100 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

100-1-03-4
100-1-04-4

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

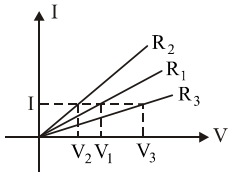
第一部份：基本電學

1. (A) $1\,\text{ev}=1.6\times10^{-19}\,\text{J}$

   (B) $1\,\text{kWh}=3.6\times10^{6}\,\text{J}$

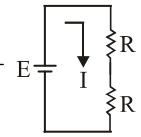
   (D) 某電動機在輸出功率維持不變的情形下，當損失功率愈大，則其效率愈小

2. $\because \dfrac{V_3}{I}>\dfrac{V_1}{I}>\dfrac{V_2}{I}\Rightarrow R_3>R_1>R_2$

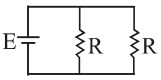


3. $\dfrac{60}{40}=\dfrac{T_o+80}{T_o+20}\Rightarrow T_o=100°\text{C}$

4. $P_{串}=(\dfrac{E}{2R})^2\times R=\dfrac{E^2}{4R}$



$P_{並}=(\dfrac{E}{R})^2\times R=\dfrac{E^2}{R}$

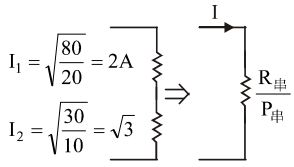


$\therefore \dfrac{P_{串}}{P_{並}}=\dfrac{\frac{E^2}{4R}}{\frac{E^2}{R}}=\dfrac{1}{4}$

5. $I=18\times\dfrac{(3//18)}{9+(3//18)}=4\,\text{A}$

6. (D) 20 Ω/80 W、10 Ω/30 W

   如右圖，取 $I=I_2$



   $R_{串}=20+10=30\,\Omega$

   $P_{串}=(\sqrt{3})^2\times30=90\,\text{W}$

7. $P_1:P_2:P_3=\dfrac{E^2}{R_1}:\dfrac{E^2}{R_2}:\dfrac{E^2}{R_3}$ ($\because$並聯)

   $=\dfrac{1}{2}:\dfrac{1}{3}:\dfrac{1}{4}=6:4:3$

8. $P=I^2\times R\Rightarrow P\propto R$ ($\because$串聯)

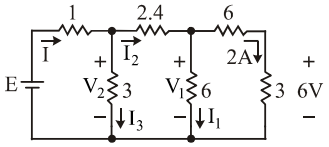
   $\dfrac{50\,\text{W}}{75\,\text{W}}=\dfrac{R_1}{45}\Rightarrow R_1=30\,\Omega$

9. $V_1=2\times(6+3)=18\,\text{V}$ ，$I_1=\dfrac{V_1}{6}=\dfrac{18}{6}=3\,\text{A}$

   $I_2=I_1+2=5\,\text{A}$ ，$V_2=2.4\,I_2+V_1=12+18=30\,\text{V}$

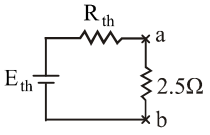
   $I_3=\dfrac{V_2}{3}=10\,\text{A}$ ，$I=I_3+I_2=15\,\text{A}$

   $E=1\times I+V_2=15+30=45\,\text{V}$



10. $R_{th}=10\,\Omega$

    $E_{th}=25\,\text{V}+5\times10=75\,\text{V}$



    $P_{2.5}=(\dfrac{75}{10+2.5})^2\times2.5=90\,\text{W}$

11. S打開：$I_1=\dfrac{18}{3+15+(5+25)//7.5}=\dfrac{3}{4}\,\text{A}$

    S關閉：$I_2=\dfrac{18}{3+(10+5)//(15+7.5)}=\dfrac{3}{2}\,\text{A}$

    $\therefore \dfrac{I_2}{I_1}=\dfrac{\frac{3}{2}}{\frac{3}{4}}=2$

12. $\begin{cases}I_A=6\,\text{A}\\5-2+5I_B-3I_A=0\end{cases}\Rightarrow 5I_B=3\times6+2-5=15$

    $I_B=3\,\text{A}$

13. $\dfrac{V_A-6}{6}+\dfrac{V_A}{3}+\dfrac{V_A+4}{4}=0\Rightarrow V_A=0\,\text{V}$

