Section - I

1. (b)
In soap solution
$$P = \frac{2T}{R}$$
In air
$$P' = \frac{2 \times 2T}{R} = 2P$$

2. (c)
For uniform circular motion $a_t = 0$ & a_r is finite.

3. (c)
Stress = $Y\alpha\Delta\theta$, is independent to length of rod.

4. (d)
$P = \sigma eA(T^4 - T_o^4)$ depends on area, nature, difference in temperature between body & surrounding.

5. (a)
$$\frac{I_1}{I_2} = \left(\frac{f_1a_1}{f_2a_2}\right)^2$$
or, $$\frac{1}{36} = \left(\frac{1}{2} \times \frac{a_1}{a_2}\right)^2$$
or, $$\frac{1}{9} = \left(\frac{a_1}{a_2}\right)^2$$
or, $$\frac{a_1}{a_2} = \frac{1}{3}$$

6. (a)
$$T = \frac{1}{4\pi\varepsilon_o}\frac{q^2}{(2l)^2} = \frac{q^2}{4\pi\varepsilon_o \times 4l^2}$$

7. (b)
$$\frac{R'}{R} = \frac{\left(l + \frac{l}{10}\right)^2}{l^2} = 1.21$$
$R' = 12.1\Omega$

8. (b)
$$\mu = \frac{\sin i}{\sin i/2} = \frac{2\sin i/2 . \cos i/2}{\sin i/2}$$
or, $$\cos\frac{i}{2} = \frac{\mu}{2}$$
or, $$i = 2\cos^{-1}\left(\frac{\mu}{2}\right)$$

9. (c)
$$\lambda = \frac{h}{P} = \frac{h}{\sqrt{2mE}}$$
$$\frac{\lambda'}{\lambda} = \sqrt{\frac{E}{2E}} = \frac{1}{\sqrt{2}} \qquad \therefore \lambda' = \frac{\lambda}{\sqrt{2}}$$

10. (c)
$$\alpha = \frac{\Delta I_c}{\Delta I_e}$$
or, $\Delta I_c = 0.99 \times 5 = 4.95$ mA

11. (d)
$F = bt^2$
or, $$b = \frac{MLT^{-2}}{T^2} = MLT^{-4}$$

12. (a)
$F = ma$
or, $$m = \frac{\sqrt{6^2 + 8^2 + 10^2}}{1} = 10\sqrt{2}\text{ kg}$$

13. (d)
In isothermal expansion only temperature remain constant

14. (b)
$$m = \frac{f_0}{f_e}$$
Eye piece has high power if focal length is less $p = \frac{1}{f}$

15. (c)
$v = \sqrt{\frac{E}{\rho}}$, Here ratio of $\frac{E}{\rho}$ is maximum for steel

16. (c)
$$\frac{R'}{R} = \frac{l'}{A'} \times \frac{A}{l} = \frac{2l \times \pi r^2}{\pi\left(\frac{r}{2}\right)^2 l} = 8$$
$\therefore$ $R' = 80\ \Omega$

17. (c)
$$\frac{1}{\lambda} = (z_1 - 1)^2\left[\frac{1}{1^2} - \frac{1}{2^2}\right] \text{ .... (i)}$$
$$\frac{1}{\lambda'} = (z_2 - 1)^2\left[\frac{1}{1^2} - \frac{1}{2^2}\right] \text{ .... (ii)}$$
Dividing (i) by (ii)
$$\frac{\lambda'}{\lambda} = \left(\frac{43 - 1}{29 - 1}\right)^2 = \left(\frac{3}{2}\right)^2$$
$$\therefore \lambda' = \frac{9}{4}\lambda$$

18. (b)
If $A \subset B$, then $A \cup B = B$

19. (c)
$$\frac{1}{1 + i} = \frac{1}{1 + i} \times \frac{1 - i}{1 - i} = \frac{1 - i}{2} = \left(\frac{1}{2}, -\frac{1}{2}\right)$$

20. (b)
$$HM = \frac{2ab}{a + b} = \frac{2 \times 2 \times 8}{2 + 8} = 3.2$$

21. (b)
θ lies in 4th quadrant
So, $\theta = 2\pi - \frac{\pi}{4} = \frac{7\pi}{4}$
$\therefore$ Most general value $= 2n\pi + \frac{7\pi}{4}$

