101 學年四技二專聯合複習考試
電機與電子群　專業科目（一）　詳解

JA00-1-03-4
JA00-1-04-4

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

第一部份：基本電學

1. 原子序＝電子數＝質子數＝32
   K 層＝2 個電子，L 層＝8 個電子，M 層＝18 個電子，
   N 層＝4 個電子
   最外層電子爲價電子爲 4 個電子
2. 蓄電池之容量常以安時作爲容量單位
3. $V_x = 80 + \frac{\Delta W}{Q} = 80 + \frac{20}{0.25} = 160\ V$
4. $Q = I \times T = 20 \times 10 \times 3600 = 720000$庫倫$= 7.2 \times 10^5$庫倫
   $n = 7.2 \times 10^5$庫倫$\times 6.25 \times 10^{18} = 45 \times 10^{23}$
   $= 4.5 \times 10^{24}$個電子
5. 1 HP＝550 呎磅/秒＝746瓦特
   $$P = \frac{W}{t} = \frac{\frac{(F \times d)}{\eta}}{t} = \frac{\frac{(1000 \times 10)}{0.8}}{10} = 1250\ ft - \ell b / sec$$
   $$P = \frac{1250 ft - \ell b / sec}{550 ft - \ell b / sec} \cong 2.27\ HP$$
   $$I_L = \frac{P}{V} = \frac{2.27 \times 746}{220} \cong 7.7\ A$$
6. $W = Q \times V = 5 \times 10^5 \times 12 = 60 \times 10^5 = 6 \times 10^6$ (J)
   $$t = \frac{W}{P} = \frac{6 \times 10^6}{60} = 10^5\ sec = 27.7\ hr$$
7. $P = \frac{W}{t} = \frac{V^2}{R} \Rightarrow P \propto V^2 \Rightarrow$電壓提升 2 倍，功率上升 4 倍
8. $W = 10 \times (\frac{1}{2} \times 5 \times 5) + 0 \times (\frac{1}{2} \times 5 \times 5) = 125\ J$
9. $\frac{R_2}{R_1} = \frac{A_1}{A_2} = (\frac{D_1}{D_2})^2 \Rightarrow \frac{R_2}{R_1} = (\frac{1.6}{3.2})^2 = \frac{1}{4}$
10. $R_1 = \frac{V^2}{P} = \frac{100^2}{125} = 80\ \Omega \Rightarrow$5公分
    $$R_2 = \frac{V^2}{P} = \frac{200^2}{250} = 160\ \Omega$$
    $$\frac{R_2}{R_1} = \frac{L_2}{L_1} \Rightarrow \frac{160}{80} = \frac{L_2}{5} \Rightarrow L_2 = 10$$公分
11. $R = 47 \times 10^2 \pm 5\% = 4700 \pm (4700 \times 0.05)$
    $= 4700 \pm 235\ \Omega$ ，$\therefore R_{MAX} = 4700 + 235 = 4935\ \Omega$
12. $I = 1.00 \pm 0.05\ A = 1.00 \pm 5\%A$
    $R = 100 \pm 10\ \Omega = 100 \pm 10\%\Omega$
    $P = I^2 \times R = (1.00 \pm 5\%)^2 \times 100 \pm 10\%$
    $= 100 \pm 20\% = 100 \pm 20\ W$
13. $R_{甲} = \frac{4}{0.5} = 8\ \Omega \Rightarrow P_{甲} = (\frac{10}{20+8})^2 \times 8 \cong 1.02\ W$
14. $R_{甲} = \frac{10}{0.5} - 5 = 15\Omega \Rightarrow P_{甲} = (0.5)^2 \times 15 = 3.75\ W$
15. $\frac{R_2}{R_1} = \frac{234.5 + 50}{234.5 + 20} \Rightarrow R_2 = 18 \times \frac{284.5}{254.5} \cong 20.1\ \Omega$
16. $\alpha_1 = \frac{R_2 - R_1}{t_2 - t_1} \times \frac{1}{R_1} = \frac{3-2}{20-10} \times \frac{1}{2} = 0.05$
17. $R_2 = R_1 \times [1 + \alpha_1 \times (t_2 - t_1)]$
    $0.54 = R_1 \times [1 + 0.00393 \times 20] \Rightarrow R_1 = 0.503\ \Omega$
18. $H = m \times s \times \Delta T = 0.24 \times I^2 \times R \times t$
    $\Rightarrow 1000 \times 1 \times (32 - 20) = 0.24 \times 5^2 \times 50 \times t \Rightarrow t \cong 40$秒
19. $P = I^2 \times R = (\sqrt{\frac{1}{2R}})^2 \times (R + 2R) = \frac{3R}{2R} = 1.5\ W$
20. $R_1 : R_2 = 2 : 4 \Rightarrow V_1 : V_2 = 2 : 4$
    $\Rightarrow \therefore V_2 = 20\ V\ (\because V_1 = 10\ V)$
    $$P_{R2} = 25 = \frac{20^2}{R_2} \Rightarrow R_2 = \frac{400}{25} = 16\ \Omega$$
21. $150 = V \times \frac{12000}{12000 + 36000} \Rightarrow V = 150 \times \frac{48}{12} = 600\ V$
22. 惠斯登電橋原理 $\Rightarrow 3 \times 4 = 2 \times 6$
    $\Rightarrow$ 平衡 $\Rightarrow$ XY 兩端等電位，$\therefore I_1 = I_2$
23. 惠斯登電橋原理 $\Rightarrow 3 \times 4 = 2 \times 6$
    $\Rightarrow$ 平衡 $\Rightarrow$ XY 兩端等電位
24. 惠斯登電橋原理 $\Rightarrow 3 \uparrow \times 4 \neq 2 \times 6 \Rightarrow$ 不平衡
    $\Rightarrow$ XY 兩端電位不相等
    $\because V_Y > V_X \Rightarrow$ 電流由 Y 點流向 X 點
25. $R = 5K\ //\ 5K = 2.5\ K\Omega$
    $V_1{}^2 = 5.5K \Rightarrow V_2{}^2 = 3.5K \Rightarrow$ 並聯電壓取小
    $$\therefore P_1 = \frac{3.5K}{5K} \Rightarrow P_2 = \frac{3.5K}{5K}$$
    $\Rightarrow \therefore P = P_1 + P_2 = 3 + 3 = 6\ W$