    $V_{AB}=3\times\dfrac{V_A+4}{4}=3\,\text{V}$

14. $R_N=3//6=2\,\Omega$ ，$I_N=I_{ab}=6+\dfrac{9}{3}+(-\dfrac{36}{6})=3\,\text{A}$

15. $V_{th}=V_{ab}=6\times2+9\times\dfrac{6}{3+6}+(-36)\times\dfrac{3}{3+6}=6\,\text{V}$

16. $\dfrac{6-V'}{4}+2=\dfrac{V'-2}{2}$ ，$6-V'+8=2V'-4$

    $\Rightarrow 3V'=18\Rightarrow V'=6\,\text{V}$ ，$\therefore I=\dfrac{6-V'}{4}=0\,\text{A}$

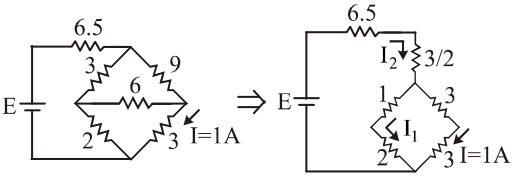
17. $R_L=R_{th}=2+3+3=8\,\Omega$

18. $V_{th}=5\,\text{V}$ ，$R_{th}=3//6=2\,\Omega$

$P_{RL}=\dfrac{5^2}{4\times2}=\dfrac{25}{8}=3.125\ \text{W}$

19. $I_1=\dfrac{(3+3)\times1}{(1+2)}=2\ \text{A}\Rightarrow I_2=I_1+I=3\ \text{A}$

$\therefore E=I_2\times[6.5+\dfrac{3}{2}+(1+2)//(3+3)]=3\times10=30\ \text{V}$



20. (A) $E=0$ ， $V=\dfrac{1}{4\pi\varepsilon}\times\dfrac{Q}{r}$

(B) $E=\dfrac{1}{4\pi\varepsilon}\times\dfrac{Q}{r^2}$ ， $V=\dfrac{1}{4\pi\varepsilon}\times\dfrac{Q}{r}$

(C) $V=\dfrac{1}{4\pi\varepsilon}\times\dfrac{Q}{R}$ ， $E=\dfrac{1}{4\pi\varepsilon}\times\dfrac{Q}{R^2}$

21. $Q_T=150\times[(3+2+4)//6//18]\ \mu\text{F}=450\ \mu\text{C}$

$Q_{2\,\mu\text{F}}=450\ \mu\text{C}\times\dfrac{2}{3+2+4}=100\ \mu\text{C}$

22. $Q_T=30\ \text{V}\times(9//18)\ \mu\text{F}=180\ \mu\text{C}$

$W_1=\dfrac{Q_T^2}{2C_1}=\dfrac{180^2}{2\times9}=1800\ \mu\text{J}=1.8\ \text{mJ}$

23. $\dfrac{\mu_B}{\mu_A}=\dfrac{\dfrac{2\times10^{-5}}{400}}{\dfrac{2\times10^{-5}}{1000}}=\dfrac{5}{2}=2.5$

24. $M=0.5\sqrt{4\times16}=4\ \text{mH}$ (互消)

$L_{ab}=\dfrac{4\times16-4^2}{4+16+2\times4}=\dfrac{48}{28}=\dfrac{12}{7}\ \text{mH}$

$W_{ab}=\dfrac{1}{2}\times L_{ab}\times7^2=42\ \text{mJ}$

第二部份：電子學

26. (A) 價電子成爲自由電子條件爲獲得能量
(C) N 型半導體爲在本質半導中摻雜五價元素以增加導電性，其形成電流的多數載子爲電子
(D) 無論是本質或外質半導體，其整體電性質不帶電

27. $160\ \text{nA}=I_S\times2^{(\frac{80-20}{10})}\Rightarrow I_S=2.5\ \text{nA}$

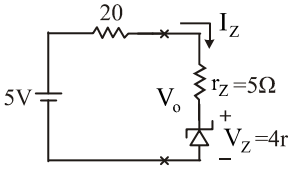
28. (B) 二極體在順偏時，主要之電容效應爲擴散電容，其值隨通過電流的增加而變大

29. D off，$\therefore V_o=0\ \text{V}$

30. $V_{o(rms)}=\dfrac{V_{sm}}{\sqrt{2}}=\dfrac{\dfrac{120}{5}}{\sqrt{2}}=\dfrac{24}{\sqrt{2}}\ \text{V}$

