101 學年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

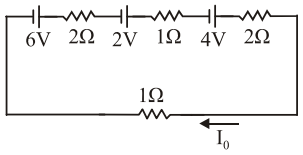
101-1-03-4
101-1-04-4

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

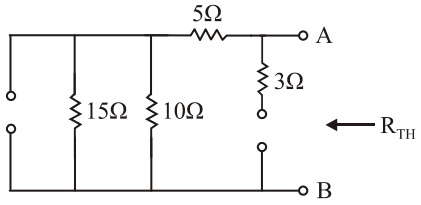
第一部份：基本電學

1. $4600\times -1.602\times 10^{-19}=-7.36\times 10^{-16}$ (庫倫)

2. $0.8\times\dfrac{15}{60}=0.2$ (度)(kw-hr)

3. 

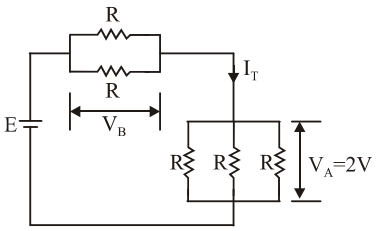
故 $I_0=\dfrac{12}{6}=2$ (A)

4. 

$R_{TH}=(15//10)+5=11\ (\Omega)$

5. 達因 dyne 爲力的單位，$1\ J=10^7\ erg$，$1\ ev=1.6\times 10^{-19}\ J$

6. $R=\sigma\dfrac{L}{A}=1.723\times 10^{-8}\times\dfrac{100}{\frac{\pi}{4}\times(1.65\times 10^{-3})^2}=0.806$

7. 

$I_T=\dfrac{2}{\frac{R}{3}}=\dfrac{6}{R}$ ， $V_B=I_T\times\dfrac{R}{2}=\dfrac{6}{R}\times\dfrac{R}{2}=3$ (V)

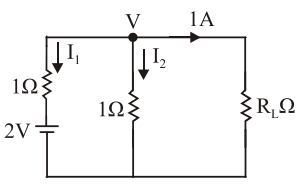
$E=V_A+V_B=3+2=5$ (V)

8. 設 V 點方程式

$\Rightarrow\dfrac{V-2}{1}+\dfrac{V}{1}+1=0$

$V-2+V+1=0$

$2V=1$ ， $V=\dfrac{1}{2}$



故 $I_1=-(\dfrac{2-\frac{1}{2}}{1})=-1.5$ A ， $I_2=0.5$ A

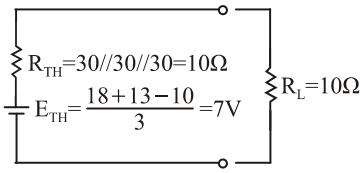
9. $I_{R1}=6$ A ， $I_{R2}=\dfrac{6\times 8}{12}=4$ A

故 $I=I_{R1}+I_{R2}+I_{R3}=12$ A ， $I_{R3}=\dfrac{6\times 8}{24}=2$ A

10. 因直流電壓源和可變電阻器與 10 Ω 電阻皆爲並聯，改變可變電阻的大小，並不會改變流經 10 Ω 電阻的電流大小

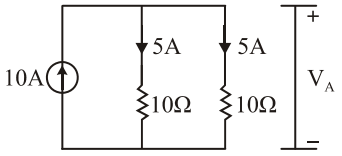
11. $G_1=\dfrac{G_bG_c+G_aG_c+G_aG_b}{G_a}$

13、14 Bus-Bar 的電路

$\Rightarrow$ 

當 $R_L=10\ \Omega$ 時有最大功率

故 $P_{max}=\dfrac{E_{TH}{}^2}{4R_{TH}}=\dfrac{7^2}{4\times 10}=\dfrac{49}{40}$ W

15. 

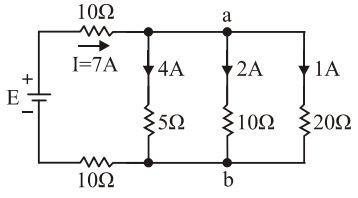
三個電流源合併 $6-3+7=10$ A

$60\ \Omega//30\ \Omega//20\ \Omega=10\ \Omega$ ， $V_A=5\times 10=50$ (V)

16. $\because V=I\times R$ ，$\therefore V\propto I$ ， $V\propto R$ ， $I\propto\dfrac{1}{R}$

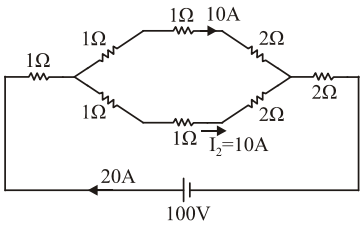
故 $I_1:I_2:I_3=\dfrac{1}{R_1}:\dfrac{1}{R_2}:\dfrac{1}{R_3}=\dfrac{1}{1}:\dfrac{1}{2}:\dfrac{1}{3}=6:3:2$

$V_1:V_2:V_3=R_1:R_2:R_3=1:2:3$

17. 

