PART (A) : PHYSICS

SOLUTIONS

1. (D)

2. (C)

3. (C)

4. (B)

5. (D)

6. (A)

7. (A)

8. (B)

9. (C)

10. (B)

11. (B)

12. (A)
When R reduce then I_B increase and I_C also increase.

13. (C)

14. (A)

15. (C)
$$v = 332\sqrt{\frac{303}{273}} \Rightarrow \text{Beat frequency} = f_1 - f_2 = v\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right)$$
$$= 332\sqrt{\frac{303}{273}}\left(\frac{1}{49} - \frac{1}{50}\right) \times 100 \cong 14$$

16. (C)

17. (D)

18. (C)

$d < R \Rightarrow B \propto d; \quad d > R \Rightarrow B \propto \frac{1}{d}$

19. (A)

Torque on the solenoid is given by

$\tau = MB\sin\theta$

Where θ is the angle between the magnetic field and the axis of solenoid

M = niA

$\therefore \tau = niAB\sin 30^0$

$= 2000 \times 2 \times 1.5 \times 10^{-4} \times 5 \times 10^{-2} \times \frac{1}{2}$

$= 1.5 \times 10^{-2}\ N - m$

20. (B)

21. (5)

22. (32)

23. (2)

24. (2)

25. (12)

26. (70)

27. (17)

Rate of flow of liquid $V = \frac{P}{R}$

Where liquid resistance $R = \frac{8\eta l}{\pi r^4}$

For another tube liquid resistance;

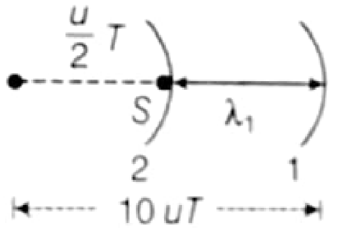
$R' = \frac{8\eta l}{\pi\left(\frac{r}{2}\right)^4}.16 = 16R$

For the series combination

$V_{New} = \frac{P}{R + R'} = \frac{P}{R + 16R} = \frac{P}{17R} = \frac{V}{17}$

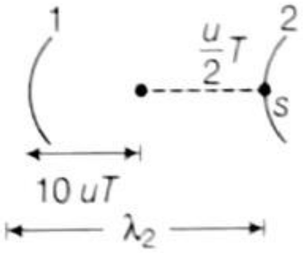
28. (19)

Consider the wave received by R_1. Say at $t = 0$, a wavefront comes from S. At $t = T$ another wavefront is emitted from S. The distance travelled by S in this time is $\frac{u}{2}T$ and the distance travelled by first wavefront is $10uT$.



$\because$ $$\lambda_1 = 10uT - \frac{u}{2}T = \frac{19}{2}uT$$

Similarly, for waves coming in the backward direction



$$\lambda_2 = 10uT + \frac{u}{2}T = \frac{21}{2}uT$$

$\therefore$ $$\frac{\lambda_1}{\lambda_2} = \frac{19}{21}$$

29. (10)

Using $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{1}{v} - \frac{1.5}{(-20)} = \frac{1-1.5}{20} \Rightarrow V = -10 \text{ cm}$

30. (1200)

$P_t = P_c\left(1 + \frac{m_a^2}{2}\right)$; Here $m_a = 1 \Rightarrow 1800 = P_c\left(1 + \frac{(1)^2}{2}\right) \Rightarrow P_c = 1200\,\text{W}$

PART (B) : CHEMISTRY

SOLUTIONS

31. (A)

32. (A)

33. (A)

34. (D)

35. (B)

36. (B)
Thermal stability α ionic character for salt having polyatomic anion.

37. (B)

38. (B)

39. (D)

40. (C)

41. (B)

42. (C)

43. (A)

44. (D)

45. (B)

46. (A)

47. (B)

48. (B)

49. (C)

50. (B)

$\Delta G = \Delta H - T\Delta S$

At equilibrium $\Delta G = 0$

$\Rightarrow 0 = (170 \times 10^3 J) - T(170 JK^{-1})$

$\Rightarrow T = 1000K$

For spontaneity, ΔG is -ve, which is possible only T > 1000K.

