103 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

103-1-03-4、103-1-04-4

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

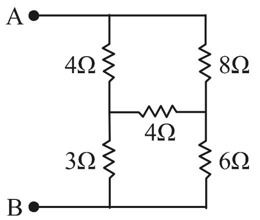
第一部分：基本電學

1. 由圖(一)-a 得知 $R_1(\Omega) = R_2(\Omega)$

   故圖(一)-b 的 $I_T = \dfrac{3E}{5}$ A

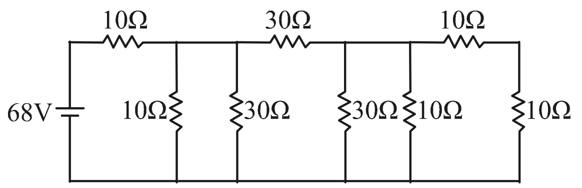
   流過圖(一)-b 的 R_2 電流 $= \dfrac{E}{5}$ A，所以 $V_2 = \dfrac{1}{5}E$ V

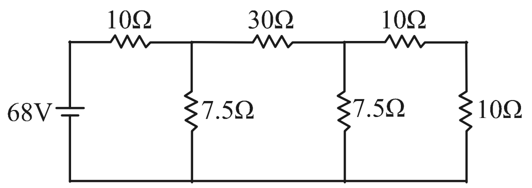
2. 552 卡 $= V\times 2\times 10\times 0.24 \Rightarrow V = 115$ V

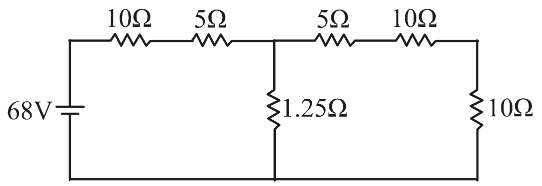
3. 

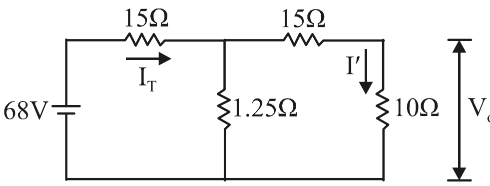
   故 $R_{AB} = (4 /\!/ 8) + 2 = \dfrac{14}{3}\ \Omega$

4. 原圖 ⇒



⇒ 

⇒ 

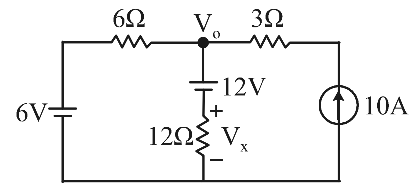
⇒ 

   $I_T = \dfrac{68}{15 + (25 /\!/ 1.25)} = 4.2$ A，$I' = 4.2\times\dfrac{1}{21} = 0.2$ A

   故 $V_o = 0.2\times 10 = 2$ V

5. $I_T = \dfrac{60}{30} = 2$ A，$I = -2\times\dfrac{20}{30+20} = -0.8$ A

6. 使用諾頓等效模型分析，$I = \dfrac{120}{10} + 8 + \dfrac{100}{5+5} = 30$ A

7. 

   $\dfrac{V_o - 6}{6} + \dfrac{V_o - 12}{12} = 10$，$2V_o - 12 + V_o - 12 = 120$

   $3V_o = 144$，$V_o = 48$ V

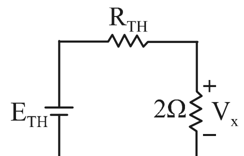
   故 $V_x = V_o - 12 = 48 - 12 = 36$ V

8. 達因爲力學單位

9. $\dfrac{E}{R} = \dfrac{10}{4} = I = 2.5 = \dfrac{Q}{t} = \dfrac{n\times 1.602\times 10^{-19}}{2\times 60}$

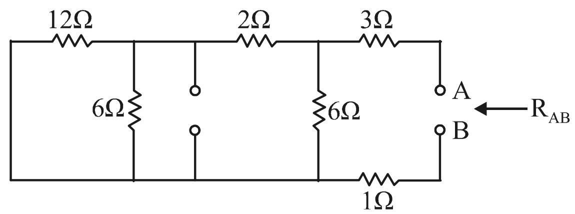
   $\Rightarrow n = 1.875\times 10^{21}$ 個電子

