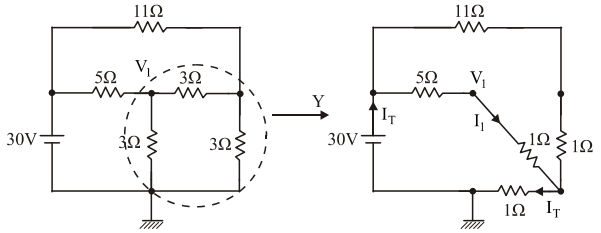
(2) 由於總功因爲 0.707 落後，即 $\theta_Z=\theta_V-\theta_I=45^\circ$

(3) 由上兩式得知總阻抗

$\overline{Z}=48\sqrt{2}\angle 45^\circ=48+j48=A+jB$

故得 $A=B=48\dfrac{A}{4}+B=\dfrac{48}{4}+48=60$

4.



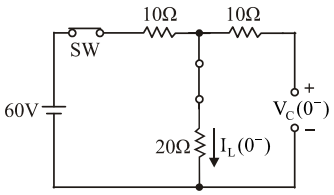
$I_T=\dfrac{30}{1+(6//12)}=6$ A $\Rightarrow V_1=I_1\times 1+I_T\times 1$

$=(6\times\dfrac{12}{12+6}\times 1)+(6\times 1)=10$ V

5. $\overline{Z}=30//j40//-j20=19.2-j14.4=24\angle -37^\circ\,\Omega$

故電路爲電容性 $\bar{I}=\dfrac{\overline{V}}{\overline{Z}}=\dfrac{120\angle 30^\circ}{24\angle -37^\circ}=5\angle 67^\circ$ A

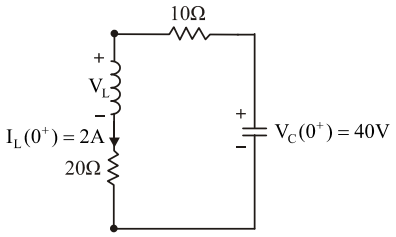
6. (1)



穩態時，可求得 $I_L(0^-)=\dfrac{60}{30}=2$ A

且 $V_C(0^-)=2\times 20=40$ V

(2)

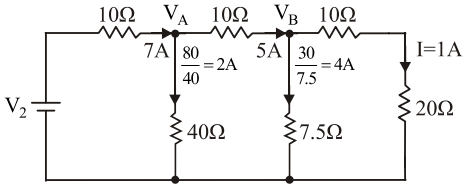


開關打開瞬間，可得 $V_L=-2\times(20+10)+40=-20$ V

7. $e=L\dfrac{\Delta i}{\Delta t}=10\times\dfrac{14-4}{8-3}=20$ V

8. 利用單位電流法：$V_A=5\times 10+30=80$ V

$V_B=1\times(10+20)=30$ V ，$V_2=7\times 10+80=150$ V

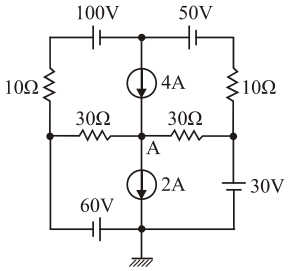


9. $V_{av}=\dfrac{1}{3\pi}(6\times 3\pi-\dfrac{1}{2}\times 6\times\pi-\dfrac{2}{\pi}\times 3\times\pi)$

$=\dfrac{18\pi-3\pi-6}{3\pi}=5-\dfrac{2}{\pi}=4.36$ A

11. 利用密爾門定理

$V_A=(-\dfrac{60}{30}-2+4+\dfrac{30}{30})\times(30//30)=15$ V



12. $W = Q\times(V_A - 20) \Rightarrow -40 = -5\times(V_A - 20)$
$\Rightarrow V_A = 28\text{ V}$，故知爲逆電場移動

