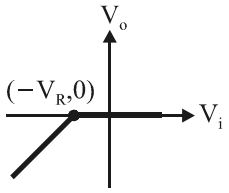
107 學年度四技二專第二次聯合模擬考試
電機與電子群　專業科目(一)　詳解

107-2-03-4、107-2-04-4

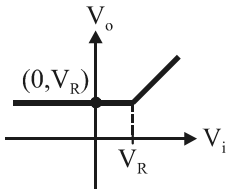
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
D	C	A	C	D	A	C	D	D	A	B	D	C	A	C	D	B	A	B	B	B	D	D	D	A
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	C	B	A	D	A	A	C	C	B	C	D	C	B	D	C	A	C	B	B	B	B	D	C	A

第一部分：電子學

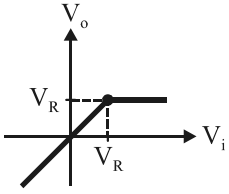
1. (A) FET 爲主要元件
   (B) 4C 爲元件、通訊、計算、控制
   (C) 屬 ULSI，零件數 100000 個以上
2. (A) 導體沒有擴散電流
   (B) 均隨溫度上升，電阻值下降
   (D) 不帶電
3. (A) 漏電流不隨逆偏大小改變
4. (C) 穩定度不佳
5. BE 接面順偏，BC 接面逆偏
6. (B)



(C)



(D)



7. $I_B=\dfrac{I_E}{1+\beta}=\dfrac{1\text{ m}}{100}=0.01\text{ mA}$

   $V_E=I_E\cdot R_E=V_{CC}-I_CR_C-V_{CE}=12-4-5=3\text{ V}$

   $R_B=\dfrac{V_{CC}-V_{BE}-V_E}{I_B}=\dfrac{12-0.7-3}{0.01\text{ m}}=830\text{ k}\Omega$

9. (A) 通道長度調變

   (B) $\alpha=\dfrac{I_C}{I_E}$ ，$I_E\uparrow$ ，$\alpha\downarrow$

   (C) 共集極輸出阻抗最低

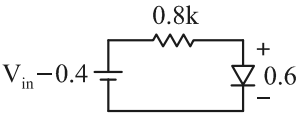
10. $I_D=I_{DSS}(1-\dfrac{V_{GS}}{V_P})^2$ ，$1\text{ m}=4\text{ m}(1-\dfrac{V_{GS}}{-2})^2$

    $V_{GS}=-1,-3$(不合)，$V_{GS}=-1=V_G-V_S=5-V_S$

    $V_S=6\text{ V}$ ，$R_S=\dfrac{6}{I_D}=6\text{ k}\Omega$

    $V_{DD}=I_D\times R_D+V_{DS}+I_DR_S\Rightarrow R_D=4\text{ k}\Omega$

11. $R_{th}=4\text{ k}//1\text{ k}=0.8\text{ k}$ ，$E_{th}=V_{in}-0.4$



$\Rightarrow V_{in}=1$ 時導通，$I_D=\dfrac{V_{in}-1}{0.8\text{ k}}=(1.25V_{in}-1.25)\text{ mA}$

12. (A) $V_Z<6\text{ V}$ ，稽納崩潰

    (B) $P_{Z(max)}=30\text{ m}\times5=150\text{ mW}$

    (C) $10\times\dfrac{500}{R+500}\geq5\text{ V}$ ，$R\leq500\,\Omega$ ，$R_{max}=500\,\Omega$

    (D) $R_{min}=\dfrac{(10-V_Z)}{I_{ZM}+I_L}=\dfrac{10-5}{30\text{ m}+10\text{ m}}=125\,\Omega$

13. (A) PIV 值 $=20\text{ V}$

    (B) $C\cdot V_{r(P-P)}=\dfrac{20}{10\text{ k}}\times\dfrac{1}{100}$ ，$V_{r(P-P)}=\dfrac{1}{50\text{ k}\cdot C}$