10. $\dfrac{R_甲}{R_乙} = \dfrac{\frac{L}{3S}}{\frac{2L}{4S}} = \dfrac{2}{3}$，因 $I = \dfrac{V}{R}$，故 $\dfrac{V_甲}{V_乙} = \dfrac{2}{3}$

11. 由 V_x 端求戴維寧模型 ⇒ 

    $E_{TH} = 16\times\dfrac{3}{5} + 8 = \dfrac{88}{5}$ V，$R_{TH} = 2 /\!/ 3 = \dfrac{6}{5}\ \Omega$

    故 $V_x = \dfrac{88}{5}\times\dfrac{2}{\frac{6}{5}+2} = \dfrac{88}{5}\times\dfrac{\frac{10}{5}}{\frac{16}{5}} = 11$ V

12. 

    $R_{AB} = R_L = \{[(12 /\!/ 6) + 2] /\!/ 6\} + 3 + 1 = 7\ \Omega$

13. 使用密爾門定理，$E_{TH}=\dfrac{\dfrac{20}{2}+\dfrac{32}{4}+\dfrac{-24}{8}}{\dfrac{1}{2}+\dfrac{1}{4}+\dfrac{1}{8}+\dfrac{1}{16}}=16\text{ V}$

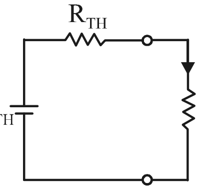
14. 電路爲惠斯登電橋

故 $R_{TH}=(4+6+5+10)\,//\,(5+2.5+5)=\dfrac{25}{3}\text{ k}\Omega$

則Ⓐ $=\dfrac{25}{\dfrac{25}{3}}=3\text{ mA}$

15. 使用重疊定理 $I_x=(-9\times\dfrac{4}{4+2})+(\dfrac{-12}{4+2})=-8\text{ A}$

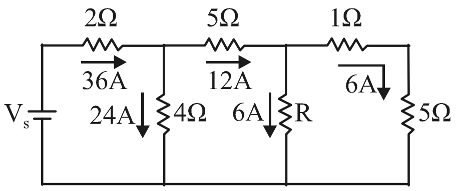
16. 使用戴維寧模型⇒



$E_{TH}=48-36=12\text{ V}$，$R_{TH}=(3\,//\,6)+(6\,//\,6)=5\,\Omega$

故 $I=\dfrac{12}{5+1}=2\text{ A}$

17.



故 $R=\dfrac{6(1+5)}{6}=6\,\Omega$

18. 以 L_1 迴路依 KCL ⇒ $(12-6)=6I_1+6(I_1+I_2)$

$=12I_1+6I_2=6\Rightarrow 2I_1+I_2=1$，故 $x=2$，$y=1$

則 $x+y=3$

19. $R_2=R_1[1+\alpha_1(50)]=20\text{ k}\times[1+(0.006\times50)]=26\text{ k}\Omega$

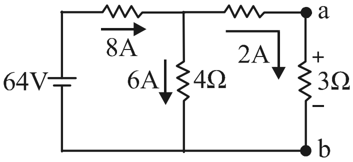
故 $I=\dfrac{100}{26\text{ k}\Omega}\doteqdot 3.85\text{ mA}$

21. 使用重疊定理，求出流經 4 Ω 的電流

$=[10\times\dfrac{6}{4+6}]-[5\times\dfrac{6}{4+6}]-[\dfrac{10}{4+6}]=2\text{ A}$

則 $P_{4\Omega}=2^2\times4=16\text{ W}$

22.



故 $V_{ab}=V_{3\Omega}=2\times3=6\text{ V}$

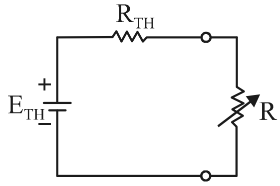
23. $\begin{cases}R_A+R_B=\dfrac{6}{3}=2\,\Omega\\ R_B+R_C=\dfrac{7.5}{3}=2.5\,\Omega\\ R_A+R_C=\dfrac{6.75}{2.5}=2.7\,\Omega\end{cases}\Rightarrow\begin{cases}R_A=1.1\,\Omega\\ R_B=0.9\,\Omega\\ R_C=1.6\,\Omega\end{cases}$

