104 學年度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

104-3-03-4、104-3-04-4

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

第一部分：電子學

1. $V_{av}=\dfrac{\frac{2}{\pi}\times10\times\pi+\frac{2}{\pi}\times(-10)\times\frac{\pi}{2}+\frac{\pi}{2}\times8\times\frac{1}{2}}{2\pi}\fallingdotseq2.59\text{ V}$

2. s.w OFF： $I_{D1}=I\fallingdotseq I_s e^{\frac{V_o}{\eta V_T}}$

   s.w ON： $I_{D1}=\dfrac{I}{2}\fallingdotseq I_s e^{\frac{V_o'}{\eta V_T}}$

   $\Delta V_o=V_o'-V_o$ ， $\dfrac{\frac{I}{2}}{I}=e^{\frac{V_o'-V_o}{\eta V_T}}$

   $\ell_n\dfrac{1}{2}=\dfrac{\Delta V_o}{\eta V_T}$ ， $\Delta V_o=\eta V_T\times\ell_n\dfrac{1}{2}\fallingdotseq-0.036\text{ V}$

3. $r_Z=\dfrac{\Delta V_Z}{\Delta I_Z}=\dfrac{200}{5}=40\ \Omega$

   $34.5\times\dfrac{0.6}{0.3+0.6}=23\ (>5\text{ V}$ ，二極體崩潰)

   $V=\dfrac{\frac{34.5}{300}+\frac{5}{40}}{\frac{1}{300}+\frac{1}{40}+\frac{1}{600}}=8\text{ V}$

   $I_Z=\dfrac{8-5}{40}=75\text{ mA}\ (>I_{ZK}$ ，二極體崩潰)

4. $V_{r(p-p)}=3\text{ V}$ ， $V_{2(p)}=V_{o(dc)}+\dfrac{V_{r(p-p)}}{2}=31.5\text{ V}$

   $n=\dfrac{156}{31.5}\fallingdotseq4.95$

5. D_2 平均電流 $I_{dc}=\dfrac{100\sqrt{2}\times\frac{1}{2}\times\frac{1}{\pi}}{1\text{ k}}\fallingdotseq22.5\text{ mA}$

6. $f_i=1\text{ kHz}$ ， $T_i=10^{-3}\text{ sec}$ ， $\tau=RC=10^{-9}$

   $\because T_i>>\tau$ ，$\therefore V_{o(av)}\fallingdotseq0\text{ V}$

7. BJT 工作於逆向主動區時，CB 接面爲順偏($V_B>V_E$)，BE 接面爲逆偏($V_C>V_B$)，故合理選項只有(D)

9. $I_B=\dfrac{1}{100\text{ k}}=0.01\text{ mA}$ ， $I_E=\dfrac{10-1.7}{5\text{ k}}=1.66\text{ mA}$

   $(1+\beta)=\dfrac{I_E}{I_B}=166$ ， $\beta=165$

   $I_C=\beta I_B=1.65\text{ mA}$

   $V_C=-10+1.65\text{ m}\times5\text{ k}=-1.75\text{ V}$

12. $I_E=\dfrac{10-0.7}{\frac{900\text{ k}}{100}+0.3\text{ k}}=1\text{ mA}\fallingdotseq I_C$

    $g_m=\dfrac{I_C}{V_T}=40\text{ m A/V}$

13. $I_B\fallingdotseq\dfrac{10.7-0.7}{100\text{ k}+7.5\text{ k}\times120}=0.01\text{ mA}$

    $I_C=\beta I_B=1.2\text{ mA}$

    $A_i=120\times\dfrac{7.5\text{ k}}{7.5\text{ k}+15\text{ k}}=40$

    $r_\pi=\dfrac{V_T}{I_B}=\dfrac{25\text{ m}}{0.01\text{ m}}=2.5\text{ k}\Omega$

    $A_V=\dfrac{120\times(7.5\text{ k}\,//\,15\text{ k})}{100\text{ k}+2.5\text{ k}+120\times(7.5\text{ k}\,//\,15\text{ k})}\fallingdotseq0.85$

14. $A_{p(dB)}=20\log|A_V|+10\log\dfrac{R_i}{R_L}$

    $=20\log|-100|+10\log\dfrac{100\text{ k}}{10}=80\text{ dB}$

15. -3 dB 處之電壓增益爲 $\dfrac{150}{\sqrt{2}}\fallingdotseq106$

16. $A_i=\beta_1\times\beta_2=900$

    $R_i\fallingdotseq\beta_1\times\beta_2\times1\text{ k}=900\text{ k}\Omega$

17. $R_D=\dfrac{3}{0.5\text{ m}}=6\text{ k}\Omega$ ， $I_D=k(V_{GS}-V_t)^2$

    $0.5\text{ m}=0.5\text{ m}(V_{GS}+1)^2$ ， $V_{GS}=-2\text{ V}$

    $V_{GS}=0\text{ V}$ (不合理)