$V_{ab}=2\times 10=20$ V ， $I=\dfrac{20}{5}+2+\dfrac{20}{20}=7$ A

18.



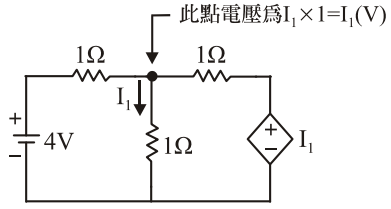
$R_T = 1+(1+1+2)//(1+1+2)+2 = 5\ \Omega$

$I = \frac{100}{5} = 20$ A ， $I_1 = I_2 = \frac{20}{2} = 10$ A

19. $R = e\frac{\ell}{A}$ ， $R' = \frac{3}{4}R$

$P' = \frac{V^2}{R'} = \frac{V^2}{\frac{3}{4}R} = \frac{4}{3}\frac{V^2}{R} = \frac{4}{3}\times 600 = 800$ (W)

20.



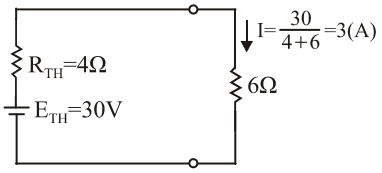
故 $\frac{I_1-4}{1}+I_1+\frac{I_1-I_1}{1}=0$ ， $I_1-4+I_1=0$

$2I_1 = 4$ ， $I_1 = 2$ (A)

21. 電流 I 爲最大⇒ 電阻組合要最小⇒ 故總電阻 $= R_1//(R_2+R_3+R_4)$ ， R_1 要選擇最小的電阻

22. 由 10 Ω 上方節點來看，流入等於流出，故流過 5 Ω 的電流爲 15 A(向左)，故 $V_s = -10\times 10+15\times 5 = -25$ V

23. 使用戴維寧⇒



24. 此電路中 15 V 和 20 V 電壓源皆被短路(分析時)
故 $E_{TH} = (5\times 6)+(-10) = 20$ (V)

25. 使用重疊定理：
分析 12 V 電源時，流過 6 V 電源的電流爲 4 A(向下)
分析 6 V 電源時，流過 6 V 電源的電流爲 2 A(向下)
故流過 6 V 電源的總電流爲 4 A + 2 A = 6 A
6 V 電源所提供的電功率 $= 6\times 6 = 36$ W

第二部份：電子學

26. 由圖知， $i(t) = 4+2\sin\omega t$

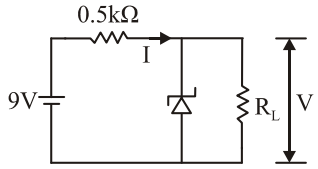
$\therefore I_{rms} = \sqrt{4^2+(\frac{2}{\sqrt{2}})^2}$ A

27. Zener 工作在逆向飽和區

28. 因 D_1 ，OFF， $V_o = 12\text{ V}\times\frac{1\text{ k}}{1\text{ k}+1\text{ k}} = 6$ (V) ， $V_o < 9$ V

故 D_2 ，OFF，故 $V_o = 6$ (V)

29.



考慮 Zener 內阻 $\Rightarrow V = V_{ZK}+r_Z\times I_{ZK}$
$= 6.7+20\times 0.2$ (mA) $= 6.704$

$I = \frac{V-V_Z}{R} = \frac{9-6.704}{0.5\text{ k}} = 4.592$ (mA)

$I_{RL} = I-I_{ZK} = 4.592-0.2 = 4.392$ (mA)

$R_L = \frac{V_Z}{I_L} = \frac{6.704}{4.392} = 1.52$ (kΩ)

31. $V_{dc} = \frac{2}{\pi}V_m = \frac{2}{\pi}\times 10 = \frac{20}{\pi} = 6.36$ (V)

$PIV = V_m = 10$ (V)

32. $V_{CC}-0.7 = I_BR_B+(1+\beta)I_BR_B$

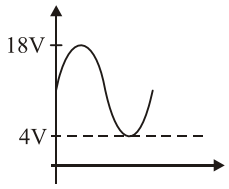
$20-0.7-I_B\times 250\text{ k}-(1+\beta)\times I_B\times 2\text{ k} = 0$

$\Rightarrow 19.3 = 452I_B \Rightarrow I_B = 0.043$ (mA)

故 $I_C = \beta I_B = 4.3$ (mA)

33. (D) 二極體不具放大能力

34.