22. (d)
The slope of tangent to $x^2 = 4ay$ at (x_1, y_1) is $\frac{x_1}{2a}$
$$\therefore \frac{x_1}{2a} = m \Rightarrow x_1 = 2am$$
$$y_1 = \frac{x_1^2}{4a} = am^2 \qquad (x_1, y_1) = (2am, am^2)$$

23. (a)
If k < 0 then k = –p where p > 0. The equation becomes
$\frac{y^2}{p/b} - \frac{x^2}{p/a} = 1 \Rightarrow e = \sqrt{1 + \frac{p/a}{p/b}} = \sqrt{1 + \frac{b}{a}}$

24. (c)
$\lim_{n\to\infty} \left(\frac{n}{n+1}\right)^n = \lim_{n\to\infty} \left[\left(\frac{n+1}{n}\right)^n\right]^{-1}$
$= \lim_{n\to\infty} \left[\left(1 + \frac{1}{n}\right)^n\right]^{-1} = e^{-1} = \frac{1}{e}$

25. (b)
$y = \sin^2 x,\ z = \cos x$
$\frac{dy}{dx} = 2\sin x \cos x,\qquad \frac{dz}{dx} = -\sin x$
$\frac{dy}{dz} = \frac{2\sin x \cos x}{-\sin x} = -2\cos x$

26. (b)
$\int \log_e x.\ 1\ dx = x\log_e x - \int \left(\frac{1}{x}.x\right) dx + c_1$
$= x\log_e x - \int 1\ dx + c_1 = x\log_e x - x + c$

27. (a)
Let $\vec{a} = x\vec{i} + y\vec{j} + z\vec{k}$
$\vec{a}.\ \vec{i} = x \Rightarrow (\vec{a}.\ \vec{i})^2 = x^2$
Similarly,
$\vec{a}.\ \vec{j} = y \Rightarrow (\vec{a}.\ \vec{j})^2 = y^2,\ (\vec{a}.\ \vec{k})^2 = z^2$
$(\vec{a}.\ \vec{i})^2 + (\vec{a}.\ \vec{j})^2 + (\vec{a}.\ \vec{k})^2 =$
$x^2 + y^2 + z^2 = \vec{a}.\ \vec{a} = \vec{a}^{\ 2}$

28. (c)
Function f(x) is defined if $a^2 - x^2 \geq 0$
$\therefore\quad a^2 \geq x^2$
$\therefore\quad x \in [-a, a]$

29. (b)
$\cos\left(\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)^{-3} = \cos(-\pi) + i\sin(-\pi) = -1$

30. (b)
Binomial coff. of 4^{th} term = coff. of $T_4 = {}^5c_3 = 10$

31. (a)
Using L-Hospital's rule
$\lim_{x\to 0} \frac{a^{\sin x}.\log a \cos x}{b^{\sin x}.\log b.\cos x} = \frac{\log a}{\log b} = \log_b a$

32. (b)
Normal || to x-axis means tangent in $\perp^{lr}$ to x-axis
$\therefore\quad \frac{dy}{dx} = \infty \qquad \therefore \frac{dx}{dy} = 0$

33. (d)
$\int_0^2 |2 - x|\ dx = \int_0^2 (2x)\ dx = \left[2x - \frac{x^2}{2}\right]_0^2 = 4 - 2 = 2$

34. (c)
Distance from x-axis = $\sqrt{2^2 + 3^2} = \sqrt{13}$

35. (d)
Angle between lines is π if $h^2 = ab$
$\therefore\quad 9 = 2K \qquad \therefore K = \frac{9}{2}$

36. (c)
$\log_5 A = 3 \qquad \therefore\ A = 5^3 = 125$

37. (d)
$\cos^{-1}\left(\frac{1}{2}\right) + \sin^{-1}\left(\frac{1}{2}\right) + \sin^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{2} + \frac{\pi}{6} = \frac{4\pi}{6}$
$= \frac{2\pi}{3}$

38. (c)
17g of $NH_3 = 10\times N_A$ electrons
3.4 g of $NH_3 = 2N_A$ electrons
(∵ 1 molecule of NH_3 conains 10 electrons)

39. (b)
The configuration of Ca-atom is
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$. Each orbital has 1 electron having m = 0 and s = +1/2

40. (b)
For $PbCl_2$, $k_{sp} = 4s^3$
$s = \left(\frac{k_{sp}}{4}\right)^{1/3} = \left(\frac{5\times10^{-7}}{4}\right)^{1/3}$
$= 5\times10^{-3}$ mols/litre

41. (b)
NH_4Cl is salt of weak base and strong acid so its solution is acidic and has pH less than 7.