    $V_{r(rms)}=\dfrac{1}{100\sqrt{3}\cdot k\cdot C}$ ，$r\%\approx\dfrac{\dfrac{1}{100\sqrt{3}\times10^3C}}{20}<1.2\%$

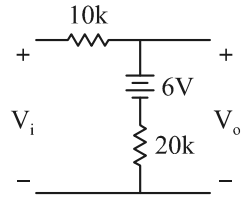
    $C>24\,\mu\text{F}$

    (C) $C\cdot V_{r(P-P)}=\dfrac{20}{10\text{ k}}\times\dfrac{1}{100}$ ，$V_{r(P-P)}=\dfrac{1}{50\text{ k}\cdot C}<0.1$

    $C>200\,\mu\text{F}$

    (D) 沒變

14.



$V_i=15\text{ V}$ 時，$\dfrac{V_o-15}{10\text{ k}}+\dfrac{V_o-6}{20\text{ k}}=0$ ，$V_o=12\text{ V}$

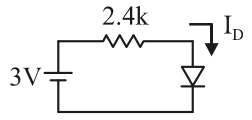
$V_i=3\text{ V}$ 時，$V_o=3\text{ V}$ ，$x+y=15$

15. $\dfrac{V_o}{V_i}=\dfrac{-g_mV_{gs}(R_D//R_L)}{V_{gs}}=-0.5\text{ m}\times5\text{ k}=-2.5$

16. 以二極體兩端取載維寧

    $E_{th}=3\text{ V}$ ，$R_{th}=2.4\text{ k}$

    $I_D=\dfrac{3}{2.4\text{ k}}=\dfrac{5}{4}\text{ mA}$



    $I_1=I_4=\dfrac{7.5}{3\text{ k}}=2.5\text{ mA}$ ，$I_2=I_3=\dfrac{7.5}{2\text{ k}}=3.75\text{ mA}$

17. (A) 只有 D 是增強型
    (C) B 爲空乏型 P 通道 FET
    (D) C 爲空乏型 N 通道 FET

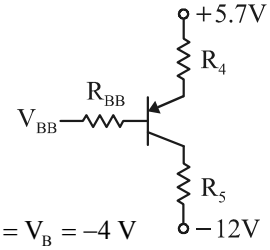
18. $Z_i = R_S // \dfrac{1}{g_m} = 2\text{ k} // 250 \fallingdotseq 220\ \Omega$

19. $Z_{ib} = (4\text{ k} // 12\text{ k}) \times 50 \times 80 = 12\text{ M}\Omega$

$\dfrac{i_o}{i_i} = \dfrac{1}{4} \times 80 \times 50 \times \dfrac{3}{4} = 750$

20. 等效電路如右圖所示

$V_{BB} = \dfrac{\dfrac{+6}{R_1} + \dfrac{-6}{R_2} + \dfrac{-6}{R_3}}{\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}}$



$\Rightarrow V_{BB} = -4\text{ V}$

$\because \beta$ 極大，$\therefore I_B \cong 0\text{ A} \Rightarrow V_{BB} = V_B = -4\text{ V}$

$V_E = -3.3\text{ V}$ ，$I_E = \dfrac{5.7 - (-3.3)}{3\text{ k}} = 3\text{ mA}$

$\because I_B \cong 0\text{ A}$ ，$\therefore I_C = I_E$

$V_C = -12 + 3\text{ m} \times 2\text{ k} = -6\text{ V}$

$V_{EC} = -3.3 - (-6) = 2.7$

21. $40\text{ dBm} = 10\log\dfrac{P_o}{1\text{ mW}}$ ，$P_o = 10\text{ W} = \dfrac{V_3^2}{250}$ ，$V_3 = 50\text{ V}$

$V_1 = A_{V1} \cdot V_i = 50 \cdot 50\ \mu = 2.5\text{ mV}$

$A_{V2} = 26\text{ dB} = 20\log\dfrac{V_2}{V_1}$

$\log\dfrac{V_2}{V_1} = 1.3 = \log 20$ ，$\dfrac{V_2}{V_1} = 20$

$V_2 = 2.5\text{ mV} \times 20 = 50\text{ mV}$ ，$A_{V3} = \dfrac{50}{50\text{ m}} = 1000$

