九十九學年四技二專第二次聯合模擬考試
電機與電子群　專業科目（一）　詳解

99-2-03-4
99-2-04-4

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
A	D	A	C	D	C	C	A	A	C	B	D	A	D	B	A	C	A	D	B	D	A	B	C	C
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
D	B	C	D	C	A	B	A	D	A	D	C	B	C	B	A	B	A	D	B	C	D	B	D	A

第一部份：基本電學

1. $\frac{P_o}{500}=\eta_2=0.85\Rightarrow P_o=425\text{ W}$

$\frac{P_o}{P_i}=\eta_1\times\eta_2\Rightarrow\frac{425}{P_i}=0.7\times0.85\Rightarrow P_i\fallingdotseq714\text{ W}$

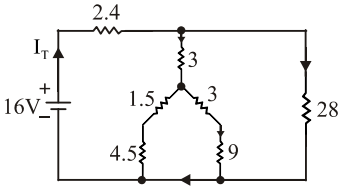
$\therefore P_{loss}=714-425\fallingdotseq290\text{ W}$

2. 長度拉長 3 倍 $\Rightarrow$ 截面積縮小爲 $\frac{1}{3}$ 倍

$R'=\rho\cdot\frac{3\cdot\ell}{\frac{1}{3}A}=9\cdot\rho\cdot\frac{\ell}{A}=9\text{ R}$

3. $\begin{cases}R_2=R_o\cdot[1+\alpha_o\cdot t_2]\\R_1=R_o\cdot[1+\alpha_o\cdot t_1]\end{cases}\Rightarrow\frac{1.5}{1}=\frac{1+\alpha_o\times70}{1+\alpha_o\times20}\Rightarrow\alpha_o=\frac{1}{80}$

4. $I_T=\frac{16}{2.4+(7//28)}=2\text{ A}$

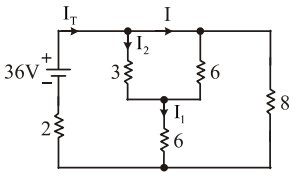


5. $I_T=\frac{36}{2+[(3//6)+6]//8}=6\text{ A}$

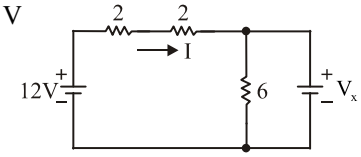
$I_1=6\text{ A}\times\frac{8}{8+8}=3\text{ A}$

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

$\therefore I=I_T-I_2=6-2=4\text{ A}$



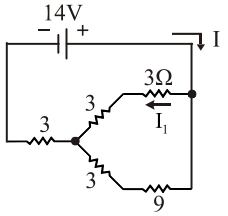
6. $V_x=12-2\times(2+2)=4\text{ V}$



7. $I=\frac{14}{3+(6//12)}=2\text{ A}$

$I_1=2\text{ A}\times\frac{12}{6+12}=\frac{4}{3}\text{ A}$

$\therefore P_{3\Omega}=(\frac{4}{3})^2\times3\Omega=\frac{16}{3}\text{ W}$

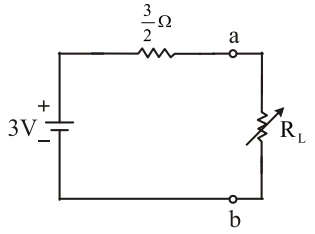


8. $R_{th}=6//2=\frac{3}{2}\Omega$

$V_{th}=3\text{ V}$

當 $R_L=R_{th}=\frac{3}{2}\Omega$

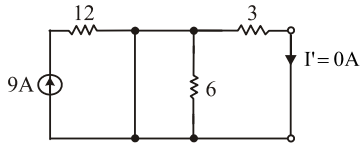
則 $P_{max}=\frac{3^2}{4\times\frac{3}{2}}=1.5\text{ }\Omega$

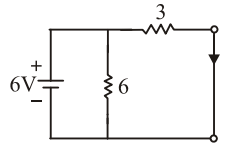


9. $I_1=\sqrt{\frac{20}{5}}=2\text{ A}$ ， $I_2=\sqrt{\frac{10}{10}}=1\text{ A}$

故 $I_1>I_2\Rightarrow5\text{ }\Omega/20\text{ W}$ 耐電流較大

10.