42. (c)
In C_2H_2(H – C ≡ C – H), there are 3σ and 2π bonds.

43. (b)
NH_3 is reduced by sodium metal to H_2 gas
$Na + NH_3 \longrightarrow NaNH_2 + H_2$

44. (a)
Li_2CO_3 due to diagonal relation with $MgCO_3$ decomposes while other alkali metal carbonates are thermally stable.

45. (d)
Zinc is obtained by distillation so, it doesn't require flux.

46. (c)
Iron becomes passive due to formation of Fe_3O_4.

47. (b)
SO_3 is electrophile due to presence of polar S = O bond rest are nuleophilies.

48. (c)
Ethyl iodide is formed by reacting red P and I_2 with ethanol and H_3PO_3 is formed as byproduct.

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

Section - II

61. (d)

$x = 40 + 12t - t^3$

or, $v = \frac{dx}{dt} = 12 - 3t^2$

If comes to rest $v = 0$ so

$0 = 12 - 3t^2$

or, $t^2 = 4$

or, $t = 2sec$

$x = \int_0^2 v\,dt = \int_0^2 (12 - 3t^2)\,dt = 12\,(t)_0^2 - 3\left(\frac{t^3}{3}\right)_0^2$

$= 12(2 - 0) - (2^3 - 0^3) = 24 - 8 = 16m$

62. (b)

$T_{max} = m(g + a)$

or, $300 = 10(10 + a)$

or, $a = 20\ m/s^2$

∴ $h = 1/2\ at^2$

$t = \sqrt{\frac{2h}{a}} = \sqrt{\frac{2 \times 10}{20}} = 1sec$

63. (b)

$\tau = I\alpha$

$\alpha = \frac{6.9 \times 10^2}{3 \times 10^2} = 2.3\ rad/s^2$

Again, $\omega = \omega_o + \alpha t$

or, $0 = 4.6 - 2.3 \times t$

or, $t = 2sec$

64. (a)

F = Breaking stress × Area

or, $mr\omega^2 = 4.8 \times 10^7 \times 10^{-6}$

or, $\omega = \sqrt{\frac{4.8 \times 10^7 \times 10^{-6}}{10 \times 0.3}} = 4\ rad/s$

65. (a)

$d_{100} = d_0(1 + \alpha\Delta\theta)$

$= 2.54(1 + 2.3 \times 10^{-5} \times 100) = 2.55\ cm$

66. (a)

1st case

$\frac{V_2}{V_1} = \frac{T_2}{T_1}$ or, $T_2 = \frac{2V}{V} \times 300 = 600k$

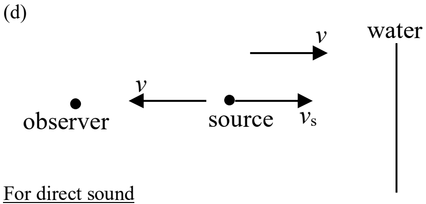
2nd case

$T_3V_3^{\gamma-1} = T_2V_2^{\gamma-1}$

or, $\left(\frac{V_3}{2\times20}\right)^{5/3 - 1} = \frac{600}{300}$

or, $V_3 = (2)^{3/2} \times 40 = 113$ lts

67. (d)



For direct sound

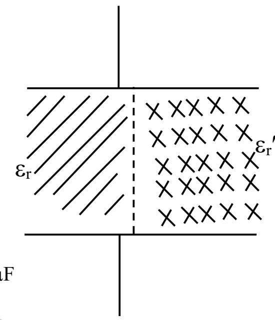
$f' = \frac{v}{v + v_s} \times f = \frac{330}{330 + 5} \times 256 = 252.2Hz$

For reflected sound

$f'' = \frac{v}{v - v_s} \times f = \frac{330}{330 - 5} \times 256 = 260Hz$

$f_b = f'' - f' = 260 - 252.2 = 7.8$ beats/s

68. (c)