    R_{G1} 、 R_{G2} 之合理值爲 2 MΩ、3 MΩ

19. $R=\dfrac{0.7}{0.1\text{ m}}=7\text{ k}\Omega$

20. 共閘極放大之輸入阻抗很小，輸出阻抗很大，電壓增益很大，輸入與輸出訊號同相

21. $A_V=-g_m(R_D\,//\,R_L)=-0.5\times(10\text{ k}\,//\,10\text{ k})=-2.5$

23. μA741 開迴路增益約爲 10^5

24. S.R. $\triangleq\dfrac{\Delta V_o}{\Delta t}$ ，當訊號爲弦波時

    $f_{o(max)}\le\dfrac{\text{S.R.}}{2\pi V_m}$ ， $f_{o(max)}\le\dfrac{0.5\text{ V/}\mu\text{s}}{2\pi\times5}$ ， $f_{o(max)}\le15.9\text{ kHz}$

25. $R_1=R_2=R$ ， $R_3=R_4=R'$ ， $R_5=R_6=R_f$

$V_o=\frac{R_f}{R'}(1+\frac{2R}{R_G})(V_+-V_-)=\frac{100\text{ k}}{50\text{ k}}(1+\frac{2\times 40\text{ k}}{20\text{ k}})(5-3)$

$=20\text{ V}$

第二部分：基本電學

26. (B) 電壓調整率越小越好，理想爲零

27. (B) 導線間相互吸引

28. $M=K\sqrt{L_1L_2}=0.5\times\sqrt{9\times4}=3$

$L_i=L_1+L_2+2M=19\text{ mH}$

29. (A) i_1 落後 i_2 30°

(B) $i_1=\frac{20}{\sqrt{2}}\angle 30°=10\sqrt{2}\angle 30°$

$=10\sqrt{2}\cos 30°+j10\sqrt{2}\sin 30°=5\sqrt{6}+j5\sqrt{2}$

(C) $i_{lav}=20\times\frac{2}{\pi}=\frac{40}{\pi}\fallingdotseq 12.7\text{ V}$

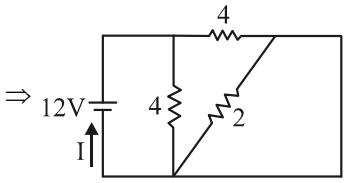
(D) $W=314=2\pi f$ ， $f=50\text{ Hz}$ ， $T=0.02\text{ s}$

時間差 $30°\Rightarrow 0.02\times\frac{30}{360}=\frac{1}{600}\text{ s}$

30. $W=CV^2$ ， $8=C\times 200^2$ ， $C=200\ \mu\text{F}$

(電源提供之電能， $W=QV=CV^2$ ，電容儲存能量爲電源提供之一半)

31. 瞬間電容短路，電感開路



$I=\frac{12}{4//4}=6\text{ A}$

32. $100\text{ V}/200\text{ W}\Rightarrow R=\frac{V^2}{P}=\frac{100^2}{200}=50\ \Omega$

均勻拉長， $\ell'=2\ell$ ，體積不變

$\therefore A'=\frac{1}{2}\text{ A}$ ， $R'=\rho\cdot\frac{2\ell}{\frac{1}{2}\text{ A}}=4R$

剪成 2 段並聯， $2R//2R=R=50\ \Omega$

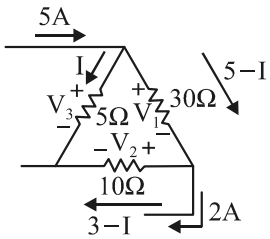
$P=\frac{100^2}{50}=200\text{ W}$

33. $V_1+V_2=V_3$

$30(5-I)+10(3-I)=5I$

$180=45I$

$I=4\text{ A}$



34. $W=1000$ ， $X_C=\frac{1}{WC}=40$

$Z=R-jX_C=30-j40=50\angle -53°$

$\bar{I}=2\angle 23°$ ， $\bar{E}=\bar{I}Z=100\angle -30°$

35. $R_{th}=5+5=10$ ，開路電壓 $E_{th}=25+5\times 5=50$

R_L 最大功率

$P=\frac{E_{th}^2}{4R_{th}}=\frac{2500}{40}=62.5\text{ W}$

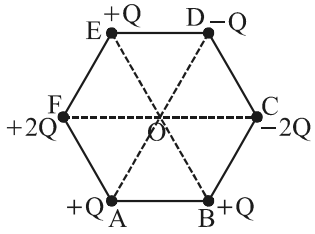
36. 棕、紅、綠、棕、紅 $\Rightarrow 125\times10^1\pm 2\%\ \Omega$

$I=\frac{10}{1.25\text{ k}}=8\text{ mA}=nevA$

$8\times10^{-3}=10^{29}\times1.6\times10^{-19}\times v\times5\times10^{-6}$

$v=10^{-7}\text{ m/s}$

37.

