九十九學年四技二專第三次聯合模擬考試
電機與電子群　專業科目（一）　詳解

99-3-03-4
99-3-04-4

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

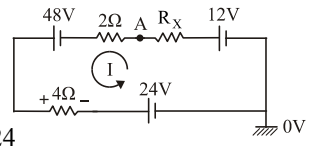
第一部份：基本電學

1. $2.5\times(2\times\frac{3}{4}\text{K}\times16+\frac{40\times20}{1000}\times200)=460$

2. $\text{R}=\frac{\text{V}^2}{\text{P}}=\frac{12^2}{290}=0.4965\,\Omega$ ，約爲 0.5 Ω
   綠黑銀金電阻爲 $50\times10^{-2}\pm5\%=(0.5\pm5\%)\,\Omega$

3. $\text{R}=\frac{\text{P}}{\text{I}^2}=\frac{100}{10^2}=1\,\Omega$ ，拉長 3 倍 $\text{R}'=3^2\times\text{R}=9\,\Omega$
   $\text{P}'=(\text{I}')^2\times\text{R}'=3^2\times9=81$ W

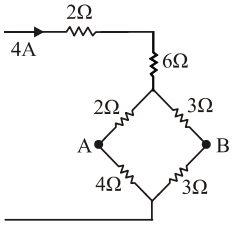
4. $\text{V}_\text{A}=24+4\text{I}-48+2\text{I}$
   $\text{I}=2$ A
   又 $\text{V}_\text{A}=12-2\text{R}_\text{X}\Rightarrow2\text{R}_\text{X}=24$
   $\therefore\text{R}_\text{X}=12\,\Omega$



5. $\begin{cases}(25-\text{I}_\text{A})(\text{R}_1+\text{R}_2+\text{R}_3)=5\times1\,\text{k}\\(50-\text{I}_\text{A})(\text{R}_2+\text{R}_3)=5(1\,\text{k}+\text{R}_1)\end{cases}$
   $\text{R}_1+\text{R}_2+\text{R}_3=\frac{1}{4}\text{k}\cdots\cdots(1)$
   $9(\text{R}_2+\text{R}_3)=1\,\text{k}+\text{R}_1\cdots\cdots(2)$
   由(1) $\text{R}_2+\text{R}_3=\frac{1}{4}\text{k}-\text{R}_1$ 代入(2)
   $9(\frac{1}{4}\text{k}-\text{R}_1)=1\,\text{k}+\text{R}_1$ ， $10\text{R}_1=\frac{9}{4}\text{k}-1\,\text{k}$
   $\text{R}_1=\frac{5}{4}\text{k}\times\frac{1}{10}=125\,\Omega$

6. $\frac{\text{V}_\text{A}-24}{4}+\frac{\text{V}_\text{A}-16}{4}=5$ ， $\text{V}_\text{A}-24+\text{V}_\text{A}-16=20$
   $\text{V}_\text{A}=30$ V ， $\text{I}_{4\,\Omega}=\frac{\text{V}_\text{A}-24}{4}=1.5$ A

7. $\text{R}_\text{T}=2+6+(2+4)//(3+3)=11\,\Omega$
   $\text{I}_\text{T}=\frac{44}{11}=4$ A
   $\text{V}_\text{A}=2\times4=8$ V
   $\text{V}_\text{B}=3\times2=6$ V
   $\therefore\text{I}_{6\,\Omega}=\frac{\text{V}_\text{A}-\text{V}_\text{B}}{6}=\frac{8-6}{6}=\frac{1}{3}$ A



8. 電橋電路 40 Ω 無效
   $\text{R}_\text{T}=6+4+(20+80)//[30+240//240]//60//60=30\,\Omega$

9. $\text{R}_\text{TH}=\text{R}_\text{N}=4\,\Omega$ ， $\text{E}_\text{TH}=\text{V}_\text{ab}=5\times4+12=32$ V
   $\text{I}_\text{N}=\frac{\text{E}_\text{TH}}{\text{R}_\text{TH}}=\frac{32}{4}=8$ A，$\text{P}_{\text{L}\,\max}=\frac{\text{E}_\text{TH}^{\,2}}{4\text{R}_\text{TH}}=\frac{32\times32}{4\times4}=64$ W

