109 學年度四技二專第一次聯合模擬考試
電機與電子群　專業科目(一)　詳解

109-1-03-4、109-1-04-4

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

第一部分：電子學

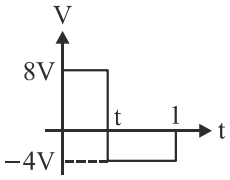
1. $I_B=\dfrac{9.7-0.7}{200\,k+(1+99)\times 1\,k}=\dfrac{9}{300\,k}=0.03\,mA$

   $I_C=\beta I_B=99\times 0.03\,mA=2.97\,mA$

   $I_{C(sat)}=\dfrac{9.7}{1\,k+1\,k}=4.85\,mA>I_C$

   $\therefore V_o=9.7-2.97\,mA\times 1\,k\Omega=6.73\,V$

2. $\dfrac{8t+(-4)(1-t)}{1}=0.8$ ，$12t=4.8$　$\therefore t=0.4$



   $\therefore D\%=\dfrac{t}{1}\times 100\%=\dfrac{0.4}{1}\times 100\%=40\%$

3. 當降低基極寬度或提高射極摻雜濃度時，則 $I_C\uparrow$、$I_B\downarrow$、$\beta\uparrow$

5. $I_L=\dfrac{5\,V}{200\,\Omega}=25\,mA$

   $I_z=\dfrac{12\,V-5\,V}{200\,\Omega}-I_L=35\,mA-25\,mA=10\,mA$

   $P_z=V_z\cdot I_z=5\,V\times 10\,mA=50\,mW$

6. $r=\dfrac{2.4}{R_L\cdot C}\Rightarrow 0.0001=\dfrac{2.4}{20\,k\Omega\cdot C\,\mu F}$

   $C=\dfrac{2.4}{0.0001\times 20}=1200\,\mu F$

9. 過渡電容 $C_T=\varepsilon\dfrac{A}{d}$ ，逆偏↑，d↑，$C_T\downarrow$

   擴散電容 $C_D=\dfrac{\tau I_D}{\eta V_T}$ ，$I_D\uparrow$，$C_D\uparrow$

10. $\because n_i^2=p\times n$

    $\therefore (1.5\times 10^{10})^2=p\times(\dfrac{5\times 10^{22}}{10^5})$

    故 $p=0.45\times 10^3/cm^3$

12. (A) 操作在作用區時，E-B 接面爲順向偏壓，C-B 接面爲逆向偏壓

13. $R_{BB}=12\,k\Omega\,//\,4\,k\Omega=3\,k\Omega$

    $V_{BB}=-12\,V\times\dfrac{4\,k}{12\,k+4\,k}=-3\,V$

    $I_{C(sat)}=\dfrac{12-0.2}{1\,k\Omega+1\,k\Omega}=5.9\,mA$

    $I_B=\dfrac{3\,V-0.7\,V}{103\,k\Omega}=22.33\,\mu A$

    $I_C=\beta\times I_B\fallingdotseq 2.21\,mA<5.9\,mA$

    $\therefore V_{EC}=12-2.21\,mA(1\,k\Omega+1\,k\Omega)=7.58\,V$

14. $I_B=\dfrac{8.7\,V-0.7\,V}{40\,k\Omega}=0.2\,mA$

    $I_C=\beta I_B=99\times 0.2\,mA=19.8\,mA$

    $I_{C(sat)}=\dfrac{8.7\,V-0.2\,V}{800\,\Omega}=10.625\,mA$

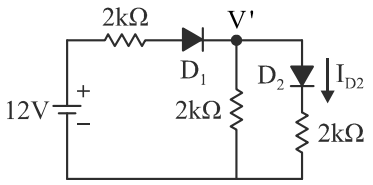
    $\because I_C>I_{C(sat)}$　$\therefore I_C=I_{C(sat)}=10.625\,mA$

15. 假設 D_1、D_2 皆導通，運用密爾門定理，列算式如下：

    $V'=(\dfrac{12\,V}{2\,k}+\dfrac{0\,V}{2\,k}+\dfrac{0\,V}{2\,k})\times(2\,k\,//\,2\,k\,//\,2\,k)$

    $=6\times\dfrac{2}{3}=4\,V$ (D_1、D_2 導通符合)

    $\therefore I_{D2}=\dfrac{V'}{2\,k}=\dfrac{4\,V}{2\,k}=2\,mA$



16. $V_{p-p}=\dfrac{V_m\cdot t}{R_L\cdot C}=\dfrac{100\sqrt{2}\times\frac{1}{60}}{2\,k\times 500\,\mu}=2.36\,V\fallingdotseq 2.4\,V$

18. V_o 介於 3 V~−7 V 之間，故 $V_{o(p-p)}=10\,V$

20. $\because I_E=\dfrac{8.7\,V-3\,V}{1\,k\Omega}=5.7\,mA$

    $\therefore I_B=\dfrac{5.7\,mA}{1+99}=57\,\mu A$ ，$R_B=\dfrac{3-0.7}{57\,\mu A}\approx 40.35\,k\Omega$

