# 101 學年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

101-2-03-4
101-2-04-4

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | B | D | B | A | B | D | B | A | D | D | A | C | C | A | D | B | A | D | C | A | C | C | D | 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 | C | D | B | C | B | A | C | D | A | B | A | D | C | C | D | A | B | C | A | D | C | B | A | C |

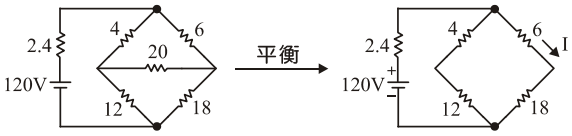
## 第一部份：基本電學

1. $\$ = 220\times 2 + 440\times 2.5 + 100\times 3.2 = 1{,}860$ 元

2. $I_1$迴路：$R_1 + R_2 + R_3 = 7\,\Omega$，$R_2 = 2\,\Omega$
   $R_3 = 1\,\Omega \Rightarrow R_1 = 4\,\Omega$
   $I_3$迴路：$R_4 = 3\,\Omega$，$R_3 + R_4 + R_5 = 6\,\Omega \Rightarrow R_5 = 2\,\Omega$
   $\therefore R_1 + R_3 + R_5 = 4 + 1 + 2 = 7\,\Omega$

3. $I_T = \dfrac{5\text{ V}}{R_T} = \dfrac{5}{\frac{10}{50}} = 25\text{ A}$

4. $I = \dfrac{120}{2.4 + (4+12)//(6+18)} \times \dfrac{16}{16+24} = 4\text{ A}$
   $P_{6\,\Omega} = 4^2 \times 6 = 96\text{ W}$




5. $90\text{ Ah} = I \times \dfrac{720}{60} \Rightarrow I = 7.5\text{ A}$

6. 馬力(hP)：功率單位

7. $R = \rho \cdot \dfrac{\ell}{A}$，$\ell_1 \cdot A_1 = \ell_2 \cdot (\frac{1}{2})^2 \cdot A_1 \Rightarrow \ell_2 = 4\ell_1$

$$\frac{R_1}{R_2} = \frac{\frac{\ell_1}{A_1}}{\frac{4\ell_1}{(\frac{1}{2})^2 \cdot A_1}} = \frac{1}{16} \Rightarrow \frac{G_2}{G_1} = \frac{1}{16}$$

$$\Rightarrow G_2 = \frac{1}{16} \times G_1 = \frac{1}{16} \times 4 = \frac{1}{4}\,\text{℧}$$

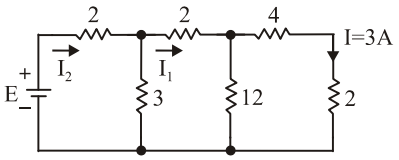
8. $R = \dfrac{24}{6} = 4\,\Omega$
   $I = \dfrac{15}{4} + \dfrac{5}{4} = \dfrac{20}{4} = 5\text{ A}$
   $P_R = 5^2 \times 4 = 100\text{ W}$

9. $\dfrac{P_{並}}{P_{串}} = \dfrac{\frac{V^2}{(\frac{R}{2})}}{\frac{V^2}{(2R)}} = 2 \times 2 = 4$

10. $I_1 = 3 + \dfrac{3\times(4+2)}{12} = 3 + \dfrac{3}{2} = \dfrac{9}{2}\text{ A}$

$$I_2 = I_1 + \frac{2\times\frac{9}{2} + 3\times(4+2)}{3} = \frac{9}{2} + \frac{9+18}{3} = \frac{27}{2}\text{ A}$$

$$E = 2\times I_2 + 2\times I_1 + (4+2)\times I = 27 + 9 + 18 = 54\text{ V}$$



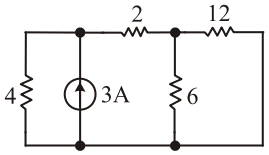

11. 選擇 (15V , 2A)

$$I = \frac{15}{6+3} + 2\times\frac{6}{6+3} = \frac{15}{9} + \frac{12}{9} = \frac{27}{9} = 3\text{ A}$$

12. (A) N 個節點，可列出 (N –1) 個方程式

13. $V_{6\,\Omega} = 3\times\dfrac{4}{4+(2+6//12)}\times\dfrac{12}{6+12}\times 6$

$$= 3\times\frac{4}{10}\times\frac{12}{18}\times 6 = 4.8\text{ V}$$




14. $I_N = I_{ab} = (-I)\times\dfrac{6}{3+6} - (-I)\times\dfrac{3}{6+3} = -\dfrac{3}{9}I = -\dfrac{1}{3}I$