$I_{o(rms)}=\dfrac{V_{o(rms)}}{R_L}=1.2\sqrt{2}\ \text{mA}$

31. $I_Z=\dfrac{5-4}{20+5}=40\ \text{mA}$



$V_o=40\times0.005+4=4.2\ \text{V}$ ， $P_Z=40\times4.2=168\ \text{mW}$

32. $V_{o(dc)}=\dfrac{2}{\pi}\times V'_{sm}=\dfrac{2}{\pi}\times(\dfrac{1}{2}\times\dfrac{50\sqrt{2}}{10})=\dfrac{5}{\pi}\sqrt{2}\ \text{V}$

33. $\text{PIV}=V_m$

34. $V_1:V_2:V_3=V_m:2V_m:V_m=1:2:1$

35. (1) $V_i>-V_1\Rightarrow V_o=-V_1$
(2) $V_i<-V_2\Rightarrow V_o=-V_2$
(3) $-V_2<V_i<-V_1\Rightarrow V_o=V_i$

36. (1) $V_i=-5\ \text{V}\Rightarrow\text{D ON}\Rightarrow V_o=-2\ \text{V}$
(2) $V_i=+10\ \text{V}\Rightarrow\text{D OFF}\Rightarrow V_o=+13\ \text{V}$

37. $r\%=\dfrac{4.8}{R_L\times C}\times100\%=\dfrac{4.8}{10\times50}\times100\%=0.96\%$

38. $\dfrac{R_i}{6}=(\dfrac{5}{1})^2\Rightarrow R_i=6\times25=150\ \Omega$

40. 作放大器用，BE 順偏，$V_E>V_B$ ；BC 逆偏，$V_B>V_C$
故 $V_E>V_B>V_C$

41. $\beta=\dfrac{I_E}{I_B}-1=\dfrac{1\ \text{mA}}{5\ \mu\text{A}}-1=199$ ， $\alpha=\dfrac{\beta}{1+\beta}=\dfrac{199}{200}=0.995$

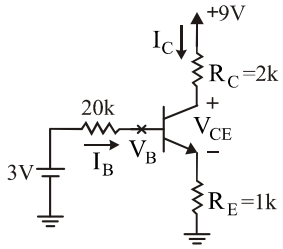
43. $I_C=\beta I_B+(1+\beta)I_{CO}=49\times20\ \mu\text{A}+(1+49)\times0.05\ \mu\text{A}$
$=0.9825\ \text{mA}$

44. $\dfrac{10-0.2}{0.47}<100\times\dfrac{10-0.7}{R_B}\Rightarrow R_B<44.6\ \text{k}\Omega$
選橙白橙金 $R_B=39\ \text{k}\Omega$

46. $I_B=\dfrac{10.7-0.7}{100+(1+99)\times1}=50\ \mu\text{A}$ ， $I_C\fallingdotseq I_E=\beta I_B\fallingdotseq5\ \text{mA}$
$V_E=-5\times1=-5\ \text{V}$ ， $V_C=-10.7-(-0.5\times5)=-8.2\ \text{V}$
$\therefore V_{EC}=V_E-V_C=3.2\ \text{V}$

47. $I_B=\dfrac{5.7-0.7}{300+(1+199)\times1}=10\ \mu\text{A}=0.01\ \text{mA}$
$V_C=5.7-(1+199)\times0.01\times1=3.7\ \text{V}$

48. $I_B=\dfrac{3-0.7}{20+(1+100)\times1}\fallingdotseq19\ \mu\text{A}$， $I_C=\beta I_B=1.9\ \text{mA}$
$\therefore V_B\fallingdotseq0.7+1.9\times1=2.6\ \text{V}$
$\therefore V_{CE}=(9-1.9\times2)-(1\times1.9)=3.3\ \text{V}$



49. (B) $V_{BE(t)}$ 下降
(C) I_{CQ} 上升
(D) Q 接近飽和區

50. $-0.7+V_{CC}=I_ER_E+I_BR_B+I_ER_C$
$\because I_E=(1+\beta)I_B$ ，$\therefore I_B=\dfrac{V_{CC}-0.7}{R_B+(1+\beta)(R_C+R_E)}$