22. $I_{LED}=\dfrac{15\,V}{500\,\Omega}=30\,mA$

23. 近似符合條件 $\beta\times R_C>R_B\Rightarrow R_C\uparrow R_B\downarrow$

24. $I_E=\dfrac{10-0.7}{9.3\,k\Omega}=1\,mA$

$V_{CE}=20\,V-1\,mA(3\,k\Omega+9.3\,k\Omega)=7.7\,V$

第二部分：基本電學

27. $W=Q\times V=3\,C\times 4\,V=12\,J$

28. $R=\rho\times\dfrac{\ell}{A}=2.83\times10^{-8}\times\dfrac{20\,m}{\frac{\pi}{4}(1.6\times10^{-3})^2}=0.283\,\Omega$

29. 黃紫黃金 $=47\times10^4\pm5\%=446.5\,k\Omega\sim493.5\,k\Omega$

30. $R=51\times10^1\pm20\%=408\,\Omega\sim612\,\Omega$

$\therefore I_{min}=\dfrac{24\,V}{612\,\Omega}=39.2\,mA$

31. ∵均勻拉長 V 不變 $\ell'=\dfrac{6}{5}V$ ， $A'=\dfrac{5}{6}A$

$R'=\rho\times\dfrac{\ell'}{A'}=\rho\times\dfrac{\frac{6}{5}\ell}{\frac{5}{6}A}=\dfrac{36}{25}\cdot R=\dfrac{36}{25}\times50=72\,\Omega$

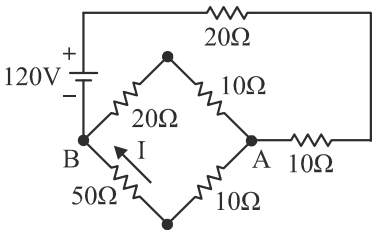
32. 15°C 時 $V_{THW}=6\,V\times\dfrac{2\,k}{3\,k+2\,k}=2.4\,V$

20°C 時 $V_{THW}=6\,V\times\dfrac{1.5\,k}{3\,k+1.5\,k}=2\,V$

33. S ON 時， $V_{ab}=12\,V$ ，S OFF 時， $V_{ab}=0\,V$

34. $V_{AB}=120\,V\times\dfrac{60\,//\,30}{20+10+(60\,//\,30)}=120\times\dfrac{20}{50}=48\,V$

$\therefore I=\dfrac{48\,V}{50+10}=0.8\,A$



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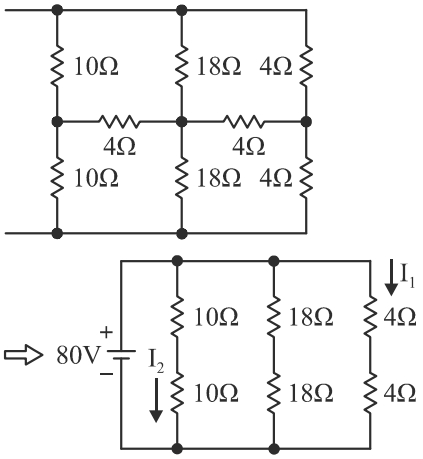
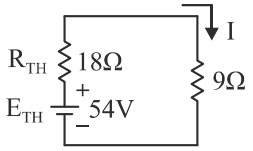


$I_1=\dfrac{80\,V}{4+4}=10\,A$ ， $I_2=\dfrac{80\,V}{10+10}=4\,A$

36. $R_{TH}=6+6+6=18\,\Omega$

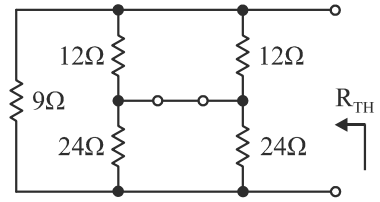
$E_{TH}=4\,A\times6\,\Omega+30\,V=54\,V$

$\therefore P=\dfrac{V^2}{R}=\dfrac{(54\times\frac{1}{3})^2}{9}=36\,W$



37. $R_{TH}=9\,//\,[(12\,//\,12)+(24\,//\,24)]=9\,//\,18=6\,\Omega$

當 $R_L=R_{TH}=6\,\Omega$ 時，可獲得最大功率



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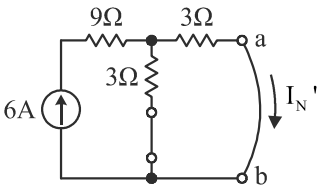
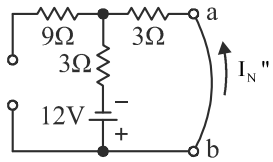