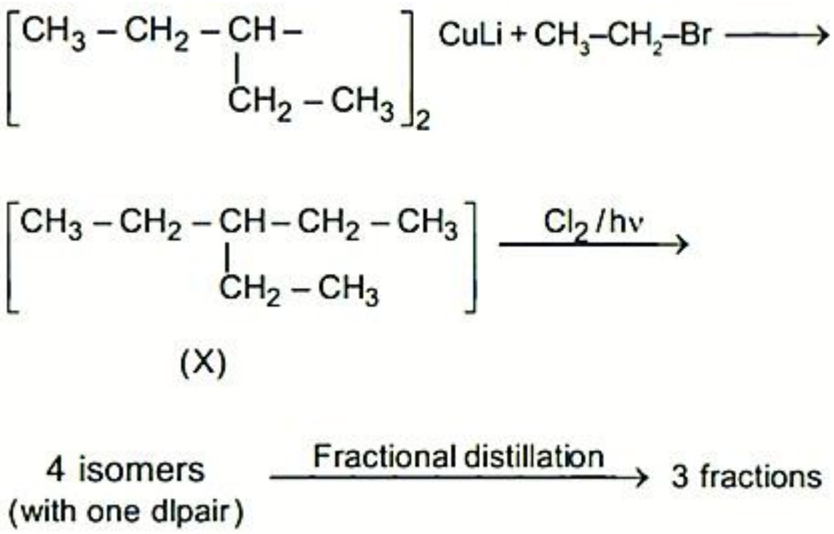
51. (2)

52. (2)

53. (3)

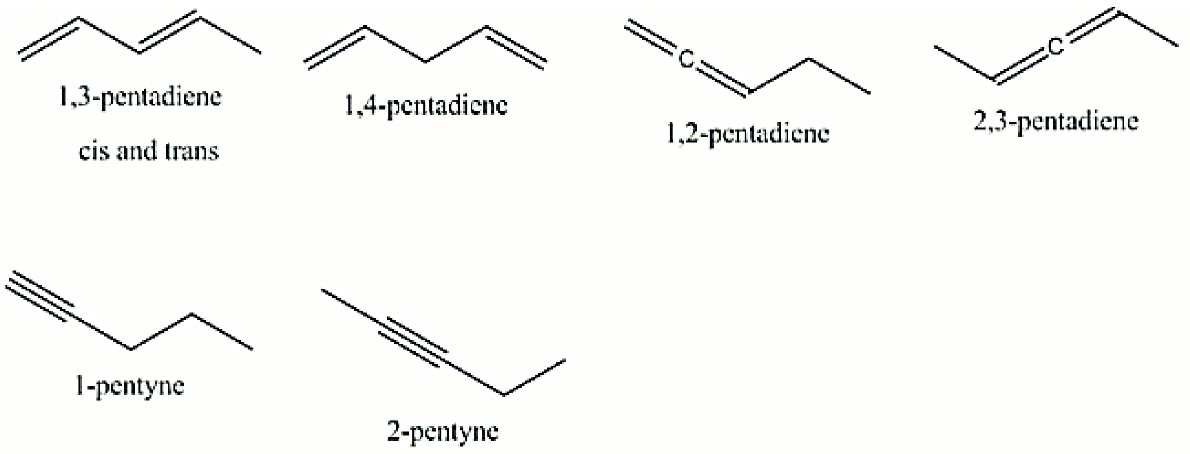
54. (4)

55. (3)



56. (7)

7 different acyclic isomers of C_5H_8 on catalytic hydrogenation give the same n-pentane.
These are as given below.



57. (5)

$$R-NH_2 + CH_3-\overset{O}{\overset{\|}{C}}-Cl \longrightarrow R-NH-\overset{O}{\overset{\|}{C}}-CH_3 + HCl$$

Each $CH_3-\overset{O}{\overset{\|}{C}}$ addition increases the molecular wt. by 42.

