Section - I

1.(a) $2^{n-4} + 1$

$2^{6-4} + 1 = 5$

2. (d)

$$\overset{4}{CH_3} - \overset{3}{\underset{}{CH}}\overset{CH_3}{} - \overset{2}{CH}\overset{CH_3}{} - \overset{1}{CH_3}$$

3. (c)
4. (c)
5. (a)
6. (b)
7. (a)
8. (c)
9. (d)
10. (c)
11. (b)

12. (c) Total no. of elements = 5, no. of subsets having 3 elements = c(5, 3) = 10

13. (a) $\sec^2\theta = \frac{4}{3}$ i.e. $\cos^2\theta = \frac{3}{4}$ i .e. $\cos^2\theta = \left(\frac{\sqrt{2}}{2}\right)^2$

i.e. $\cos^2\theta = \cos^2\frac{\pi}{6}$

$\therefore$ $\theta = n\pi \pm \frac{\pi}{6}$

14. (b) asinA = bsinB

i.e. $a.\frac{a}{2R} = b.\frac{b}{2R}$

i.e. $a^2 = b^2$

i.e. $a = b$

$\therefore$ Δ is isosceles

15. (b) $\frac{|\vec{a} \times \vec{b}|}{\vec{a}.\vec{b}} = \frac{3}{\sqrt{3}}$

$\frac{ab\sin\theta}{ab\cos\theta} = \sqrt{3}$ $\tan\theta = \sqrt{3}$

i.e. $\theta = 60°$

16. (b) Logarithm is defined for positive values only so option 'b'

17. (c) Product of roots = 1

i.e. $\frac{-5}{K-2} = 1$

i.e. $K - 2 = -5$

i.e. $K = -3$

18. (a) By definition the determinant of a matrix and its transpose are equal, so 'a'

19. (b) For no solution, D = 0

$\therefore$ $\begin{vmatrix} \lambda & 3 \\ 1 & 2 \end{vmatrix} = 0$

i.e. $2\lambda - 3 = 0$

i.e. $\lambda = \frac{3}{2}$

20. (d) The required line is $3(x - 1) + 5(y - 2) = 0$

i.e. $3x + 5y - 13 = 0$

21. (c) Given equations are $5x + 12y + 8 = 0$, $10x + 24y - 3 = 0$

i.e. $10x + 24y + 16 = 0$, $10x + 24y - 3 = 0$

$\therefore$ Distance $= \pm\frac{16 - (-3)}{\sqrt{10^2 + 24^2}} = \frac{19}{26}$ units

22. (b) Radius $= \sqrt{g^2 + f^2 - c} = \sqrt{\sin^2\theta + \cos^2\theta + 8}$

$= \sqrt{9} = 3$

23. (d) Here, $\left(\frac{x}{a}\right)^2 + \left(\frac{y}{b}\right)^2 = \cos^2\theta + \sin^2\theta$, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, which is an ellipse

24. (b) Given $x^2 - 4y^2 = 1$

i.e. $\frac{x^2}{1} - \frac{y^2}{\frac{1}{4}} = 1$

So, $e = \sqrt{1 + \frac{1}{4}} = \sqrt{\frac{5}{4}} = \frac{\sqrt{5}}{2}$

25. (c) The equation is true only for x = 0, y = 0

So it represents z-axis

26. (a) $\lim_{x \to 0} \frac{e^{\sin x} - 1}{x} = \lim_{x \to 0} \frac{e^{\sin x} - 1}{\sin x} . \frac{\sin x}{x} = 1.1 = 1$

27. (c) For point of discontinuity, $x - 3 = 0$

i.e. $x = 3$

28. (b) By formula, option 'b' is correct.

29. (c) $2\frac{dy}{dx} = 0 - 2x$

i.e. $\frac{dy}{dx} = -1$

i.e. $\tan\theta = -1$

$\theta = 135°$

30. (b) Put $t = \sqrt{x}$

i.e. $dt = \frac{1}{2}\sqrt{x}\, dx.$

So, $\frac{1}{2}\int \sec^2 t\, dt = \tan t + c = \tan\sqrt{x} + c$

31. (b) Rea. area $\int_0^\pi \sin x\, dx = \int_0^\pi \sin x\, dx$

$= [-\cos x]_0^\pi$

$= (1 + 1)$

$= 2$ sq units

32. (a) When book is held stationary then work done is 0

33. (c) When position of particle changes then its distance as well as displacement are non zero.