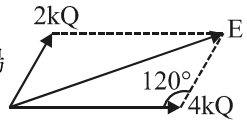


B、E 二點之電場抵消

A、D 二點產生之電場大小均爲 $\frac{kQ}{l^2}$ ，方向爲↗

C、F 二點產生之電場大小均爲 $\frac{2kQ}{l^2}$ ，方向爲→

$\Rightarrow$ 總電場



$E=\sqrt{2^2+4^2-2\cdot2\cdot4\cos120°}kQ=2\sqrt{7}kQ$

38. $Z_1=5+5j=5\sqrt{2}\angle 45°$

$Z_2=3-4j=5\angle -53°$

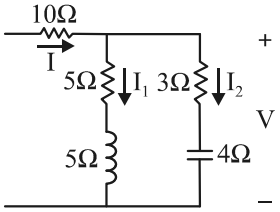
$V=\bar{I}_1Z_1=\bar{I}_2Z_2=100\angle 0°$

$\Rightarrow\bar{I}_1=10\sqrt{2}\angle -45°$

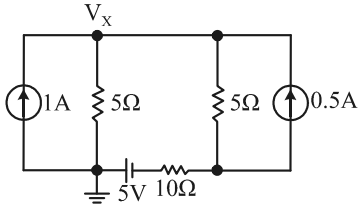
$\bar{I}=\bar{I}_1+\bar{I}_2$

$=10-j10+12+j16$

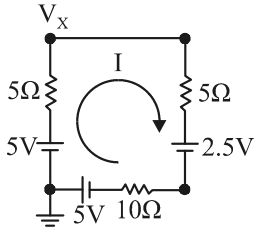
$=22+j6$



39. 壓流互換：



$\Rightarrow$

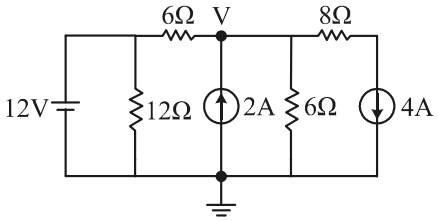


$I=\frac{7.5}{20}=0.375\text{ A}$ ， $V_X=5-0.375\times5=3.125\text{ V}$

$\therefore I_1=\frac{3.125}{10}=0.3125\text{ A}$

40. 密爾門： $V=(\frac{12}{6}+2-4)\times(6//6)=0\text{ V}$

$\therefore P_{2A} = 2\times 0 = 0$ W



41. $V_{av} = \dfrac{\frac{2\times 2}{2} + 4\times 1 + (-4\times 1) + \frac{2\times 1}{2}}{5} = 0.6$ V

$V_{rms} = \sqrt{\dfrac{(\frac{2}{\sqrt{3}})^2\times 2 + 4^2\times 2 + (\frac{2}{\sqrt{3}})^2\times 1}{5}} = \dfrac{6}{5}\sqrt{5}$ V

42. $V(t) = 100\sin(314t + 60°)$

$P_{max} = EI(\cos\theta + 1) = \dfrac{100}{\sqrt{2}}\times\dfrac{20}{\sqrt{2}}(\cos 30° + 1)$

$= 1000\times 1.866 = 1866$ W

43. $Q = \dfrac{100}{\sqrt{2}}\times\dfrac{20}{\sqrt{2}}\times\sin 30° = 500$ Var

$500 = \dfrac{E^2}{X_C}$ ， $X_C = \dfrac{E^2}{500} = \dfrac{(\frac{100}{\sqrt{2}})^2}{500} = 10 = \dfrac{1}{WC} = \dfrac{1}{314C}$

$\Rightarrow C = \dfrac{1}{3140} \fallingdotseq 318$ μF

44. $W = QV = Pt$ ， $1810\times 3.8 = P\times 14$ ， $P \fallingdotseq 491$ mW

45. $W = \dfrac{1}{2}\dfrac{Q^2}{C}$ ， $45\text{ m} = \dfrac{1}{2}\times\dfrac{Q^2}{4\times 10^{-6}}$ ， $Q = 6\times 10^{-4}$ C