10. $\text{I}_2=4$ A ， $\text{I}_4=2$ A
    $10\text{I}_3-4\text{I}_2-4\text{I}_4=-24\Rightarrow\text{I}_3=0$ A
    $10\text{I}_1-4\text{I}_2-4\text{I}_4=12\Rightarrow\text{I}_1=3.6$ A

11. $\text{C}_\text{T}=\{[(6+6)//(5+7)]+6\}//12=6\,\mu\text{F}$
    $\text{Q}_\text{T}=\text{Q}_\text{ad}=\text{Q}_\text{db}=\text{C}_\text{T}\text{V}_\text{T}=6\,\mu\times200=1200\,\mu\text{C}$
    $\text{V}_\text{bd}=\frac{\text{Q}_\text{bd}}{\text{C}_\text{bd}}=\frac{1200\,\mu\text{C}}{12\,\mu\text{F}}=100$ V
    $\text{V}_\text{ad}=\text{V}_\text{T}-\text{V}_\text{db}=100$ V ， $\text{C}_\text{ac}=\text{C}_\text{cd}=12\,\mu\text{F}$
    $\therefore\text{V}_\text{ac}=\text{V}_\text{cd}=50$ V ， $\text{Q}_\text{cd}=50\times12=600\,\mu\text{C}$

12. $\text{L}_\text{T}=4+6+8+2\times2-2\times2-2\times2=14$ H

13. (D) 佛萊明右手定則大姆指爲導體運動方向，而非受力方向

14. (B) RC 充放電， V_C 之極性相同

15. $\text{R}_\text{TH}=(6\,\text{k}//12\,\text{k})//(2\,\text{k}+2\,\text{k})=2\,\text{k}\Omega$
    $\tau=\text{R}_\text{TH}\times\text{C}=2\,\text{k}\Omega\times500\,\mu\text{F}=1$ 秒

16. $\bar{\text{i}}_1=15+\text{j}0$ ， $\bar{\text{i}}_2=0-\text{j}20$
    $\bar{\text{i}}_1+\bar{\text{i}}_2=15-\text{j}20=25\angle-53°=25\sqrt{2}\sin(377\text{t}-53.1°)$
    $=25\sqrt{2}\sin(377\text{t}-143.1°)$

17. $\text{f}=50$ Hz ， $\text{V}_\text{rms}=70.7$ V ， $\text{V}_\text{av}=63.6$ V
    $\text{V}(\frac{1}{200})=100\sin(2\pi\times50\times\frac{1}{200}+60°)$
    $=100\sin(\frac{\pi}{2}+60°)=50$ V

18. $\bar{\text{Z}}=4+\text{j}3=5\angle37°$ ， $\bar{\text{I}}=\frac{100\angle37°}{5\angle37°}=20\angle0°$ A
    $\bar{\text{V}}_\text{L}=\bar{\text{I}}\times\bar{\text{X}}_\text{L}=20\angle0°\times3\angle90°=60\angle90°$
    $\therefore\text{V}_\text{L}(\text{t})=60\sqrt{2}\sin(377\text{t}+90°)=60\sqrt{2}\cos(377\text{t})$

19. $\bar{\text{Z}}_1=\text{R}_1+\text{j}\,\text{X}_\text{L}=20\,\text{k}+\text{j}20\,\text{k}=20\sqrt{2}\,\text{k}\angle45°\,\Omega$
    $\bar{\text{I}}_1=\frac{100\angle0°}{20\sqrt{2}\,\text{k}\angle45°}=\frac{5}{\sqrt{2}}\angle-45°$ mA
    $\bar{\text{V}}_\text{A}=\bar{\text{I}}_1\times\bar{\text{X}}_\text{L}=\frac{5}{\sqrt{2}}\angle-45°\,\text{mA}\times20\,\text{k}\angle90°\,\Omega$
    $=\frac{100}{\sqrt{2}}\angle45°$ V
    $\bar{\text{Z}}_2=50\,\text{k}-\text{j}50\,\text{k}=50\sqrt{2}\angle-45°\,\text{k}\Omega$

$\bar{I}_2 = \dfrac{100\angle 0°}{50\sqrt{2}\angle -45°\ \text{k}} = \dfrac{2}{\sqrt{2}}\angle 45°\ \text{mA}$