34. (d) In smooth inclined plane friction is zero so no torque is produced i.e. can't roll.

35. (c) When ball is in space craft revolving around earth then the speed of ball is equal to speed of space craft i.e. orbital velocity so will revolve around earth with same speed.

36. (b) Cylindrical bulb thermometer is most sensitive since it has greatest surface area for given volume so quickly respond or most sensitive.

37. (a) Pressure is force per unit area

38. (c) When frequency of pendulum is 'f' then frequency of KE is 2f ie in each cycle KE become maximum two times.

39. (b) For open, $n = \frac{v}{2l}$

For closed, $n' = \frac{v}{4 \times \frac{l}{2}} = \frac{v}{2l} = n$

40. (b) In air $= F_a = 9 \times 10^9 \frac{Q_1Q_2}{r^2}$

For glass, $F_g = \frac{9 \times 10^9}{K} \frac{Q_1Q_2}{r^2}$

Here $K > 1$

So, $F_g < F_a$

41. (b) The potential at any point inside the hollow sphere is equal to polential on surface.

42. (a) $P = \frac{V^2}{R_T}$

Here, $R_T = R + r$, increases on increasing R so power decreases.

43. (b)

44. (b) $v = \frac{fu}{u - f} = \frac{10 \times 20}{20 - 10} = 20$ cm

45. (a) $\beta = \frac{D\lambda}{d}$

λ_r is about 7800 Å & λ_v is about 3800 Å

So, $\beta_r \approx 2\beta_v$

46. (a) $\lambda = \frac{h}{mv}$

Here $m_\alpha > m_n > m_p > m_e$ mass is least for electron so wave length will be maximum.

47. (c) As the quantum number increases the energy levels become more crowded ie energy difference decreases.

48. (a) $\alpha = 0.96 = \frac{I_c}{I_e}$

or, $I_c = 0.96 \times 7.2 = 6.912$ mA

$I_b = I_e - I_c = 7.2 - 6.912 = 0.29$ mA

49. (a)	50. (d)	51. (b)	52. (d)	53. (c)	54. (b)
55. (a)	56. (b)	57. (d)	58. (c)	59. (b)	60. (a)

Section - II

61. (c) At. wt. of an element $= 6.644 \times 10^{-23} \times 6.023 \times 10^{23} = 40$

$\therefore$ 40 kg = 40000 g

$\therefore$ 40 g of the element = 1 g atom

$\therefore$ 40000 g of the element $= \frac{1}{40} \times 4000$

$= 1000$ g

62. (b) No. of moles of HCl $= \frac{100}{36.5} = 2.74$

No. of moles of NaOH $= \frac{100}{40} = 2.5$

HCl	+	NaOH	$\longrightarrow$	NaCl + H_2O
1 mole		1 mole		1 mole
(2.74 – 2.5)		2.5		2.5 moles

1 moles NaCl = 58.5 g

2.5 moles NaCl = 58.5 × 2.5

= 146.25 g

63. (a) $3HCl + HNO_3 \longrightarrow NaCl + H_2O + 2[4]$

Conc^n Conc^n

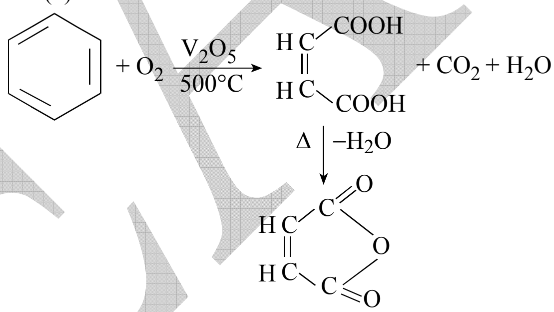
$Hg + 2[Cl] \longrightarrow HgCl_2$

$HgCl_2 + 2KI \longrightarrow HgI_2 + 2KCl$

excess

$HgI_2 + KI \longrightarrow K_2[HgI_4]$

64. (d)