第二部份：電子學

26. $\because \frac{T}{2} = 8\ \mu - 0\ \mu = 8\ \mu S \Rightarrow T = 2 \times 8\ \mu = 16\ \mu S$
    $$\Rightarrow F = \frac{1}{16\mu} = 62.5\ kH_2$$

27. $\because T = \frac{1}{F} = \frac{1}{200} = 0.005\ s = 5\ ms$

$\Delta t = \frac{\theta}{2\pi} \times T \Rightarrow T = \frac{60°}{360°} \times 5\ ms \cong 0.83\ ms$

28. 本質半導體具有負電阻溫度係數，故溫度增加，導電性會上升

29. N 型半導體，所摻雜雜質爲五價原子
N 型半導體，多數載子爲電子、少數載子爲電洞，主導電載子爲電子
整塊 N 型半導體，其電性呈電中性

30. 障壁電位受摻雜濃度影響，隨摻雜濃度升高而升高

31. $\frac{I_1}{I_2} = e^{\frac{V1-V2}{\eta \times VT}} \Rightarrow 0.6 - V_2 = \eta \times V_T \times \ln\frac{1\ mA}{50\ mA}$
$\Rightarrow V_2 \cong 0.702\ V$

32. $I_{D1} = I_S(e^{\frac{V_{D1}}{\eta \times V_T}} - 1) = I_S \Rightarrow V_{D1} = \eta \times V_T \times \ln 2$
$= 0.017\ V$

33. 假設二極體皆爲導通→則 $V_o = 3V_D = 1.5\ V$
$I_D = 1\ mA - \frac{1.5}{10\ K} = 0.85\ mA > 0$ (假設成立)
故 $V_o = 1.5\ V$ ， $I_D = 0.85\ mA$

34. 直流分析 $\Rightarrow$ 令電容斷路 $\Rightarrow I_D = \frac{30 - 0.7}{20\ K} = 1.465\ mA$
$r_d = \frac{\eta V_T}{I_D} = \frac{2 \times 25\ mV}{1.465\ mA} \cong 34.1\ \Omega$

35. D_1 與 D_2 爲 OFF $\Rightarrow V_o = 3\ V$

36. D_1 爲 ON $\Rightarrow V_o = -2.5\ V$

37. $R_L = 100\ \Omega$ ， $V_s = 20\ V$ 時， I_z 爲最大
$\Rightarrow I_z = \frac{20 - 10}{16} - \frac{10}{100} \cong 0.53\ A$

38. 當 $I_z = 12\ mA$ 時負載可得最大調整範圍
$R_1 = \frac{15 - 4.7}{I_{ZK} + I_{L\,max}} = \frac{10.3}{12 + 100} = \frac{10.3}{112\ mA} \cong 91\ \Omega$

39. $P_{max} = 4.7V \times 112\ mA = 527\ mW$

40. $I_L = \frac{8}{0.22\ K} = 36.36\ mA$ ， $I_{Zmax} = \frac{400\ mW}{8\ V} = 50\ mA$
$V_{imin} = 0.091\ K \times 36.36\ mA + 8 = 11.3\ V$
$V_{imax} = 0.091\ K \times (36.36\ mA + 50\ mA) + 8 = 15.8\ V$

41. $V_r = \frac{V_m}{2fRC} \Rightarrow C = \frac{10}{2 \times 3 \times 60 \times 10\ K} \cong 0.0278\ mF$
$= 27.8\ \mu F$

43. $\frac{N_1}{N_2} = \sqrt{\frac{Z_1}{Z_2}} \Rightarrow \frac{10}{1} = \sqrt{\frac{Z_1}{8}} \Rightarrow 100 = \frac{Z_1}{8} \Rightarrow Z1 = 800\ \Omega$

44. $Vdc = 0.636 \times Vm = 0.636 \times (100 \times \sqrt{2}) \cong 89.9\ V$

45. $r\% = \frac{V_{r(rms)}}{V_{dc}} \times 100\% = \frac{\frac{1}{\sqrt{2}} \times 0.5}{15} \times 100\% = 2.35\%$

46. $r = \frac{Vr(rms)}{Vdc} = \frac{1}{2\sqrt{3} \cdot R_L \cdot C \cdot f \uparrow}$
$\Rightarrow$ 就濾波效果而言，全波比半波來得佳

47. 電容器 C_1 耐壓(值)： $V_{C1} = V_m$
其餘電容器耐壓(值)： $V_C = 2V_m$
每個二極體 PIV 值爲 $2V_m$

49. $\because$當 $V_i = 4\ V$ 時， D_1 及 D_2 爲 OFF
$\Rightarrow$ 電路失去功能 $\Rightarrow \therefore V_o = 4\ V$

50. $\because$當 $V_i = -11\ V$ 時， D_1 爲 ON 及 D_2 爲 OFF
$\Rightarrow V_o = (-11 + 5) \times \frac{10}{20 + 10} + (-5) = -7\ V$