$\bar{V}_B = \bar{I}_2 \times \bar{X}_C = \dfrac{2}{\sqrt{2}}\angle 45°\ \text{mA} \times 50\ \text{k}\angle -90°\ \Omega$

$= \dfrac{100}{\sqrt{2}}\angle -45°\ \text{V}$ ， $\bar{V}_{AB} = \bar{V}_A - \bar{V}_B = \bar{V}_A + (-\bar{V}_B)$

$= 50 + \text{j}50 + (-50 + \text{j}50) = \text{j}100 = 100\angle 90°\ \text{V}$

20. $\bar{Y} = \dfrac{1}{10} + \dfrac{1}{3+\text{j}4} + \dfrac{1}{8-\text{j}6} = \dfrac{1}{10} + \dfrac{3-\text{j}4}{25} + \dfrac{8+\text{j}6}{100}$

$= \dfrac{1}{100}(10 + 12 - \text{j}16 + 8 + \text{j}6) = \dfrac{1}{100}(30 - \text{j}10) = \dfrac{1}{10}(3 - \text{j})$

$\bar{Z}_T = \dfrac{1}{\bar{Y}} = \dfrac{10}{3-\text{j}} = 10\dfrac{3+\text{j}}{(3-\text{j})(3+\text{j})} = 3 + \text{j}$

21. (D) 負載之實功率不變

比對 $P(t) = P - S\cos(2\text{w}t + \theta_v + \theta_i)$

22. $P = 400\ \text{W}$ ， $S = 500\ \text{VA}$ ， $P_{max} = P + S = 900\ \text{W}$

$\cos\theta = \dfrac{P}{S} = \dfrac{400}{500} = 0.8$

23. $x_{Co} = \dfrac{1}{\omega C} = \dfrac{1}{10^3 \times 5 \times 10^{-6}} = 200\ \Omega = x_{Lo}$

$x_{Lo} = \omega L$ ， $200 = 1000 \times L$ ， $L = 0.2\ \text{H}$

$Q = \dfrac{x_{Lo}}{R} = \dfrac{x_{Co}}{R} = \dfrac{200}{10} = 20$

$V_L = V_C = QV_m = 20 \times 1000 = 20000$

$f_o = \dfrac{W_o}{2\pi} = \dfrac{1000}{2\pi}\text{Hz}$

24. (C) 並聯諧振 f ↑ ，Y 爲先減後增

25. $R' = \dfrac{R^2 + X_L{}^2}{R} = \dfrac{6^2 + 8^2}{6} = \dfrac{50}{3}\Omega$

$X_L{}' = \dfrac{R^2 + X_L{}^2}{X_L} = \dfrac{100}{8}\Omega = X_{Co} = \dfrac{1}{\omega C}$

$\dfrac{8}{100} = 10^3 \times C$ ， $C = 80\ \mu\text{F}$

第二部份：電子學

26. $\text{DT}(\%) = \dfrac{t_H}{t_L + t_H} \times 100\% = \dfrac{5\ \text{mS}}{25\ \text{mS}} \times 100\% = 20\%$

27. 設漏電流增至 $2^{10}\sqrt{2}$ nA 時之溫度爲 t_2

$2^{10}\sqrt{2}\ \text{nA} = 4\ \text{nA} \times 2^{\frac{t_2 - 25°\text{C}}{10}}$ ， $t_2 = 110°\text{C}$

28. (B) LED 的發光亮度和流過 LED 的順向電流成正比

29. $V_{AD(m)} = 2 \times 110 \times \sqrt{2} = 311\ \text{V}$

$\because \dfrac{933}{311} = 3 \Rightarrow$ 所求爲三倍壓

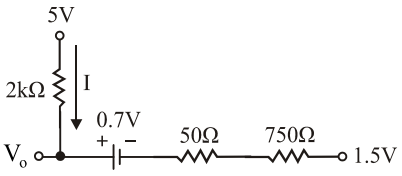
$\Rightarrow$ 由 AC 端取得之電壓爲三倍壓即爲 933 V

30. (A) 二極體 D 的主要功能爲保護電晶體

31. 電路中 D_1 off、D_2 on

$I = \dfrac{5\ \text{V} - 0.7\ \text{V} - 1.5\ \text{V}}{2\ \text{k}\Omega + 50\ \Omega + 750\ \Omega} = \dfrac{2.8\ \text{V}}{2.8\ \text{k}\Omega} = 1\ \text{mA}$