65. (a) $[0.1] \times [OH^-]^2 = 1 \times 10^{-11}$

$[OH^-] = 10^{-5}$

$pOH = \log[OH^-]$

$= -\log[10^{-5}] = 5$

$pH = 14 - 5 = 9$

66. (d) Chalk + NaOH = HCl

$\frac{W}{50} = \frac{10.7 \times 1}{1000} = \frac{50 \times 1}{1000}$

W = 1.965 g

$\% = \frac{1.965}{2.014} \times 100 = 97.56\%$

67. (d) $n = 4$, for d, $l = 2$, $m = -2, -1, 0, +1, +\frac{1}{2}$,

$s = +\frac{1}{2}$ or, $-\frac{1}{2}$

68. (d) We have $e^x = y + \sqrt{1 + y^2}$

i.e. $e^x - y = \sqrt{1 + x^2}$

i.e. $(e^x - y)^2 = 1 + y^2$

i.e. $e^{ex} - 2e^x y + y^2 = 1 + y^2$

i.e. $e^{2x} - 1 = 2e^x y$

i.e. $y = \frac{e^x - e^{-x}}{2}$

69. (c) $\tan^{-1}\frac{xy}{zr}+\tan^{-1}\frac{yz}{xr}+\tan^{-1}\frac{zx}{yr}$

$$=\tan^{-1}\frac{xy}{zr}+\tan^{-1}\frac{\frac{yz}{xr}+\frac{zx}{yr}}{1-\frac{yz}{xr}\cdot\frac{zx}{yr}}$$

$$=\tan^{-1}\frac{xy}{zr}+\tan^{-1}\frac{\frac{x}{xyr}(y^2+x^2)}{\frac{r^2-z^2}{r^2xy}}$$

$$=\tan^{-1}\frac{xy}{zr}+\tan^{-1}\frac{zr}{xy}\cdot\frac{y^2+x^2}{y^2+x^2}$$

$$=\tan^{-1}\frac{xy}{zr}+\tan^{-1}\frac{zr}{xy}=\tan^{-1}\frac{xy}{zr}+\cot^{-1}\frac{xy}{zr}=\frac{\pi}{2}$$

70. (c) $|\vec{x}|=|\vec{y}|=|\vec{z}|=1$ and $\vec{x}+\vec{y}+\vec{z}=\vec{0}$

So, $\vec{y}+\vec{z}=-\vec{x}$

i.e. $y^2+2\vec{y}.\vec{z}+z^2=x^2$

i.e. $1+2.11\cos\theta+1=1$

i.e. $\cos\theta=-\frac{1}{2}$ $\therefore\ \theta=\frac{2\pi}{3}$

71. (b) Total no. of distribution of prizes = $4^3=64$ & no of ways of getting all the prizes to one = 4
$\therefore$ Total no. of ways of distribution = 64 – 4 = 60

72. (d) We have, $(1+x)^n=c_0+c_1x+c_2x^2+c_3x^3+\ldots+c_nx^n$

Integrating, $\frac{(1+x)^{n+1}}{n+1}=c_0x+\frac{c_1}{2}x^2+\frac{c_2}{3}x^3+\frac{c_3}{4}x^4+\ldots+c_n\frac{x^{n+1}}{n+1}+K$

Putting x = 0, $K=\frac{1}{n+1}$

Then $\frac{(1+x)^{n+1}}{n+1}$

$$=c_0x+\frac{x^2}{2}c_1+\frac{x^3}{3}c_2+\frac{x^4}{4}c_3+\ldots+\frac{x^{n+1}}{n+1}c_n+\frac{1}{n+1}$$

Putting x = 2, $\frac{3^{n+1}}{n+1}-\frac{1}{n+1}=2c_0+\frac{2^2}{2}c_1+\frac{2^3}{3}c_2+\frac{2^4}{4}c_3+\ldots+\frac{2^{n+1}}{n+1}c_n$

73. (b) Put a = K, b = K + d, c = K + 2d
Also (b – a), (–b), a are in G.P.
So, d, d, a are in GP
i.e. $d^2=ad\Rightarrow a=d$
So, a : b : c = K : 2K : 3K
= 1 : 2 : 3

74. (d) $(1+\omega^2)^m=(1+\omega^4)^m$

or, $(1+\omega^2)^m=(1+\omega)^m$

i.e. $(-\omega)^m=(-\omega^2)^m\Rightarrow\left(\frac{\omega^2}{\omega}\right)^m=1$

i.e. $\omega^m=1=\omega^3\Rightarrow m=3$

75. (c) Pair of lines: xy – x – y + 1 = 0
i.e. x(y – 1) = 0
i.e. (x – 1) (y – 1) = 0
i.e. x – 1 = 0, y – 1 = 0
As the lines are concurrent, so put x = 1, y = 1 in ax + 2y – 3 = 0, we get a.1 + 2.1 – 3 = 0
i.e. a = 1