並上 AB 後，電壓降爲 75 V

$Q = (C_{AB} + 4\,\mu)\times V$ ， $6\times 10^{-4} = (C_{AB} + 4\,\mu)\times 75$

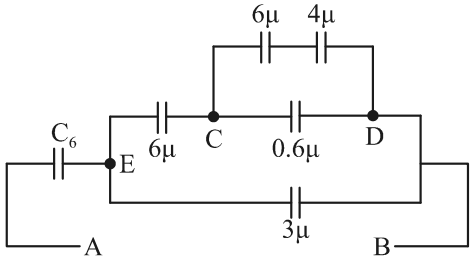
$C_{AB} = 4$ μ

$C_{CD} = \dfrac{6\times 4}{6+4} + 0.6 = 3$ μ

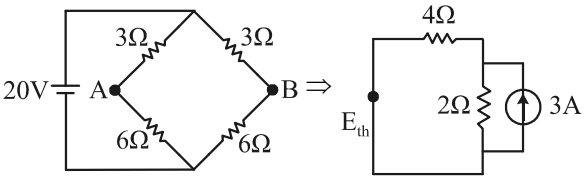
$C_{BE} = \dfrac{3\times 6}{3+6} + 3 = 5$ μ

$C_{AB} = \dfrac{5\times C_6}{5 + C_6} = 4$

$20 + 4C_6 = 5C_6$ ， $C_6 = 20$ μF



46.



⇒ AB 看入之戴維寧

⇒ 滿足惠斯登電橋 $E_{th} = 0$

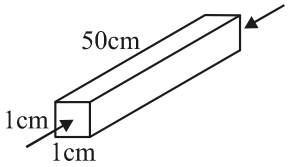
$R_{th} = (3\,//\,6) + (3\,//\,6) = 4\ \Omega$

$\therefore I_{2\Omega} = 3\times\dfrac{4}{2+4} = 2$ A

47. $R_{20} = \rho\cdot\dfrac{\ell}{A} = 3.5\times 10^{-5}\times\dfrac{0.5}{10^{-4}} = 0.175\ \Omega$

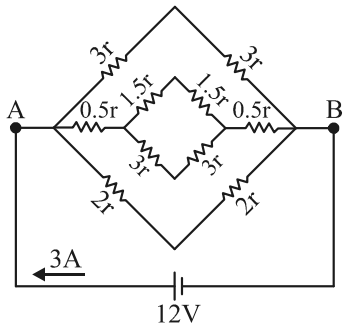
$\Rightarrow \begin{matrix}\alpha_0 = \dfrac{1}{180} \\ T_o = -180\end{matrix}$ ， $\dfrac{R_{80}}{R_{20}} = \dfrac{|T_0|+80}{|T_0|+20} = \dfrac{260}{200} = \dfrac{R_{80}}{0.175}$

$R_{80} = 0.2275\ \Omega$



48. 由中垂線對稱法

⇒



$\therefore R_{AB} = 6r\,//\,(0.5r + 3r\,//\,6r + 0.5r)\,//\,4r$

$= 6r\,//\,3r\,//\,4r = \dfrac{12}{9}r = \dfrac{4}{3}r$

$\Rightarrow R_{AB} = \dfrac{12}{3} = 4 = \dfrac{4}{3}r \Rightarrow r = 3\ \Omega$

49. S 撥至 1　$V(t) = 12 + (0-12)e^{-\frac{t}{2m}}$

$V(4\text{ ms}) = 12 - 12e^{-2}$

S 撥至 2　$V'(t) = -12 + (12 - 12e^{-2} + 12)e^{-\frac{t}{4m}}$

$V(4\text{ ms}) = -12 + 24e^{-1} - 12e^{-3}$

50. $Z = 10\sqrt{5}\angle\tan^{-1}2 = 10 + j20$

$Y = \dfrac{1}{Z} = \dfrac{1}{10+j20} = \dfrac{10-j20}{500} = \dfrac{1}{50} - j\dfrac{1}{25}$

$\Rightarrow R = 50$ ， $X_L = 25$

$\omega \to 2\,\omega$ ， $\therefore X_L' = 50$

串聯 $Z' = 50 + j50 = 50\sqrt{2}\angle 45°$

$\overline{E} = 100\angle 0°$ ， $\overline{I} = \dfrac{\overline{E}}{Z} = \sqrt{2}\cdot\angle -45°$