$I_N'=6\,A\times\dfrac{3\,\Omega}{3\,\Omega+3\,\Omega}=3\,A$



$I_N''=\dfrac{12\,V}{3\,\Omega+3\,\Omega}=2\,A$

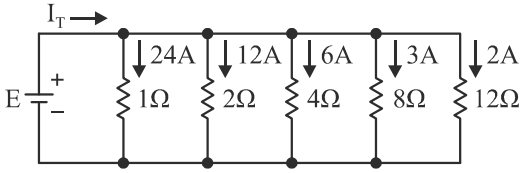
$\therefore I_N=I_N'-I_N''=3-2=1\,A$

$R_N=3\,\Omega+3\,\Omega=6\,\Omega$

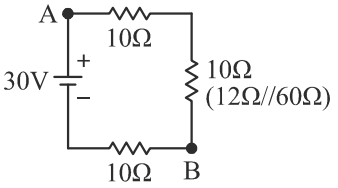
39. $I=\dfrac{12+12-6}{3+3+6}=1.5\,A$

40. $I_T=\dfrac{24\,V}{1\,\Omega}+\dfrac{24\,V}{2\,\Omega}+\dfrac{24\,V}{4\,\Omega}+\dfrac{24\,V}{8\,\Omega}+\dfrac{24\,V}{12\,\Omega}$

$=24\,A+12\,A+6\,A+3\,A+2\,A=47\,A$



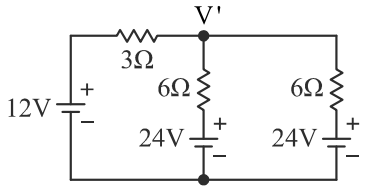
41. $V_{AB}=30\,V\times\dfrac{10\,\Omega+10\,\Omega}{10\,\Omega+10\,\Omega+10\,\Omega}=20\,V$



42. $V' = (\frac{12\text{ V}}{3\,\Omega} + \frac{24\text{ V}}{6\,\Omega} + \frac{24\text{ V}}{6\,\Omega}) \times (3 // 6 // 6)\,\Omega$

$= 12 \times \frac{6}{4} = 18\text{ V}$

$V_{3\Omega} = 18 - 12 = 6\text{ V} \quad \therefore P_{3\Omega} = \frac{6^2}{3\,\Omega} = 12\text{ W}$



44. $I_{4\Omega} = \frac{2\text{ A} \times 6\,\Omega}{4\,\Omega} = 3\text{ A}$ ， $I_{2\Omega} = \frac{2\text{ A} \times 6\,\Omega}{2\,\Omega} = 6\text{ A}$

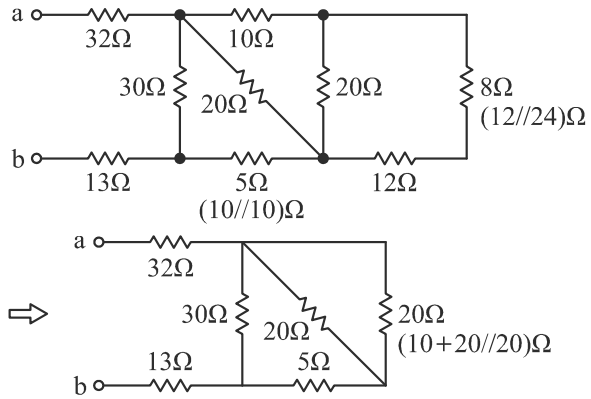
$\therefore I_{3\Omega} = 2 + 3 + 6 = 11\text{ A}$

45. 流入＝流出

$3\text{ A} + 1\text{ A} + 2\text{ A} + 4\text{ A} = I_x + 4\text{ A} + 5\text{ A} + 3\text{ A}$

$\therefore I_x = -2\text{ A}$

46.



$\therefore R_{ab} = 32 + (30 // 15) + 13 = 55\,\Omega$

47. 藍黑橙金： $60 \times 10^3 \pm 5\%$

橙黑橙金： $30 \times 10^3 \pm 5\%$

並聯爲 $20 \times 10^3 \pm 5\%$ (紅黑橙金)

48. R_1 斷路： $R_{ab} = 0\,\Omega$

R_2 斷路： $R_{ab} = 15 + (30 // 15) + 10 = 35\,\Omega$

R_3 短路： $R_{ab} = 15 + (20 // 30 // 15) = 21.67\,\Omega$

R_4 短路： $R_{ab} = 15 + (20 // 10) = 21.67\,\Omega$

49. $V_a = 10\text{ V} \times \frac{2\,\Omega}{2\,\Omega + 3\,\Omega} - 20\text{ V} = -16\text{ V}$

$V_b = -50\text{ V} \times \frac{2\,\Omega}{3\,\Omega + 2\,\Omega} = -20\text{ V}$

50. $P_s = 30\text{ W} = \frac{E^2}{2R} \Rightarrow \frac{E^2}{R} = 60$

$P_P = \frac{E^2}{\frac{R}{2}} = \frac{2E^2}{R} = 2 \times 60 = 120\text{ W}$