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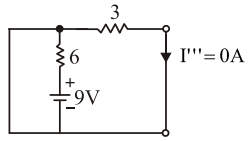


$\therefore I_N=I'+I''+I'''=2\text{ A}$

11. $Q_T=150\times[[(6+3)//18+9]//30]=1500\text{ }\mu\text{C}$

$Q_{18\,\mu F}=1500\text{ }\mu\text{C}\times\frac{[(6+3)//18]}{9+[(6+3)//18]}=600\text{ }\mu\text{C}$

$Q_{3\,\mu F}=600\text{ }\mu\text{C}\times\frac{3}{6+3}=200\text{ }\mu\text{C}$

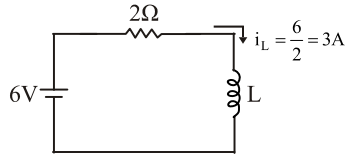
12. $E_A=\frac{F}{Q}=\frac{5\times10^{-2}}{2\times10^{-5}}=2.5\times10^3\text{ V/m}$

13. $L_T=L_1+L_2+L_3+2\text{ M}-2\text{ M}-2\text{ M}$
$=6+3+2-2\times2=7\text{ H}$

$W_{L_T}=\frac{1}{2}L_T\times I^2=\frac{1}{2}\times7\times5^2=87.5\text{ J}$

14. $e_{ab}=-5\times\frac{4-2}{1}=-10\text{ V}$ ， $e_{cd}=-3\times\frac{4-2}{1}=-6\text{ V}$

16. SW→1

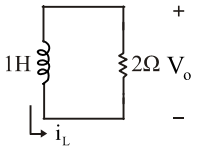


SW→2

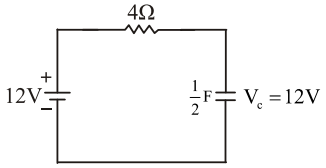
$i_L(t)=3\cdot e^{-2t}(\tau=\frac{1}{2}\sec)$

$\therefore V_o=-2\times i_L(t)=-6\cdot e^{-2t}$

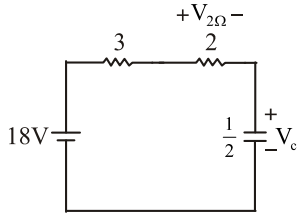
$\therefore t=1\sec\Rightarrow V_o=-6\times e^{-2}=-0.81\,V$



17. SW 打開前：



SW 打開後：



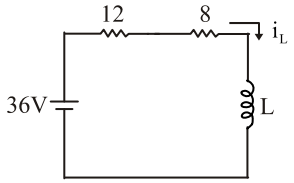
$\tau=(3+2)\times\frac{1}{2}=2.5\sec$

$V_c=12\cdot e^{-\frac{1}{2.5}t}+18(1-e^{-\frac{t}{2.5}})\,(V)$

$V_{2\Omega}=(18-V_c)\times\frac{2}{3+2}=\frac{12}{5}\cdot e^{-\frac{t}{2.5}}$

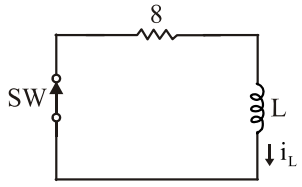
$\therefore t=5\sec$ ，$\therefore V_{2\Omega}=2.4\cdot e^{-2}\,(V)$

18. ① SW 閉合前$\Rightarrow i_L=1.8\,A$



② SW 閉合(瞬間)

$V_L=8\times i_L=14.4\,V$



19. $i(t)=5\sin 314\,t\,(A)$

$V(t)=-40\cos(314t+30°)=40\cdot\sin(314t-60°)\,(V)$

(A) $f=50\,Hz$

(B) 電路呈電容性

(C) $\overline{Z}=\frac{\overline{V}}{\overline{I}}=\frac{\frac{40}{\sqrt{2}}\angle-60°}{\frac{5}{\sqrt{2}}\angle0°}=8\angle-60°\,\Omega$

20. $V_{rms}=\sqrt{\frac{(\frac{2}{\sqrt{3}})^2\times2+3^2\times1+(-1)^2\times1+(\frac{1}{\sqrt{3}})^2\times2}{6}}$

$=\frac{2\sqrt{5}}{3}\,V$

21. $i_{1(t)}=10\cdot\sin 50\,t$ ，$i_{2(t)}=10\cdot\sin(50\,t+90°)$

$I_1+I_2=\frac{10}{\sqrt{2}}\angle0°+j\frac{10}{\sqrt{2}}=10\angle45°\,A$

$(I_1+I_2)_{max}=10\sqrt{2}\,A$

22. $PF=0.6=\frac{Z}{R}=\frac{\frac{j\cdot R\cdot X_L}{R+j\cdot X_L}}{R}\Rightarrow0.6=\frac{jX_L}{16+jX_L}$

$\Rightarrow9.6+j\cdot0.6\cdot X_L=jX_L\Rightarrow\sqrt{9.6^2+(0.6X_L)^2}=X_L$

$\Rightarrow9.6^2+0.36{X_L}^2={X_L}^2\Rightarrow X_L=12\,\Omega$

23. $\overline{I}=\frac{\overline{V}_C}{-jX_C}=\frac{30\angle-30°}{-j3}=10\angle60°A$