13. (B) 本題爲並聯運轉，故必須算出總輸入功率
故得 $h = \dfrac{P_O}{P_I} = \dfrac{746+1000}{\dfrac{746}{0.746}+\dfrac{1000}{0.8}} = \dfrac{1746}{2250} = 0.78$

14. $\bar{I} = \dfrac{600\angle 90° - 600\angle 30°}{80 - j60} = \dfrac{j600 - 300\sqrt{3} - j300}{80 - j60}$
$= \dfrac{-300\sqrt{3} + j300}{80 - j60} = 6\angle 187°\text{ A}$

15. (D) cos 函數在零度時最大
所以 $\dfrac{1000}{3}\pi t - \dfrac{\pi}{3} = 0° \Rightarrow t = 1.0\text{ ms}$

16. $V_\ell = 100\sqrt{3}\text{ A}$ ， $I_\ell = \dfrac{(\frac{100\sqrt{3}}{\sqrt{3}})}{\sqrt{8^2+6^2}} = 10\text{ A}$
$\cos\theta_z = \dfrac{4}{5}$ ， $\theta_z = 37°$ ， $P = \sqrt{3}V_\ell I_\ell \cos\theta_z$
$= \sqrt{3}\times(100\sqrt{3})\times(10)\times\cos 37° = 2400\text{ W}$

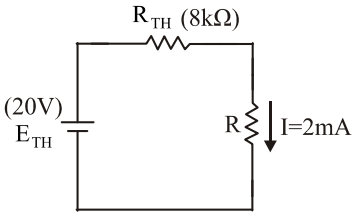
17. I_3迴路：$6I_1 + 4I_2 + 12I_3 = 32$

18. 利用密爾門定理得 $V_Y = (\dfrac{8}{3}+\dfrac{6}{1}-6)\times(3//1) = 2\text{ V}$

19. (A) $f_r = \dfrac{1}{2\pi\sqrt{LC}} = \dfrac{1}{2\pi\sqrt{4\times10^{-3}\times1\times10^{-3}}} = 80\text{ Hz}$
(B) $Q_P = R\sqrt{\dfrac{C}{L}} = 40\sqrt{\dfrac{1\text{ m}}{4\text{ m}}} = 20 \Rightarrow$
$\text{B.W.} = \dfrac{f_r}{Q_P} = \dfrac{80}{20} = 4\text{ Hz}$
(C) $\because Q_P > 15 \Rightarrow \therefore f_H = f_r + \dfrac{BW}{2} = 80 + \dfrac{4}{2} = 82\text{ Hz}$
此爲半功率點，故 $P = \dfrac{P_r}{2} = \dfrac{10^2\times40}{2} = 2\text{ kW}$
(D) 當電阻增加時，品質因數會增加，故頻寬會減少

20. $W_C = \dfrac{1}{2}\times10\times10^{-6}(50^2 - 40^2) = 4500\text{ mJ}$

21.



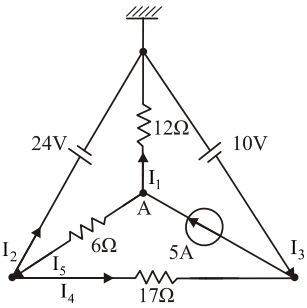
將電路化簡成戴維寧等效
$E_{TH} = 60\times\dfrac{12}{12+6} - 60\times\dfrac{6}{12+6} = 20\text{ V}$
$R_{TH} = (6\text{ k}//12\text{ k}) + (6\text{ k}//12\text{ k}) = 8\text{ k}\Omega$
$R_T = \dfrac{20}{2\text{m}} = 10\text{ k}\Omega = R_{TH} + R \Rightarrow R = 2\text{ k}\Omega$

22. 由於最大功率轉移時
$R_L = R_{TH} \Rightarrow 4 = 5//(10+R) \Rightarrow R = 10\ \Omega$

23. (1) $\alpha_{40} = 0.004 = \dfrac{1}{250} = \dfrac{1}{T+40} \Rightarrow T = 210°\text{C}$
(2) $\alpha_{-10} = \dfrac{1}{T-10} = 0.005$