Total increase in m.wt. = 390 – 180 = 210

Then number of NH_2 groups $= \frac{210}{42} = 5$

58. (5)

α–D–glucose (s) + H_2O → α–D–glucose (aq) ; Heat of dissolution = 10.84 kJ ….. (1)

β–D–glucose (s) + H_2O → β–D–glucose (aq) ; Heat of dissolution = 4.68 kJ ….. (2)

α–D–glucose (aq) → β–D–glucose (aq) ; Heat of mutarotation = –1.16 kJ ….. (3)

ΔH° for α–D–glucose → β–D–glucose ….. (4)

Equation (1) – equation (2) – equation (3) gives equation (4).

Hence, $\Delta H^\circ = 10.84\ kJ - 4.68\ kJ - 1.16\ kJ = 5\ kJ$

59. (3)

60. (5)

PART (C) : MATHEMATICS

SOLU

61. (A)

$f''(x) = f'(x) \Rightarrow f'(x) = k_1 e^x$

$\Rightarrow f(x) = k_1 e^x + k_2 \Rightarrow \lim_{x\to\infty} \frac{k_1 e^x + k_2}{k_1 e^x} = 1$

62. (B)

$(1-x)^{50}(x+1)^{50}$

$= ({}^{50}C_0 - {}^{50}C_1 \cdot x + ... + {}^{50}C_{50} \cdot x^{50}) \cdot ({}^{50}C_0 \cdot x^{50} + {}^{50}C_1 \cdot x^{49} + ... + {}^{50}C_{50})$

Compare the coefficient of x^{30} from both the sides

${}^{50}C_{15} = {}^{50}C_0 \cdot {}^{50}C_{20} - {}^{50}C_1 \cdot {}^{50}C_{21} + ...$

63. (C)

$B_1 + B_2 + B_3 = 5$

${}^{5+2}C_2 = 21$

64. (A)

Possible cases are (1,4,6), (2,4,5) and (2,3,6)

$\frac{1}{6\cdot5\cdot4}\times 3! + \frac{1}{6\cdot5\cdot4}\times 3! + \frac{1}{6\cdot5\cdot4}\times 3! = \frac{3}{20}$

65. (D)

$\vec{n}_1 = (4,-3,4)$

$\vec{n}_2 = (3,-2,1)$

$\vec{n}_1 \times \vec{n}_2 = (5,8,1)$

$(\vec{n}_1 \times \vec{n}_2)\cdot\vec{n} = 0$

$\Rightarrow 10 - 8 + a = 0 \Rightarrow a = -2$

66. (D)

$x^3 + 6x^2 + 12x + 9 = 0$

$\Rightarrow (x+2)^3 = -1 \Rightarrow x + 2 = -1, -\omega, -\omega^2$

$\Rightarrow x = -3, -2-\omega, -2-\omega^2$, then common

roots are $-2-\omega$ and $-2-\omega^2$

sum of roots $= -4 - (\omega + \omega^2) = -3$;

product of roots $= (2+\omega)(2+\omega^2)$

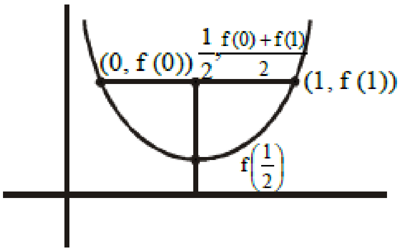
$= 4 + (-2) + 1 = 3$

$\therefore$ equation $x^2+3x+3=0$

So, $\frac{a}{1}=\frac{b}{3}=\frac{c}{3}$

67. **(C)**

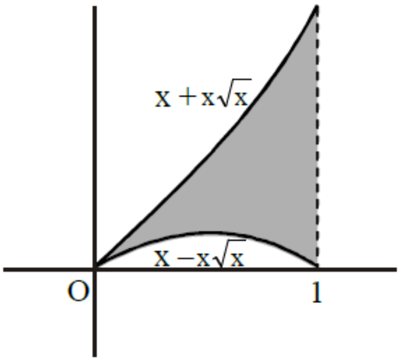
$f\left(\frac{1}{2}\right)<\frac{f(0)+f(1)}{2}$