$A_{VT} = 20\log\dfrac{50}{50\ \mu} = 120\text{ dB}$

22. $I_B = \dfrac{3 - 0.7}{5\text{ k} + 100\text{ k}} = \dfrac{2.3}{105\text{ k}} \fallingdotseq 22\ \mu$

$I_{C(sat)} = \dfrac{6 - 0.2}{2.9\text{ k}} = 2\text{ mA}$ ，$\beta I_B > I_{C(sat)} \Rightarrow$ 飽和

$3 = I_B \times 5\text{ k} + 0.7 + (I_B + I_C) \times 1\text{ k}$

$6 = I_C \times 1.9\text{ k} + 0.2 + (I_B + I_C) \times 1\text{ k}$ $\Rightarrow I_B = 53\ \mu\text{A}$

23. $Z_i = 9\text{ k} + [950\text{ k} // (1\text{ k} + 100 \times 0.3\text{ k})]$

$\fallingdotseq 9\text{ k} + 30\text{ k} = 39\text{ k}$

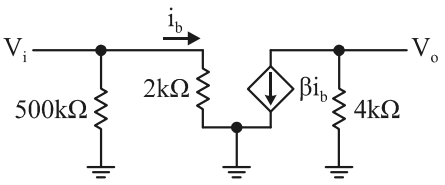
$Z_o = 300 // \dfrac{1\text{ k} + 950\text{ k} // 9\text{ k}}{100} \fallingdotseq 300 // 100 = 75\ \Omega$

24. (A) 閘極須爲高摻雜

(B) $V_{GD} \geq V_P$

(C) MOSFET 製程簡單

25.



$A_V = \dfrac{V_o}{V_i} = \dfrac{-\beta i_b \cdot 4\text{ k}}{i_b \cdot 2\text{ k}} = -198$

第二部分：基本電學

26. (B) 中子質量最大

(C) 形成正離子

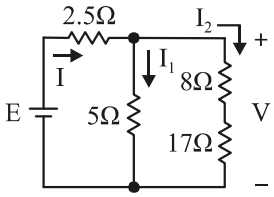
(D) 不一定相等

27. (C) 繞線型可承受之功率較大

28. $R_{AB} = [4 // 6 + 2 // 8] // 4 = 2\ \Omega$

29. $I_2^2 \times 8 = 18$ ，$I_2 = 1.5\text{ A}$

$V = 1.5 \times 25 = 37.5\text{ V}$



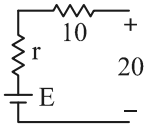
$I_1 = \dfrac{V}{5} = 7.5\text{ A}$

$I = I_1 + I_2 = 9$

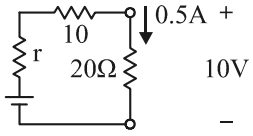
$E = 2.5 \times 9 + 37.5 = 60$

$P_T = 9 \times 60 = 540\text{ W}$

30.



$E = 20\text{ V}$



$r = \dfrac{20 - 10 - 5}{0.5} = 10\ \Omega$

31. $7I_1 - 4I_2 - 3I_3 = 18$

$-4I_1 + 11I_2 - I_3 = 2$

$-3I_1 - I_2 + 7I_3 = -5$

$\Rightarrow a_{12} + a_{23} + a_{33} = -4 - 1 + 7 = 2$

33. (C) 正電荷可單獨存在

34. RL 串：$\tau = \dfrac{2\text{ m}}{10} = 0.2\text{ ms} = A$

RC 並：$\tau = 100\text{ k} \cdot 0.01\ \mu = 1\text{ ms}$ ，$B = 5\tau = 5\text{ ms}$