故(A) $4\text{ V} \le V_o \le 18\text{ V}$

36. 假設全通 $\Rightarrow \frac{2.4-V}{4\text{ k}}+\frac{3.4-V}{2\text{ k}}+\frac{11.4-V}{1\text{ k}} = \frac{V}{2\text{ k}}$

$2.4-V+6.8-2\text{ V}+45.6-4\text{ V} = 2\text{ V}$

$\Rightarrow 9\text{ V} = 54.8 \Rightarrow V = 6.09$ (V) (假設全通錯誤！)

故只有 12 V 端導線 $\Rightarrow \frac{11.4-V_o}{1\text{ k}} = \frac{V_o}{2\text{ k}}$

$\Rightarrow 22.8-2V_o = V_o \Rightarrow 3V_o = 22.8 \Rightarrow$ 故 $V_o = 7.6$ (V)

38. 摻雜濃度大小 E > B > C ，寬度厚薄 C > E > B

39. $\uparrow I_B = \frac{V_{CC}-V_{BE}}{R_B\downarrow} \Rightarrow \uparrow I_C = \beta I_B \uparrow \Rightarrow \downarrow V_{CE} = V_{CC}-I_C\uparrow R_C$

故選 A 點

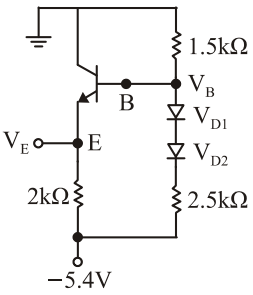
40. $I_B = \frac{V_{CC}-V_{BE}}{R_B} = \frac{15.7-0.7}{150\text{ k}} = \frac{15}{150\text{ k}} = 0.1$ mA

$I_C = \beta I_B = 10$ mA ， $V_C = 15.7-10\times 1 = 5.7$ (V)

41. 變壓器二次側爲 V_m ， C_3 兩端電壓爲 $2V_m$

$V_{C1} = V_m$ ，故 $V_{C3} = V_{C1}+V_{C2} = 2V_m$

42.



$V_B = (-5.4+1.4)\times\dfrac{1.5\text{ k}}{1.5\text{ k}+2.5\text{ k}} = -1.5\text{ (V)}$

$V_E = -1.5-0.7 = -2.2\text{ (V)}$

43. $I_E = \dfrac{10-V_{BE}}{R_E} = \dfrac{10-0.7}{20\text{ k}} = 0.465\text{ (mA)}$

$I_C = \alpha I_E = 0.46\text{ (mA)}$

44. $V_{CE} = 10-(-10)-0.46\times 10\text{ k}-0.465\times 20\text{ k}$

$= 20-4.6-9.3 = 6.1\text{ (V)}$

45. $I_E = \dfrac{V_B-V_{BE}}{R_E} = \dfrac{5-0.6}{1.1\text{ k}} = 4\text{ mA}$ ， $I_C \cong I_E \cong 4\text{ mA}$

故 $V_C = -4\text{ mA}\times 1\text{ k}\Omega = -4\text{ V}$

$V_B = -10+I_E R_E + V_{BE}$

$= -10+4\text{ m}\times 1.1\text{ k}+0.6 = -5\text{ (V)}$

因 $0-4-V_{CE}-4.4-(-10)=0$

$\Rightarrow$ 故 $V_{CE} = 1.6\text{ (V)}$

46. 硼爲三價元素，加入到本質半導體中，此硼雜質稱爲受體

47. (A) PN 接面的空乏區內只有正負離子
(C) 溫度越高，其逆向飽和電流越大
(D) 若加順向偏壓，空乏區寬度變越小

48.  代表橋式整流電路，故 V_o 頻率

$= 2f = 2\times 60 = 120\text{ Hz}$

49. $\left.\begin{aligned}\beta_1 &= \dfrac{\alpha_1}{1-\alpha_1} = \dfrac{0.96}{0.04} = 24\\ \beta_2 &= \dfrac{\alpha_2}{1-\alpha_2} = \dfrac{0.99}{0.01} = 99\end{aligned}\right\}$ ，故 $\Delta\beta = 99-24 = 75$

50. $I_{C(sat)} = \dfrac{12-0.2}{1.2\text{ k}\Omega} = 9.83\text{ (mA)}$ ，飽和條件：$\beta I_B > I_{C(sat)}$

$\Rightarrow 20\times\dfrac{10-0.7}{R_B} > 9.83\text{ (mA)} \Rightarrow 18.92\text{ k}\Omega > R_B$

故答案選擇(A) 15 kΩ