$\overline{V}=\overline{I}\times\overline{Z}=10\angle60°\times(4-j3)=10\angle60°\times5\angle-37°$

$=50\angle23°\,(V)$

$\therefore V(t)=50\sqrt{2}\cdot\sin(377t+23°)\,(V)$

$=50\sqrt{2}\cos(377t-67°)\,(V)$

24. $\overline{Z}=0.5+j3.5+[(4-j3)//(3+j4)]$

$=0.5+j3.5+3.5+j0.5=4+j4=4\sqrt{2}\angle45°\Omega$

$\therefore\overline{I_T}=\frac{\overline{V}}{\overline{Z}}=\frac{100}{4\sqrt{2}\angle45°}=\frac{25}{\sqrt{2}}\angle-45°\,A$

25. ① SW 閉合前

$0.6=\frac{R}{Z}=\frac{12}{Z}\Rightarrow Z=20\,\Omega$

$\therefore|12-jX_C|=20\Rightarrow X_C=16\,\Omega$

② SW 閉合後

$Z=20\,\Omega=12\pm jX\Rightarrow X=16\,\Omega$

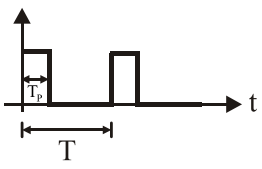
$\therefore(jX_L//-j16)=\pm jX=\pm j16\Rightarrow\frac{16\cdot X_L}{(X_L-16)}=\mp16$

$\Rightarrow X_L=\mp(X_L-16)=\pm(16-X_L)$(取+)

$2X_L=16\Rightarrow X_L=8\,\Omega$

第二部份：電子學

26. $\begin{cases}20\%=\frac{T_P}{T}\times100\%\\T_P=1\,\mu s\end{cases}$



$\Rightarrow\frac{1\,\mu s}{T}=0.2\Rightarrow T=5\,\mu s$

$\therefore f=\frac{1}{T}=200\,kHz$

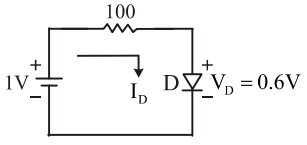
27. (B) 二極體在逆向偏壓時爲過渡電容，範圍約爲數 PF；順向偏壓時爲擴散電容，範圍約爲數 μF

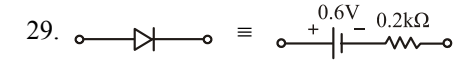
28. 原電路等效

$I_D=\frac{1-0.6}{100}=4\,mA$

$P_D=I_D\times V_D$

$=4\times0.6=2.4\,mW$



29. 

D_1 off，D_2 ON

$\therefore V_o = \dfrac{\dfrac{2}{1.5}+\dfrac{5}{8.5}}{\dfrac{1}{1.5}+\dfrac{1}{8.5}} = 2.45\ \text{V}$

30. 二次側峰值 $V_{2m} = \dfrac{110\sqrt{2}}{5} = 22\sqrt{2}\ \text{V}$

(半波) $V_{(av)} = (\dfrac{V_{2m}}{\pi} - 0.6)\times\dfrac{2}{1+2}$

$= (\dfrac{22\sqrt{2}}{\pi} - 0.6)\times\dfrac{2}{3} = 6.2\ \text{V}$

31. $V_{2m} = \dfrac{110\sqrt{2}}{10} = 11\sqrt{2}\ \text{V}$ ，$V'_{2m} = \dfrac{1}{2}V_{2m} = \dfrac{11\sqrt{2}}{2}\ \text{V}$

$V_A = \dfrac{2}{\pi}V'_{2m}\times\dfrac{5}{5+10} = \dfrac{11\sqrt{2}}{\pi}\times\dfrac{1}{3} = 1.65\ \text{V}$

32. ① $V_i > 0$ (正半週)

$V_o = 10\times\dfrac{3.3}{2.2+3.3} = 6\ \text{V} \Rightarrow$ D ON ，$\therefore V_{o(max)} = +5.5\ \text{V}$

② $V_i < 0$(負半週) $\Rightarrow$ D off

$V_{o(min)} = -10\times\dfrac{3.3}{2.2+3.3} = -6\ \text{V}$

③ $\Delta V_o = V_{o(max)} - V_{o(min)} = 5.5-(-6) = 11.5\ \text{V}$

33. $V_o = -4 \sim +16\ \text{V}$

34. $I_C = \beta I_B + (1+\beta)I_{CBO}$ ，$\beta = \dfrac{\alpha}{1-\alpha} = \dfrac{0.99}{1-0.99} = 99$