24. $E_{TH}=(40\times\dfrac{1}{3})+(40\times\dfrac{2}{3})+(40\times\dfrac{1}{2})=60\text{ V}$

$R_{TH}=(6\,//\,3)+(4\,//\,4)=4\,\Omega$

故 $R=R_{TH}=4\,\Omega$ 時有最大功率

則 $P_{max}=\dfrac{30^2}{4}=225\text{ W}$



25. 使用重疊得知 3 A 並聯的 4 Ω 的電流爲 3 A↑

故 $V_{4\Omega}=(-3)\times4=-12\text{ V}$

則電源源 3 A 的功率爲 $=3\times(-12)=-36\text{ W}$

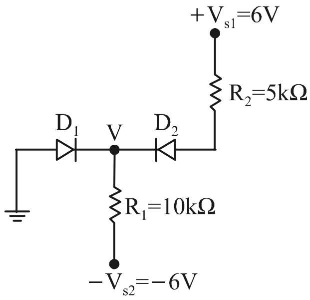
第二部分：電子學

26. $V(\dfrac{1}{600})=100\sqrt{2}\sin(314\times\dfrac{1}{600}\times\dfrac{180^\circ}{\pi}+15^\circ)$

$=100\sqrt{2}\sin45^\circ=100\sqrt{2}\times\dfrac{1}{\sqrt{2}}=100\text{ V}$

27. 在 P 型半導體中，電子被稱爲少數載子

28. 設 D_1 , OFF/D_2 , ON



$\dfrac{6-0.7-V}{5\text{ k}}=\dfrac{V-(-6)}{10\text{ k}}$

$\Rightarrow 10.6-2V=V+6$

$\Rightarrow 3V=4.6$

$\Rightarrow V=1.533\text{ V}$

故假設成立

D_1 , OFF/D_2 , ON

29. 變壓器 2 次側 $V=10\sqrt{2}$，$V_m=20$

故 $V_{c2}=2V_m=40$，$V_{c4}=2V_m=40$

則 $V_o=V_{c2}+V_{c4}=80\text{ V}$

30. 電源端部分爲 +15 V ~ −5 V

並聯截波部分爲 $+7\text{ V}\geq V_o\geq -7\text{ V}$

綜合上面兩部分分析⇒得 $+7\text{ V}\geq V_o\geq -5\text{ V}$

31. 分析時先拿掉 Zener，$I_B=\dfrac{2.7-0.7}{100\text{ k}}=20\,\mu\text{A}$

$I_{C(sat)}=\dfrac{8.2-0.2}{1.6\text{ k}}=5\text{ mA}$，因 $\beta I_B<I_{C(sat)}$

⇒故 BJT 工作在工作區，故 $I_C=2\text{ mA}$

$V_o=V_{CE}=8.2-(1.6\times2)=5\text{ V}$ 因 $V_o=5\text{ V}>V_z$

⇒故 Zener 崩潰工作所以 $V_o=V_z=4\text{ V}$

33. 稽納二極的逆向崩潰電壓與摻雜濃度成反比

34. $V_{r.m.s}=\sqrt{\dfrac{(\dfrac{20}{\sqrt{3}})^2\times2}{4}}=8.16\text{ V}$

36. 射極隨耦器爲集極接地式(CC)放大器

37. 價電子要獲得足夠的熱量，才能使共價鍵斷裂，變

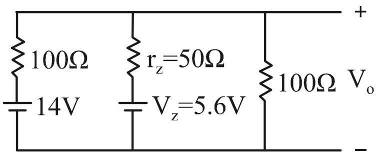
爲自由電子

38. 由圖(二十五)-a 中得知 $V_z = 5.6\ \text{V}$

$$r_z = \frac{\Delta V}{\Delta I} = \frac{6-5.6}{8\ \text{mA}} = 50\ \Omega$$

由圖(二十五)-b 中得知 $14\times\frac{100}{100+100} = 7\ \text{V} > V_z$

Zener 崩潰工作

故⇒ 

$$V_o = \frac{\frac{14}{100}+\frac{5.6}{50}}{\frac{1}{100}+\frac{1}{50}+\frac{1}{100}} = 6.3\ \text{V}$$