68. **(B)**

$y=x\pm x\sqrt{x}$

$\int_0^1 2x^{\frac{3}{2}}dx=2\times\frac{2}{5}=\frac{4}{5}$



69. **(B)**

$T_1=24,\ T_2=3,\ T_3=8$

L.C.M of $\{T_1,T_2,T_3\}\Rightarrow 24$

70. **(A)**

$(T\vee F)\vee F\Rightarrow(T\vee F)\Rightarrow T$

71. **(D)**

$ABC=BCD$

$\Rightarrow ABCC^{-1}=BCDC^{-1}$

$\Rightarrow AB=BCDC^{-1}$

$\Rightarrow ABB^{-1}=BCDC^{-1}B^{-1}$

$\Rightarrow A=BCDC^{-1}B^{-1}$

72. **(B)**

$1^5+z_1^5+z_2^5+z_3^5+z_4^5+z_5^5=0$

73. **(B)**

$\int \frac{1}{\left(\sqrt{x}\right)^7\left(1+\frac{1}{\left(\sqrt{x}\right)^5}\right)}dx$ let $\frac{1}{\left(\sqrt{x}\right)^5}=t$

$\Rightarrow \int \frac{-2dt}{5(1+t)}=-\frac{2}{5}\ln(1+t)+c$

$\Rightarrow \frac{2}{5}\ln\left(\frac{\left(\sqrt{x}\right)^5}{\left(\sqrt{x}\right)^5+1}\right)+c \Rightarrow a=\frac{2}{5},\ k=\frac{5}{2}$

74. **(D)**

Let the ratio t : 1

$\Rightarrow$point $P\equiv\left(\frac{3t-2}{t+1},\frac{-5t+4}{t+1},\frac{8t+7}{t+1}\right)$ lies on plane

$\Rightarrow\left(\frac{3t-2}{t+1}\right)1-2\left(\frac{-5t+4}{t+1}\right)+3\left(\frac{8t+7}{t+1}\right)=17$

$\Rightarrow t=\frac{3}{10}$

75. **(A)**

$\sin(xy)=xy$

$xy=0\Rightarrow x=0\ or\ y=0$

$\Rightarrow x=0$ not possible

So, $y=0\Rightarrow x=1\Rightarrow x=1$ and $y=0\Rightarrow(1,0)$

76. **(B)**

$f(x+1)=f(x)$ and $f\left(\frac{1}{2}\right)=f\left(\frac{-1}{2}\right)$

$g'(x)=f(x+n)=f(x)$

$g'\left(\frac{5}{2}\right)=f\left(\frac{5}{2}\right)=f\left(2+\frac{1}{2}\right)=f\left(\frac{1}{2}\right)=\frac{3}{2}$

77. **(C)**

$S_1<0$

$4+9-12-30+k<0\Rightarrow k<29$

$r<4$

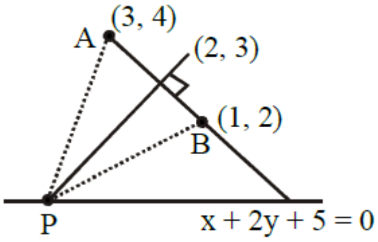
$\sqrt{9+25-k}<4\Rightarrow k>18$

78. **(C)**

$\left(f\left(f\left(x\right)\right)\right)=x$

79. **(D)**

$y-3=-1(x-2)$



$$\left.\begin{array}{l} x+y=+5 \\ x+2y=-5 \end{array}\right\} \begin{array}{l} x=15 \\ y=-10 \end{array}$$