$\therefore I_C = 99\times 15 + (1+99)\times 5\ \mu\text{A} = 1985\ \mu\text{A} = 1.985\ \text{mA}$

37. $I_B = \dfrac{2-0.7-(-2)}{2+(1+100)\times 0.5} \fallingdotseq 0.063\ \text{mA}$

$I_C = 100\times I_B = 6.3\ \text{mA}$

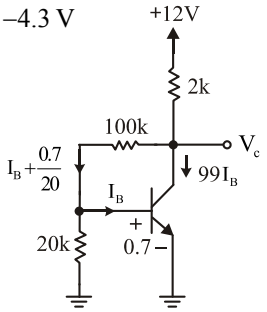
$V_{CE} = -18+(2+0.5)\times 6.3 - 2 \fallingdotseq -4.3\ \text{V}$

38. $V_C = 12 - 2\times(I_B + \dfrac{0.7}{20} + 99I_B)$

$= 100\times(I_B + \dfrac{0.7}{20}) + 0.7$

$\Rightarrow I_B = 0.0257\ \text{mA}$

$\therefore V_C \fallingdotseq 6.8\ \text{V}$



39. $V_C = 16 - 2\times(2+\dfrac{2}{100})$

$= 250\times(\dfrac{2}{100}) + 0.7 + (2+\dfrac{2}{100})\times R_E$

$\Rightarrow 11.96 = 5.7 + 2.02R_E \Rightarrow R_E \fallingdotseq 3.1\ \text{k}\Omega$

40. (1) 有 C_E ：$Z_i = 90\,//\,10\,//\,3 = 2.25\ \text{k}\Omega$

(2) 無 C_E ：$Z_i = 90\,//\,10\,//(3+101\times 1) \fallingdotseq 8.3\ \text{k}\Omega$

41. (A) 共基極(CB)具有極低輸入阻抗與極高輸出阻抗

42. $I_E = \dfrac{10.7-0.7}{5} = 2\ \text{mA}$ ，$r_e = \dfrac{V_T}{I_E} = \dfrac{25\ \text{mV}}{2\ \text{mA}} = 12.5\ \Omega$

$A_V = +\alpha\cdot\dfrac{R_C}{r_e} \fallingdotseq \dfrac{2\ \text{k}}{12.5} = 160$

$\therefore V_{o(P-P)} = A_V \times V_{i(P-P)} = 0.32\ \text{V}$

43. $-40 = 10\cdot\log(\dfrac{P_o}{1\ \text{mW}})$

$\therefore \dfrac{P_o}{1\ \text{mW}} = 10^{-4} \Rightarrow P_o = 10^{-7}\ \text{W} = 0.1\ \mu\text{W}$

44. $A_i = \dfrac{I_o}{I_i} = 800 = (1+\beta_1)\times(1+\beta_2)\times\dfrac{3}{3+6}$

$\therefore \beta_1 = 39$ ，$\beta_2 = 59$

45. $A_{VS} = \dfrac{V_o}{V_s} = \dfrac{V_o}{V_b}\times\dfrac{V_b}{V_s} = -\beta\times\dfrac{3\,//\,6}{2}\times\dfrac{(40\,//\,10\,//\,2)}{0.4+(40\,//\,10\,//\,2)}$

$= -250\times\dfrac{1.6}{2} = -200$

46. $\begin{cases}\text{NEMOS：}V_{GS} > V_t\text{ ，}V_{GD} \le V_t\text{(夾止區)}\\ \text{PDMOS：}V_{GS} < V_P\text{ ，}V_{GD} \ge V_P\text{(夾止區)}\end{cases}$

$\Rightarrow \begin{cases}3\ \text{V} < V_G \le 6.5\ \text{V(NEMOS)}\\ 3\ \text{V} \le V_G < 5.5\ \text{V(PDMOS)}\end{cases}$

$\therefore V_G = 4.5\ \text{V}$ 符合

47. (A) CS→反相
(B) CD→極高輸入阻抗，極低輸出阻抗
(C) CD→源極隨耦器

48. (B) CMOS：交換速度慢

49. $I_D = 8 = k(2.5-0.5)^2 \Rightarrow k = 2\ \text{mA/V}^2$

$I_D = 2\times(3.5-0.5)^2 = 18\ \text{mA}$

50. $I_{DQ} = I_{DSS}(1-\dfrac{V_{GS}}{V_P})^2 \Rightarrow 3 = 12\times(1-\dfrac{V_{GS}}{-4})^2$

$\therefore V_{GS} = -2\ \text{V}$

$g_m = \dfrac{2\,I_{DSS}}{-V_P}\times(1-\dfrac{V_{GS}}{V_P}) = \dfrac{2\times 12}{4}\times(1-\dfrac{-2}{-4}) = 3\ \text{mA/V}$