$V_o = 5\ \text{V} - 1\ \text{mA} \times 2\ \text{k}\Omega = 3\ \text{V}$



32. $r\% = \dfrac{V_{r(rms)}}{V_{dc}} \times 100\%$ ， $10\% = \dfrac{V_{r(rms)}}{10} \times 100\%$

$V_{r(rms)} = 1\ \text{V}$ ， $1\ \text{V} = \dfrac{V_{AB}}{2\sqrt{3}}$ ， $V_{AB} = 2\sqrt{3}\ \text{V}$

33. (A) CE 組態電路，輸出和輸入相差 180°

(B) R_E 提供電路直流負回授，可增加電路穩定度

(C) R_E 短路時，不影響電壓增益

(D) C_E 開路時，R_E 即爲回授元件，電壓增益將降低

34. (A) 電晶體逆向操作時，崩潰電壓與增益均降低

35. $I_C = \beta \times I_B + (1+\beta) \times I_{CBO}$

$5\ \text{mA} = \beta \times 0.1\ \text{mA} + (1+\beta) \times 2\ \mu\text{A}$ ， $\beta = 49$

36. $\because V_{CE} = 5\ \text{V}$ 、$V_{BE} = 0.7\ \text{V}$

$\therefore V_{RB} = V_{CE} - V_{BE} = 4.3\ \text{V}$

又 $I_C = 1\ \text{mA}$ 、$\therefore I_B = \dfrac{I_C}{\beta} = \dfrac{1\ \text{mA}}{50} = 20\ \mu\text{A}$ ， $\beta = 50$

$R_B = \dfrac{V_{RB}}{I_B} = \dfrac{4.3\ \text{V}}{20\ \mu\text{A}} = 215\ \text{k}\Omega$

37. $I_B = \dfrac{2 - V_{BE(ON)}}{10\ \text{k}} = 0.14\ \text{mA}$

$I_C = \beta \times I_B = 0.14\ \text{mA} \times 50 = 7\ \text{mA}$

$V_o = 10 - 7\ \text{mA} \times 1\ \text{k} - V_{LED} = 10 - 7 - 1.8 = 1.2\ \text{V}$

38. (A) $\beta = \dfrac{\alpha}{1-\alpha}$

39. $R_{BB} = 80\ \text{k}\Omega\ //\ 20\ \text{k}\Omega = 16\ \text{k}\Omega$

$V_{BB} = 10\ \text{V} \times \dfrac{20\ \text{k}\Omega}{20\ \text{k}\Omega + 80\ \text{k}\Omega} = 2\ \text{V}$

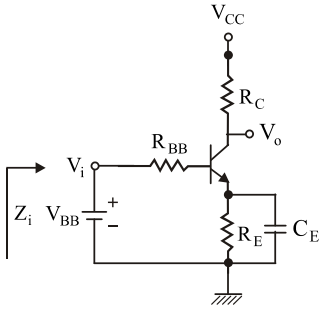
$I_B = \dfrac{V_{BB} - V_{BE}}{R_{BB} + (1+\beta) \times R_E}$

$= \dfrac{2\ \text{V} - 0.7\ \text{V}}{16\ \text{k}\Omega + (1+83) \times 1\ \text{k}\Omega} = 13\ \mu\text{A}$

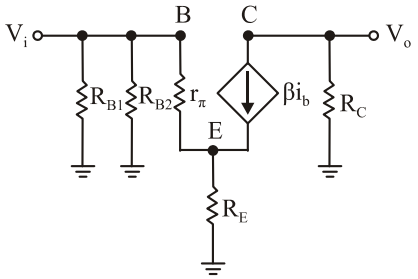
$r_\pi = \dfrac{V_T}{I_B} = \dfrac{26\ \text{mV}}{13\ \text{mA}} = 2\ \text{k}\Omega$