$5A + B = 1\text{ ms} + 5\text{ ms} = 6\text{ ms} = 0.006\text{ s}$

35. $\dfrac{I'}{I} = \dfrac{4.5}{18} = \dfrac{1}{4} \Rightarrow \dfrac{R'}{R} = \dfrac{I}{I'} = 4$ ，$R' = 4R$ ，電阻 $= \rho \cdot \dfrac{\ell}{A}$

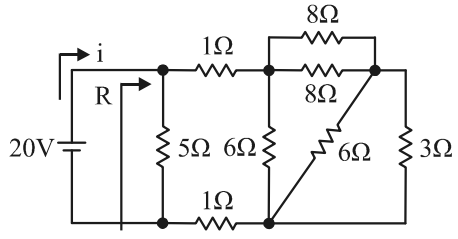
$\because$體積不變，ℓ 變 k 倍 $\Rightarrow$ A 變 $\dfrac{1}{k}$ 倍 $\Rightarrow$ 電阻變 k^2 倍

$\therefore k = 2$ ，$\ell' = 2\ell = 40\text{ cm} \Rightarrow$ 需拉長 20 cm

36. $I_{6\Omega} = \dfrac{24}{6} = 4\text{ A}$

37. S 按下瞬間，電容短路，電感開路

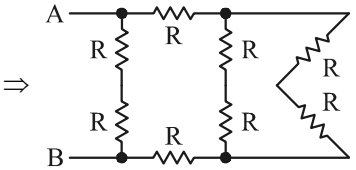
$\Rightarrow$



$R=\{[(3//6+8//8)//6]+1+1\}//5=5//5=2.5\,\Omega$

$i=\dfrac{20}{2.5}=8\text{ A}$

38. 中垂線定理

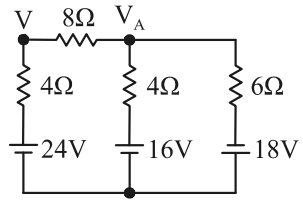


$\Rightarrow$

$R_{AB}=[(2R//2R)+2R]//2R=3R//2R$

$=18//12=7.2\,\Omega$

39. 壓流互換

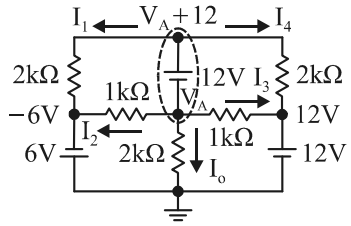


密爾門：

$V_A=(12//4//6)\times(\dfrac{24}{12}+\dfrac{16}{4}+\dfrac{-18}{6})=6\text{ V}$

$V=24-\dfrac{24-6}{12}\times4=18\text{ V}$

40.



$I_1+I_2+I_o+I_3+I_4=0$

$\dfrac{V_A+12+6}{2\text{ k}}+\dfrac{V_A+6}{1\text{ k}}+\dfrac{V_A}{2\text{ k}}+\dfrac{V_A-12}{1\text{ k}}+\dfrac{V_A+12-12}{2\text{ k}}=0$

$7V_A=-6$ ， $V_A=-\dfrac{6}{7}$ ， $I_o=\dfrac{-\frac{6}{7}}{2\text{ k}}=-\dfrac{3}{7}\text{ mA}$

41. $\alpha_{20}=\dfrac{1}{|T_o|+20}=\dfrac{1}{222}$ ，$|T_o|=202$

$\dfrac{150}{10}=\dfrac{T+202}{28+202}$ ， $T+202=3450$ ， $T=3248°\text{C}$

42. $C_T=(10\,\mu+20\,\mu)//10\,\mu//5\,\mu=\dfrac{30}{1+3+6}\,\mu=3\,\mu\text{F}$

43. 電源切斷 Q 不變

$C=\in\dfrac{A}{d}$ ， $W=\dfrac{1}{2}CV^2=\dfrac{1}{2}QV=\dfrac{1}{2}\dfrac{Q^2}{C}$

$d'=\dfrac{1}{2}d\Rightarrow C'=2C\Rightarrow W'=\dfrac{1}{2}W=\dfrac{1}{2}\times8=4\text{ J}$