76. (d) Here m = tan45° = 1, $a'=\frac{a}{4}$

So point of contact

$$=\left(\frac{a'}{m^2},\frac{2a'}{m}\right)=\left(\frac{a}{4.1^2},2.\frac{a}{4.1}\right)=\left(\frac{a}{4},\frac{a}{2}\right)$$

77. (b) Equation of plane is $lx+my+nz=1$

Which meets the coordinate axes at $\left(\frac{1}{l},0,0\right)$, $\left(0,\frac{1}{m},0\right)$ and $\left(0,0,\frac{1}{n}\right)$. Then the centroid of the triangle formed is $\left(\frac{1}{3l},\frac{1}{3m},\frac{1}{3n}\right)$. Thus $(3l)^2+(3m)^2+(3n)^2=K$

i.e. $K=9(l^2+m^2+n^2)=9$

78. (c) For continuity, $\lim_{x\to 0}f(x)=f(0)$

i.e. 0 = K

79. (c) Here $x=\sin^{-1}(3t-4t^3)=3\sin^{-1}t$,

$y=\cos^{-1}\sqrt{1-t^2}=\sin^{-1}t$

So, x = 3y i.e. $y=\frac{1}{3}x$

$\therefore\ \frac{dy}{dx}=\frac{1}{3}$ and $\frac{d^2y}{dx^2}=0$

80. (b) Here $f(x)=x^3+\lambda x^2+\mu x+1$

So, $f'(x)=3x^2+2\lambda x+\mu$

Then $f'(0)=0\Rightarrow 3.0+2.\lambda.0+\mu=0\Rightarrow\mu=0$

and $f'(1)=0\Rightarrow 3.1+2\lambda.1+0=0\Rightarrow\lambda=-\frac{3}{2}$

81. (c) $I=\int e^{\sqrt{x}}dx$ put $y=\sqrt{x}$

i.e. $dy=\frac{1}{2\sqrt{x}}dx$

i.e. dx = 2y dy

Then $I=2\int ye^ydy$

$$=2\left[y\int e^ydy-\int\left(\frac{dy}{dx}\int e^ydy\right)dy\right]$$

$$=2[ye^y-e^y]+c$$

$$=2e^{\sqrt{x}}(\sqrt{x}-1)+c$$

82. (c) Here $\frac{dy}{dx}=2x+1$

So, $y=x^2+x+K$

It passes through the point (1, 2).

So, $2 = 1 + 1 + K \Rightarrow K = 0$
The curve is $y = x^2 + x$
So it crosses x-axis a points 0 and -1

$\therefore$ Required area $= \int_{-1}^{0} y\,dx = \int_{-1}^{0} (x^2 + x)\,dx$

$$= 0 - \left[-\frac{1}{3} + \frac{1}{2}\right]$$

$$= -\frac{1}{6} = \frac{1}{6} \text{ sq. units}$$

83. (d) $K = m\omega^2$
$= 20 \times 10^{-3} (2\pi f)^2$
$= 20 \times 20^{-3} \times 4\pi^2 \times 10^2$
$= 79$ N/m

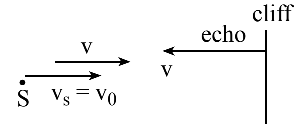
84. (d) For neutron
$KE_i = \frac{1}{2} mv^2 = \frac{1}{2} \times 1 \times v^2$
For carbon
$$v_2 = \frac{2m_1u_1}{m_1 + m_2} + \left(\frac{m_2 - m_1}{m_1 + m_2}\right) u_2$$
$$= \frac{2 \times 1 \times v}{1 + 12} + \left(\frac{12 - 1}{1 + 12}\right) \times 0 = \frac{2v}{13}$$
$$KE' = \frac{1}{2} \times 12 \times v_2^2 = 6\left(\frac{2v}{13}\right)^2 = \frac{24\ v^2}{169}$$
$$\%\ \text{energy} = \frac{KE'}{KE_i} \times 100\%$$
$$= \frac{24u^2 \times 2}{169 \times v^2} \times 100\%$$
$$= 28.4\%$$