80. **(C)**

$f(0^+)=\text{sgn (negative)}=-1$ and $f(0^-)$
= sgn (positive) = 1, discontinuous

81. **(36)**

$\left|\vec{r}\left[\vec{a}\,\vec{b}\,\vec{c}\right]\right|=\left|\vec{r}\right|\left[\vec{a}\,\vec{b}\,\vec{c}\right]=2\times3\times6=36$

82. **(2)**

$$\underbrace{\tan^2 x+\cot^2 x}_{\geq 2}=\underbrace{2\cos^2 y}_{\leq 2}$$

$\Rightarrow \tan^2 x=1$ and $\cos^2 x=1$

$\underbrace{\cos^2 y}_{1}+\sin^2 z=1\Rightarrow \sin^2 z=0$

$$\int_1^3 \frac{t^2}{t^2-4t+8}dt=2\int_1^3\frac{t^2}{2t^2-8t+16}$$

$$=2\int_1^3\frac{t^2}{t^2+(4-t)^2}dt=2\times\frac{1}{2}(3-1)=2$$

83. **(70)**

$$\frac{50\times20-300}{10}=70$$

84. **(2)**

Let $x=a\sin\theta,\ \underset{\theta\to0}{Lim}\frac{1}{a^2}\left(\frac{1-4a\cos\theta}{\sin^2\theta\cdot\cos\theta}\right)$ is finite

$\Rightarrow a = \frac{1}{4}$ and $b = 8 \Rightarrow ab = 2$

85. **(4)**

$p_1 p_2 = b^2$

86. **(9)**

Any point on the first line is $(2r_1+1, 3r_1-1, 4r_1+1)$ and on the second line is $(r_2+3, 2r_2+k, r_2)$

The line will intersect when $2r_1+1 = r_2+3, 3r_1-1 = 2r_2+k, 4r_1+1 = r_2$

$\Rightarrow \; 2r_1 - r_2 = 2, 4r_1 - r_2 = -1$

$\Rightarrow \; r_1 = -\frac{3}{2}, \; r_2 = -5$ and $k = 3r_1 - 2r_2 - 1 = -\frac{9}{2} + 10 - 1 = \frac{9}{2}$

87. **(2)**

The given equation can be written as

$\sin^4 x + \cos^4 y + 2 - 4\sin x \cos y = 0$

$\Rightarrow \; (\sin^2 x - 1)^2 + (\cos^2 y - 1)^2 + 2\sin^2 x + 2\cos^2 y - 4\sin x \cos y = 0$

$\Rightarrow \; (\sin^2 x - 1)^2 + (\cos^2 y - 1)^2 + 2(\sin x - \cos y)^2 = 0$

Which is true if $\sin^2 x = 1, \cos^2 y = 1$ and $\sin x = \cos y$

So, $\sin x + \cos y = 2$ as $0 \le x, y \le \frac{\pi}{2}$.

88. **(1)**

Given equation is possible if $\cos(\pi\sqrt{x-4}) = 1$ and $\cos(\pi\sqrt{x}) = 1$

Since, $x - 4 \ge 0 \; \Rightarrow x \ge 4$ and $x \ge 0$

So, $x = 4$ is the only solution.

89. **(7)**

Let r be the length of the line segment which makes angles α, β, γ respectively with x, y and z-axis, then $r\cos\alpha = 2, r\cos\beta = 3, r\cos\gamma = 6$

$\Rightarrow \; r^2(\cos^2\alpha + \cos^2\beta + \cos^2\gamma) = 2^2 + 3^2 + 6^2 = 49$

$\Rightarrow r = 7$ as $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

90. **(31)**

We have

$$\left|\frac{4\times2-3\times3+26}{\sqrt{4^2+3^2}}\right| = \left|\frac{3\times2-4\times3+p}{\sqrt{4^2+3^2}}\right|$$

$\Rightarrow \; \pm 25 = 6 - 12 + p$

$\Rightarrow \; = \pm 25 + 6 \qquad \Rightarrow \; p = 31$ or -19