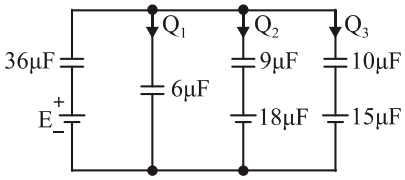
15. $R_L = R_{th} = 4\,\Omega$，$V_{RL} = V_{th} = -20 + 2\times 4 = -12\text{ V}$

$$\therefore P_{RL} = \frac{{V_{th}}^2}{4\times R_{th}} = \frac{(-12)^2}{4\times 4} = \frac{12\times 12}{4\times 4} = 9\text{ (W)}$$

16. $V_{ab} = 72\times\dfrac{3}{18+6+3} + (-2)\times\dfrac{18}{18+(6+3)}\times 3$

$$= \frac{72\times 3}{27} - \frac{2\times 18\times 3}{27} = \frac{108}{27} = 4\text{ V}$$

17. (原電路)




$Q_3 = 10\,\mu\times 360 = 3600\,\mu\text{C}$

$$Q_2 = (9//18)\times\frac{3600}{(10//15)} = 6\times600 = 3600\ \mu C$$

$$Q_1 = 6\times\frac{3600}{(10//15)} = 6\times600 = 3600\ \mu C$$

$$E = \frac{Q_1+Q_2+Q_3}{(6+6+6)//36} = \frac{10800}{12} = 900\ V$$

18. $W_C = \frac{1}{2}CV^2 = \frac{1}{2}QV = \frac{Q^2}{2C} = \frac{(4\times10^{-2})^2}{2\times20\mu}$

$$= \frac{16\times10^{-4}}{40\times10^{-6}} = 40\ J$$

19. $\vec{E}_A = \vec{E}_1 + \vec{E}_2 = E + (-E) = 0\ V/m$

20. $\frac{40\ mH}{L^2} = (\frac{600}{150})^2 = 16 \Rightarrow L_2 = \frac{40\ mH}{16} = 2.5\ mH$

21. $L_{ab} = 8 + \frac{3\times6-3^2}{3+6+2\times3} = 8+\frac{18-9}{9+6} = 8.6\ H$

22. 佛來銘左手定則之左手之中指代表電流方向

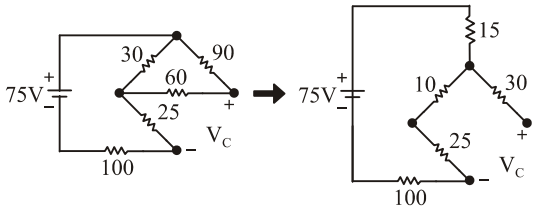
23. $V_C = 9\times\frac{3}{6+3} = 3\ V$

24. (A) $\tau = \frac{L}{R}$

(B) $V_L(t) = E\cdot e^{-\frac{t}{\tau}}$

(C) $i(t) = \frac{E}{R}(1-e^{-\frac{t}{\tau}})$

25. 穩定→L：短路，C：開路




$$V_C = 75\times\frac{(10+25)}{100+15+10+25} = 75\times\frac{35}{150} = \frac{35}{2} = 17.5\ V$$

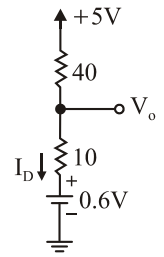
## 第二部份：電子學

26. 半導體作成的電阻其工作環境溫度上升時，其導電率增加

27. 空乏區內無電子與電洞存在，而障壁電位主要爲施體與受體離子的作用

28. (D) 外接逆向偏壓時，所產生之漏電流，主因爲少數載子的流動

29. $R_f = \frac{0.8-0.6}{20\ mA} = 10\ \Omega$ ， $V_D = 0.6\ V$




$$V_o = (5-0.6)\times\frac{10}{10+40}+0.6 = 1.48\ V$$

30. $D_1$：ON，$D_2$、$D_3$：OFF

$$\therefore I = \frac{(5-0.6-1)}{2} = 1.7\ mA$$

31. $V_{2m} = \frac{110\sqrt{2}}{10} = 11\sqrt{2}\ V$

$$I_{(dc)} = \frac{V_{dc}}{5} = \frac{\frac{2}{\pi}\times11\sqrt{2}}{5} = 1.98\ mA$$

32. 全波整流濾波：

$$r\% = \frac{2.4}{R_L\times C} \Rightarrow 0.05 = \frac{2.4}{10\times C} \Rightarrow C = 4.8\ \mu F$$

33. 當 $V_i + 2\ V < 0\ V$ ，即 $V_i < -2\ V$

則 D：ON $\Rightarrow V_o = V_i + 2\ V$

反之， $V_i > -2\ V$ ， D：OFF ， $V_o = 0\ V$

34. 分壓偏壓電路近似分析過程未用到β值，基極電壓 $V_B$ 僅由 $V_{CC}$ 與分壓電阻決定

35. 共集極電路電壓增益略小於 1

36. $10.7 = (2.5+0.5)\times(1+49)\times I_B + 50\times I_B + 0.7$

$10 = 200\times I_B \Rightarrow I_B = 0.05\ mA$

$\Rightarrow I_E = (1+49)\times I_B = 2.5\ mA$

$V_B = 0.7\ V + I_E\times R_E = 0.7 + 2.5\times0.5 = 1.95\ V$

37. $-0.7 = 5\times I_E - 8 \Rightarrow I_E = \frac{8-0.7}{5} = \frac{7.3}{5} = 1.46\ mA$