85. (b) $-\frac{Gm^2}{r} + 0 = -\frac{Gm^2}{2R} + \frac{1}{2} \times 2\ mv^2$
or, $\frac{Gm^2}{2R} - \frac{Gm^2}{r} = mv^2$
or, $Gm\left[\frac{1}{2R} - \frac{1}{r}\right] = v^2$
or, $v = \sqrt{6.67 \times 10^{-11} \times 2 \times 10^{30}\left[\frac{1}{2 \times 10^7} - \frac{1}{10^{12}}\right]}$
$= 2.58 \times 10^6$ m/s

86. (c) $T_2V_2^{\gamma-1} = T_1V_1^{\gamma-1}$
or, $T_2 = T_1\left(\frac{V_1}{V_2}\right)^{\gamma-1}$
$= 288\left(\frac{V}{8V}\right)^{5/3-1}$
$= 288\left(\frac{1}{8}\right)^{2/3}$
$= 72$ K
$\Delta T = T_1 - T_2 = 288 - 72$
$= 216$ K or 216°C

87. (b) Lose in time in 20 hrs $= \frac{1}{2} \propto \Delta\theta \times 20$ hrs
$= \frac{1}{2} \times 1.2 \times 10^{-5} \times 5 \times 20 \times 3600$s
$= 2.16$s

88. (c)



Frequency of echo $(f') = \frac{v + v_0}{v + v_s} \times f$
$= \frac{330 + 18}{330 - 18} \times 100$
$= \frac{348}{312} \times 1000$ Hz
$= 1115$ Hz

89. (c) $\theta = 32' = \frac{32°}{60} = \left(\frac{32}{60} \times \frac{\pi}{180}\right)$ rad
$\therefore\ \theta = \frac{d_I}{f}$
or, $d_I = \theta f = \frac{32\pi}{60 \times 180} \times 25$
$= 0.23$ cm
$= 2.3$ mm

90. (d) $\beta = \frac{D\lambda}{d}$
or, $d = \frac{D\lambda}{\beta} = \frac{0.4 \times 6000 \times 10^{-10}}{0.012 \times 10^{-2}}$
$= 2 \times 10^{-3}$ m
$= 0.2$ cm

91. (a) $V = E - Ir$
$= E - \frac{E}{R + r} . r$
$= 12 - \frac{12}{6.5 + 1.5} \times 1.5$
$= 9.75$ V

92. (c) For dc
$R = \frac{V}{I} = \frac{100}{1} = 100\ \Omega$
For ac
$Z = \frac{V}{I} = \frac{100}{0.5} = 200\ \Omega$
Now $Z = \sqrt{R^2 + X_L^2}$
or, $X_L = \sqrt{Z^2 - R^2} = \sqrt{200^2 - 100^2}$
$X_L = 173.2\Omega$
or, $2\pi fL = 173.2$
or, $L = \frac{173.2}{2\pi \times 50} = 0.55$ H

93. (c) $E = 9 \times 10^9 \frac{Q}{r^2}$

or, $Q = \frac{Er^2}{9 \times 10^9}$

or, $ne = \frac{0.036 \times 0.1^2}{9 \times 10^9}$

or, $n = \frac{0.036 \times 0.1^2}{9 \times 10^9 \times 1.6 \times 10^{-19}}$

$= 2.5 \times 10^5$

94. (c) $E = L\frac{dI}{dt}$

or, $L = \frac{E}{\frac{dI}{dt}} = \frac{0.05}{5 \times 10^{-3}}$

$= 10$ H

95. (c) $\lambda_L = 1216$ Å

For Lyman series, first line

$\frac{1}{\lambda_L} = R\left[\frac{1}{1} - \frac{1}{4}\right] = \frac{3R}{4}$

or, $\lambda_L = \frac{4}{3R}$ .... (i)

For series limit of Balmer series

$\frac{1}{\lambda_B} = R\left[\frac{1}{4} - \frac{1}{\infty}\right]$

or, $\lambda_B = \frac{4}{R}$ .... (ii)

Dividing (ii) by (i)

$\frac{\lambda_B}{\lambda_L} = \frac{4}{R} \times \frac{3R}{4}$

or, $\lambda_B = 3\lambda_L = 3 \times 1216$ Å $= 3648$ Å

96. (c) $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

or, $40\% = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

or, $ln\ 0.4 = \frac{t}{T_{1/2}} ln\ 0.5$

or, $t = \frac{ln\ 0.4}{ln\ 0.5} \times T_{1/2} = 5$ days.

97. (d) 98. (c) 99. (d) 100. (a)

...The End...