24. (1) $1\text{T} = 10^4\text{Gauss} \Rightarrow 10^5\text{Gauss} = 10\text{ T}$
(2) $\mu = \dfrac{B}{H} = \dfrac{10}{800} = 12.5\times10^{-3}(\dfrac{H}{m})$

25. $V_A = (\dfrac{0}{12}+5+\dfrac{24}{6})\times(12//6)$
$= 9\times4 = 36\text{ V}$
$I_1 = \dfrac{36}{12} = 3\text{ A}$
$I_5 = 5 - I_1 = 5 - 3 = 2\text{ A}$
$I_4 = \dfrac{24+10}{17} = 2\text{ A}$
$I_2 = I_5 - I_4 = 2 - 2 = 0\text{ A}$
$I_3 = 5 - I_4 = 5 - 2 = 3\text{ A}$
$I_1 + I_2 + I_3 = 3 + 0 + 3 = 6\text{ A}$



第二部份：電子學

28. 二極體加逆偏後，空乏區內電場方向由 N 指向 P 側，且漏電流大小不隨逆向偏壓大小改變

29. $D_1 \rightarrow \text{ON}$ ， $D_2 \rightarrow \text{OFF}$ ，故 $V_o = -2.5\text{ V}$

30. 當輸入 $V_i = 30\text{ V} \sim 70\text{ V}$ 時輸出隨輸入變化
故 $V_o = \dfrac{\frac{V_i}{100\text{ k}}+\frac{30}{200\text{ k}}}{\frac{1}{100\text{ k}}+\frac{1}{200\text{ k}}} = \dfrac{2}{3}V_i + 10$ ， $A = \dfrac{2}{3}$ 、 $B = 10$

31. $I_{Z(max)} = \dfrac{P_D}{V_Z} = \dfrac{50\text{ mW}}{5} = 10\text{ mA}$
$V_{I(min)} = 200\times(1\text{ m}+\dfrac{5}{250}) + 5 = 9.2\text{ V}$
$V_{I(max)} = 200\times(10\text{ m}+\dfrac{5}{250}) + 5 = 11\text{ V}$

32. FET 爲單載子元件，故溫度升高時，主要載子的碰撞機率增加，汲極電流下降，故不會產生熱跑脫

33. Q_1 、Q_3 、Q_4 、Q_5 共四個

34. $I_C = \alpha I_E = \dfrac{\beta}{1+\beta}\times I_E = \dfrac{50}{1+50}\times1\text{ mA} = 0.98\text{ mA}$

35. $I_C = \beta I_B + (1+\beta)I_{CBO} \Rightarrow 10\text{ mA}$
$= \beta\times\dfrac{5.7-0.7}{500\text{ k}} + 0.1\text{ mA} \Rightarrow \beta = 990$

36. 當 $V_{CEQ}=\frac{1}{2}V_{CC}$ 時，可得最大不失眞輸出

故 $I_{CQ}=\frac{5}{1\,k}=5\,mA$

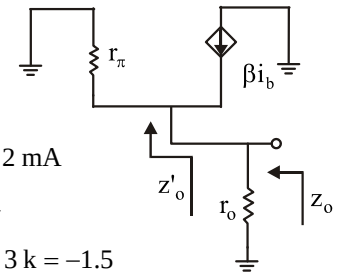
37. $I_D=I_{DSS}(1-\frac{V_{GS}}{V_P})^2\Rightarrow 4\,mA=9\,mA\times(1-\frac{V_{GS}}{-3})^2$