$Z_i = R_{BB}\ //\ r_\pi = 16\ \text{k}\Omega\ //\ 2\ \text{k}\Omega$

$= 1.77\ \text{k}\Omega$

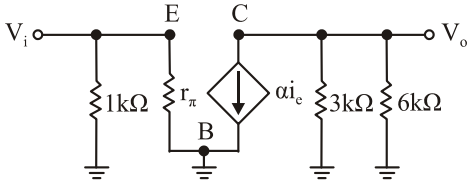


40. 小訊號模型如下圖所示，$A_v \fallingdotseq -\dfrac{R_C}{R_E} = -\dfrac{10\ \text{k}\Omega}{1\ \text{k}\Omega} = -10$



41. $v_i = i_e \times r_e$ ， $v_o = \beta \times i_b \times (3\,k\Omega // 6\,k\Omega)$

$$A_v = \frac{V_o}{V_i} = \frac{99 \times i_b \times 2\,k\Omega}{100 \times i_b \times 50\,\Omega} = 39.6$$



42. 達靈頓電路具有以下特性
(A) 高輸入阻抗
(B) 低輸出阻抗
(C) 電壓增益近似於 1，但略小於 1
(D) 高電流增益

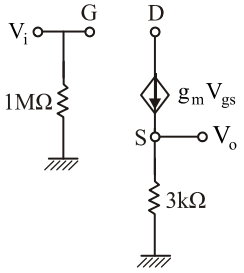
43. (B) 場效電晶體之放大倍數 μ 通常比電晶體的順向電流轉換比 β 小，因此場效電晶體之增益通常比電晶體低

44. (D) 當 $|V_{DS}|$ 很小時，JFET 位於歐姆區

45. $V_o = g_m \times V_{gs} \times R_s$

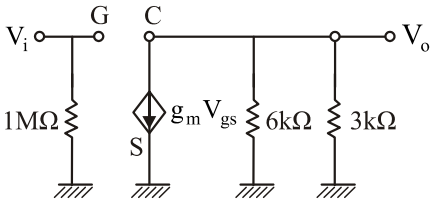
$V_i = V_{gs} + g_m \times V_{gs} \times R_s$

$$A_v = \frac{V_o}{V_i} = \frac{3\frac{mV}{V} \times 3\,k\Omega}{1 + 3\frac{mV}{V} \times 3\,k\Omega} = 0.9$$



46. $V_i = V_{gs}$ ， $V_o = -g_m \times V_{gs} \times (6\,k\Omega // 3\,k\Omega)$

$$A_v = \frac{V_o}{V_i} = -g_m \times (6\,k\Omega // 3\,k\Omega) = -5\frac{mA}{V} \times 2\,k\Omega = -10$$

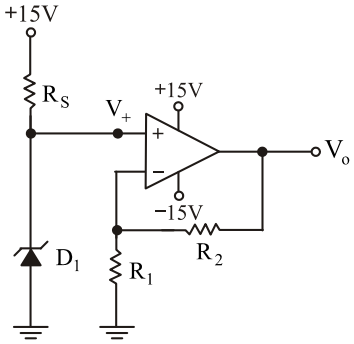


47. 題目爲減法電路

$$V_o = \frac{R_3}{R_1}(V_2 - V_1) = \frac{2\,k}{1\,k}(3\,V - 1\,V) = 4\,V$$

49. $V_- = V_+ = V_Z = 3\,V$ ， $V_o = V_- \times (1 + \frac{R_2}{R_1})$

$$= 3 \times (1 + \frac{2\,k\Omega}{1\,k\Omega}) = 9\,V$$



50. (1) $V_{H^+} = V_{T^+} = V_{O^+(sat)} \times \frac{R_1}{R_1 + R_2} + V_{ref} \times \frac{R_2}{R_1 + R_2}$

$$= 15 \times \frac{2\,k}{2\,k + 8\,k} + 2 \times \frac{8\,k}{2\,k + 8\,k} = 4.6\,V$$

(2) $V_{H^-} = V_{T^-} = V_{O^-(sat)} \times \frac{R_1}{R_1 + R_2} + V_{ref} \times \frac{R_2}{R_1 + R_2}$

$$= -15 \times \frac{2\,k}{2\,k + 8\,k} + 2 \times \frac{8\,k}{2\,k + 8\,k} = -1.4\,V$$

(3) $V_H = V_{H^+} - V_{H^-} = 6\,V$