42. 變壓器 2 次側爲 10 V，而該電路爲半波整流濾波電路，所以輸出爲 $V_o(dc) \fallingdotseq V_m = 10\sqrt{2} = 14.14\ \text{V}$

43. 漣波因數愈小，表示濾波效果愈好

44. 電流增益最大的爲共集極(CC)

45. 偏壓與控制輸出增益的倍數無關

46. $I_{C2} = \frac{V_{CC}-V_{C2}}{0.8\ \text{k}} = \frac{12-8}{0.8\ \text{k}} = 5\ \text{mA} = I_{E2}$

$$I_{B2} = \frac{I_{E2}}{1+\beta_2} = \frac{5\ \text{mA}}{101} = 50\ \mu\text{A}$$

$$I_{RC1} = \frac{V_{CC}-V_{C1}}{12\ \text{k}} = \frac{12-6}{12\ \text{k}} = 0.5\ \text{mA}$$

$I_{RC1} = I_{C1} + I_{B2} \Rightarrow I_{C1} = I_{RC1} - I_{B2}$
$= 0.5\ \text{mA} - 50\ \mu = 450\ \mu\text{A}$

$$I_{B1} = \frac{I_{C1}}{\beta_1} = \frac{450\ \mu}{50} = 9\ \mu\text{A}$$

47. $I_E \cong I_C = \frac{V_{CC}-V_{EB}}{3\ \text{k}} = \frac{12-0.7}{3\ \text{k}} = \frac{11.3}{3\ \text{k}}$

$V_{CC} - V_{EC} - V_{SS} = I_E(R_C + R_E)$

$$\Rightarrow \frac{12-0.3-(-12)}{\frac{11.3}{3\ \text{k}}} = 3\ \text{k} + R_C \Rightarrow R_C \fallingdotseq 3.3\ \text{k}\Omega$$

48. 工作點 Q_1 移動到 Q_2 代表 $I_C\uparrow$

$$I_C = \beta I_B = \beta\left(\frac{V_{CC}-V_{BE}}{R_B}\right)$$

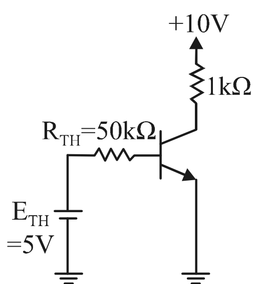
故 $I_C\uparrow$ 時 $R_B\downarrow$

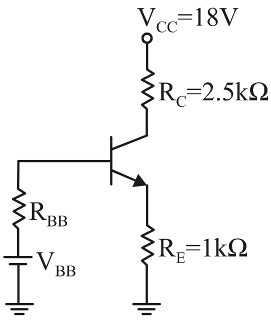
49. $I_B = \frac{5-0.7}{50\ \text{k}\Omega} = 0.086\ \text{mA}$

$I_C = BI_B = 4.3\ \text{mA}$

$V_C = 10 - 4.3 = 5.7\ \text{V}$

$V_{CE} = V_C - V_E = 5.7\ \text{V}$



50. 

$R_{BB} = 10\ \text{k}\Omega \,//\, 10\ \text{k}\Omega = 5\ \text{k}\Omega$

$$V_{BB} = 18\times\frac{10\ \text{k}\Omega}{10\ \text{k}\Omega+10\ \text{k}\Omega} = 9\ \text{V}$$

$$I_{C(sat)} = \frac{18-0.2}{2.5\ \text{k}+1\ \text{k}} = 5.086\ \text{mA}$$

$V_{BB} = I_B R_{BB} + (1+\beta)I_B R_E + V_{BE}$
$\Rightarrow 9 - 0.7 = I_B\times 5\ \text{k} + 95\times I_B \times 1\ \text{k}$

$$\Rightarrow I_B = \frac{8.3}{100\ \text{k}} = 0.083\ \text{mA}$$

因 $\beta I_B > I_{C(sat)}$ ⇒ 故工作在飽和區

$$\begin{cases} 9 = I_B\times 5\ \text{k} + 0.8 + (I_B + I_C)\times 1\ \text{k} \\ 18 = I_C\times 2.5\ \text{k} + 0.2 + (I_B + I_C)\times 1\ \text{k} \end{cases}$$

$$\Rightarrow \begin{cases} I_B = 0.545\ \text{mA} \\ I_C = 4.93\ \text{mA} \end{cases}$$