$I_C \fallingdotseq I_E = 1.46\ mA$

$V_{CE} = (12-(-8)) - (1+5)\times1.46 = 11.24\ V$

38. 欲使 LED ON $\Rightarrow$ BJT→飽和區

$$\therefore I_C \le \beta I_B \Rightarrow \frac{12-1.8-0.2}{R_C} \le 50\times\frac{5-0.7}{R_B}$$

$$\Rightarrow \frac{R_B}{R_C} \le 21.5 (\frac{R_B}{R_C} = \frac{5}{0.25} = 20)$$

39. $Z_i = R_B + r_\pi + (1+\beta)\times R_E = R_B + (1+\beta)(r_e + R_E)$

40. $A_V = \frac{V_o}{V_i} = -\beta\times\frac{R_C//R_L}{r_\pi} = -150\times\frac{(5//10)}{1.25}$

$$= -150\times\frac{(\frac{10}{3})}{1.25} = -\frac{500}{1.25} = -400$$

41. $Z_i = r_\pi + (1+\beta)\times R_E = 1+(1+99)\times1 \fallingdotseq 100\ k\Omega$

$$A_i = \frac{I_o}{I_i} = \frac{I_o}{i_b}\times\frac{i_b}{I_i} = (1+\beta)\times\frac{R_B}{R_B+Z_i}$$

$$= (1+99)\times\frac{150}{150+100} = 60$$

42. $V_B = 20\times\frac{10}{90+10} = 2\ V$ ， $R_B = 90//10 = 9\ k\Omega$

$$I_B = \frac{2-0.7}{9+(1+90)\times1} = 0.013\ mA \text{ ， } r_\pi = \frac{26\ mV}{I_B} = 2\ k\Omega$$

$$A_V = \frac{V_o}{V_i} = -\beta\times\frac{R_C//R_L}{r_\pi} = -90\times\frac{5//4}{2} = -100$$

43. $10\ dBm = 10\times\log\frac{P_o}{1\ m} \Rightarrow P_o = 10\ mW$

$$\Rightarrow P_o = \frac{V_0^2}{2.5} = 10 \Rightarrow V_o = 5\ V$$

$$A_{V1} = 20 = 20\times\log(\frac{V_x}{V_i}) \Rightarrow \frac{V_x}{V_i} = 10$$

$\Rightarrow V_i = \frac{V_x}{10} = \frac{50\text{ mV}}{10} = 5\text{ mV}$

$\therefore A_{VT} = 20\times\log\left|\frac{V_o}{V_i}\right| = 20\times\log(\frac{5}{5\text{ m}})$

$= 20\times 3 = 60\text{ dB}$

44. RC 耦合串級放大器中，耦合電容主要功用爲阻隔輸入訊號之直流成分

45. 共射極電晶體放大器之低頻響應部分主要受到射極旁路電容影響

46. (D) BJT 之操作速度較 FET 爲快

47. (C) $\begin{matrix}V_{GS} = 5-4.5 = 0.5\text{ V} < V_{GS(OFF)} = 3.5\text{ V}\\ V_{GD} = 5-3.5 = 1.5\text{ V} < V_{GS(OFF)} = 3.5\text{ V}\end{matrix} \Rightarrow$ 歐姆區

48. $V_{GS} = 12\times\frac{300}{300+600} - I_D\times 1 = (4-I_D)$

$I_D = 4\times(1-\frac{(4-I_D)}{-2})^2 = 4\times(3-\frac{I_D}{2})^2$

$= 4\times(9-3I_D+\frac{1}{4}I_D^2) = 36-12I_D+{I_D}^2$

$\Rightarrow I_D^2-13I_D+36=0 \Rightarrow I_D = \frac{13\pm\sqrt{13^2-4\times 36}}{2}$

$= 4\text{ mA}$ 或 $9\text{ mA}$(不合)

$\therefore V_{DS} = 12-I_D\times(R_D+R_s) = 12-4\times(1.5+1) = 2\text{ V}$

49. $V_{GS} = V_{DS} = 10-3\times(1+R_s) = (7-3\times R_s)$

$I_D = k\times(V_{GS}-V_t)^2 \Rightarrow 3 = 0.75\times((7-3R_s)-2)^2$

$\Rightarrow 4 = (5-3R_s)^2 \Rightarrow R_s = 1\,\text{k}\Omega$

50. N 通道增強型 FET 不適用自給偏壓法電路，因無法產生汲極電流 $I_D$