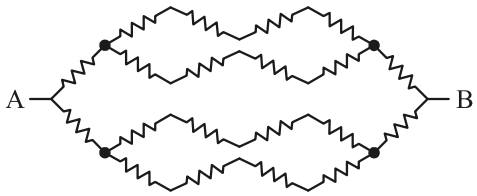
44. 電感爲串聯互消

$M=k\sqrt{L_1L_2}=1\text{ mH}$

$L_T=L_1+L_2-2M=11\text{ mH}$ ， $A=11$

$W=\dfrac{1}{2}L_1I^2+\dfrac{1}{2}L_2I^2-MI^2=18+8-4=22\text{ mJ}$，$B=22$

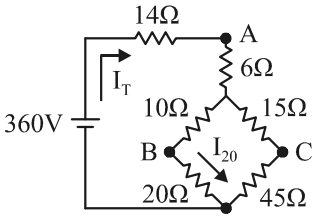
45. 等效：



$R_{AB}=[(4R//4R)+2R]//[(4R//4R)+2R]$

$=4R//4R=2R=20\,\Omega$

46. ABC 作 Δ-Y 轉換



$R_T=(30//60)+6+14=40$

$I_T=\dfrac{360}{40}=9$ ， $I_{20}=9\times\dfrac{60}{60+30}=6\text{ A}$

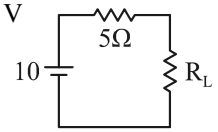
$V_A=360-9\times14=234\text{ V}$

$V_B=20\times6=120\text{ V}$

$I=\dfrac{234-120}{20}=5.7\text{ A}$

47. $R_{th}=2+3=5\,\Omega$ ， $E_{th}=6+4=10\text{ V}$

$R_L=5\,\Omega$時， $P_{max}=\dfrac{5^5}{5}=5\text{ W}$



48. (A) $R=\dfrac{\ell}{\mu A}=\dfrac{2\pi\times10^{-2}}{4\pi\times10^{-7}\times10^3\times2\times10^{-4}}$

$=\dfrac{1}{4\times10^{-6}}=2.5\times10^5\,\text{AT/Wb}$

(B) $\phi=\dfrac{N_1I_1}{R}=\dfrac{100\times20}{2.5\times10^5}=8\times10^{-3}\text{ Wb}$

$B=\dfrac{\phi}{A}=\dfrac{8\times10^{-3}}{2\times10^{-4}}=4\times10\text{ Wb/m}^2=4\times10^5\text{ Gauss}$

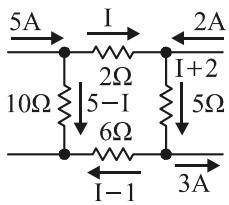
(C) $L_1=\dfrac{N_1\phi_1}{I_1}=\dfrac{100\times8\times10^{-3}}{20}=40\text{ mH}$

(D) $M=\dfrac{N_2\phi_{12}}{I_1}=\dfrac{50\times8\times10^{-3}}{20}=20\text{ mH}$

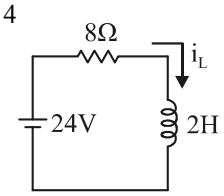
49. 由 KVL 知

$2I+5(I+2)+6(I-1)=10(5-I)$

$23I=46$ ， $I=2\text{ A}$ ，故選(C)



50. $E_{th}=24\,V$ ，$R_{th}=8\,\Omega$ ，$\tau=\frac{2}{8}=\frac{1}{4}$



$i_L(t)=3+(0-3)e^{-\frac{t}{\frac{1}{4}}}=3(1-e^{-4t})$

$V_L(t)=24-24(1-e^{-4t})=24e^{-4t}$

$V_{4\Omega}=4\times3(1-e^{-4t})=12(1-e^{-4t})$

$V_R(t)=V_{4\Omega}+V_L(t)=12-12e^{-4t}+24e^{-4t}=12+12e^{-4t}$