$\Rightarrow V_{GS}=-1\,V$

$V_{GS}=V_G-V_S\Rightarrow -1=5-V_S\Rightarrow V_S=6\,V$

故 $V_{DS}=11-6=5\,V$

38. $Z_o=Z_o'\,//\,r_o=r_e\,//\,r_o$



39. $I_D=I_S=I_E=\frac{10-0.6}{4.7\,k}=2\,mA$

$V_D=15-2\,m\times 3\,k=9\,V$

40. $A_V=-g_mR_D=-500\,\mu\times 3\,k=-1.5$

41. $I_{B1}=\frac{I_{C2}}{\beta^2}=\frac{100\,mA}{100^2}=0.01\,mA$，$r_{\pi1}=\frac{25\,m}{0.01\,m}=2.5\,k\Omega$

$r_{\pi2}=\frac{25\,m\times 100}{100\,m}=25\,\Omega$

$P_C=I_C\times V_{CE}$ 又 $I_{C2}>>I_{C1}$，故 $P_{C1}<P_{C2}$

$r_{\pi2}\cong\frac{V_T}{I_{C2}}\times\beta=\frac{25\,m}{100\,m}\times 100=25\,\Omega$

$r_{\pi1}\cong\frac{V_T}{I_{E1}}\times\beta=\frac{25\,m}{1\,m}\times 100=2.5\,k\Omega$

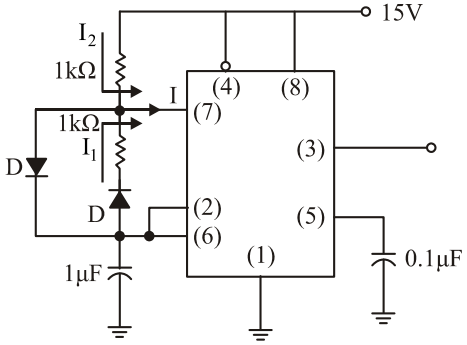
42. $f=\frac{1}{0.7\times(10\,k+10\,k)\times 1\,\mu}=\frac{1}{14\,m}\times 71.4\,Hz$

工作週期(DC%)$=\frac{10\,k}{10\,k+10\,k}\times 100\%=50\%$

43. $I=\frac{\frac{2}{3}\times 15-0.6-0.2}{10\,k}=0.92\,mA$

$I_2=\frac{15-0.2}{10\,k}=1.48\,mA$

$I=I_1+I_2=0.92\,m+1.48\,m=2.4\,mA$



44. $V_{o1}=-V_I\times\frac{20\,k}{10\,k}=-2\times 2=-4\,V$

$V_o=-V_{o1}\times\frac{20\,k}{20\,k}=-(-4)\times 1=4\,V$

45. $5\ge 400\,m\times\frac{R_x}{15\,k+R_x}\times(1+\frac{63\,k}{4.5\,k})$

$15\,k+R_x=1.2R_x\Rightarrow 0.2R_x=15\,k\Omega\Rightarrow R_x=75\,k\Omega$

46. $\frac{0-10}{10\,k}+\frac{0-V_{TL}}{10}+\frac{0-10}{1\,k}=0$

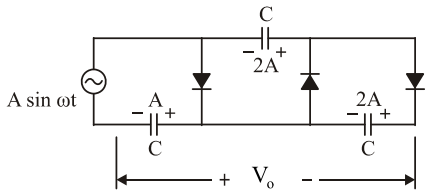
$-1\,m-\frac{V_{TL}}{10}-10\,m=0\Rightarrow V_{TL}=-110\,mV$

$\frac{0-10}{10\,k}+\frac{0-V_{TH}}{10}+\frac{0-(-10)}{1\,k}=0$

$-1\,m-\frac{V_{TH}}{10}+10\,m=0\Rightarrow V_{TH}=90\,mV$

$V_H=V_{TH}-V_{TL}=90\,m-(-110\,m)=200\,mV$

47.



故 $V_o=-3\,A$

48. $V_o=-3\times\frac{10\,k}{5\,k}=-6\,V$

49. $\beta\times A_V=1\angle 0°$

$\Rightarrow\beta\times 10\angle 173°=1\angle 0°$

故 $\beta=0.1\angle 187°$

50. $\beta A_V>1$ 會產生減幅振盪

V_o 最終會無輸出