$C = \frac{\varepsilon_o A}{d}$

$C_1 = \frac{\varepsilon_r \varepsilon_o A}{2d}$

$= \frac{2}{2} \times 10 = 10\mu F$

$C_2 = \frac{\varepsilon_r' \varepsilon_o A}{2d}$

$= \frac{4}{2} \times 10 = 20\mu F$

∴ $C_{eq} = C_1 + C_2 = 10 + 20 = 30\mu F$

69. (a) $E = -\frac{dv}{dr} = -\frac{d(4x^2)}{dx} = -8x$

At (1, 0, 2), $E = -8 \times 1 = -8$ V/m

= 8 V/m along –ve x-axis

70. (b)

$Bev\sin\theta = \frac{m(v\sin\theta)^2}{r}$

or, $r = \frac{mv\sin\theta}{Be} = \frac{10^8 \times \sin20^o}{9.6\times10^{-5}\times1.8\times10^{11}}$

$= 1.98m \approx 2m$

71. (d)

$E = -\frac{d\phi}{dt} = -A\frac{dB}{dt}$

$= 8\times2\times10^{-4}\times0.02 = 32\times10^{-6}V$

$P = \frac{V^2}{R} = \frac{(32\times10^{-6})^2}{1.6} = 6.4\times10^{-10}w$

72. (b)

$\theta = \frac{\beta}{D} = \frac{D\lambda}{dD} = \frac{\lambda}{d}$

$\frac{\theta_w}{\theta_a} = \frac{\lambda_w}{\lambda_a} = \frac{1}{\mu}$

or, $\theta_w = \frac{\theta_a}{\mu} = \frac{0.4}{4/3} = 0.3^o$

73. (b)

5% of $P = \frac{n}{t}\frac{hc}{\lambda}$

or, $\frac{n}{t} = \frac{5}{100} \times \frac{0.1 \times 2537 \times 10^{-10}}{6.62 \times 10^{-34} \times 3 \times 10^8}$

$= 6.38 \times 10^{15}$

For metal plate

$I = \left(\frac{n}{t} \times \frac{A}{4\pi r^2}\right) e$

$= \frac{6.38 \times 10^{15} \times 4 \times 10^{-4} \times 1.6 \times 10^{-19}}{4\pi \times 1^2}$

$= 32.5 \times 10^{-9}A = 32.5nA$

74. (d)

1st case

$$\frac{3000}{6000} = \left(\frac{1}{2}\right)^{\frac{t}{T_{\frac{1}{2}}}}$$

or, $\frac{1}{2} = \left(\frac{1}{2}\right)^{\frac{140}{T_{\frac{1}{2}}}}$

or, $T_{1/2} = 140$ days

Again,

$$\frac{C}{C_o} = \left(\frac{1}{2}\right)^{\frac{t}{T_{\frac{1}{2}}}}$$

or, $\frac{6000}{C_o} = \left(\frac{1}{2}\right)^{\frac{280}{140}}$

or, $C_o = 24000$ dis/s

75. (d)

$y = \frac{x}{1 + x^2}$

$yx^2 - x + y = 0$

$x = \frac{1 \pm \sqrt{1 - 4y^2}}{2y}$

To be x real, $1 - 4y^2 \geq 0$

$4y^2 \leq 1 \Rightarrow y^2 \leq \frac{1}{4} \Rightarrow |y| \leq \frac{1}{2}$

$\Rightarrow -\frac{1}{2} \leq y \leq \frac{1}{2}$

$y = \left[-\frac{1}{2}, \frac{1}{2}\right]$

76. (c)

$\Delta = (a + b - c)(a - b + c) = 2(s - c) \times 2(s - b)$

$\frac{1}{4} = \frac{(s - b)(s - c)}{\Delta} = \tan\frac{A}{2}$

$\tan A = \frac{2\tan A/2}{1 - \tan^2 A/2} = \frac{2 \times 1/4}{1 - (1/4)^2} = \frac{8}{15}$

77. (c)

For no solution

$$\begin{vmatrix} \alpha & 1 & 1 \\ 1 & \alpha & 1 \\ 1 & 1 & \alpha \end{vmatrix} = 0$$

$\alpha = 1$ satisfies this, now for other value,

$c_1 \to c_1 + c_2 + c_3$

$$\begin{vmatrix} \alpha+2 & 1 & 1 \\ \alpha+2 & \alpha & 1 \\ \alpha+2 & 1 & \alpha \end{vmatrix} = 0 \Rightarrow \alpha = -2$$

So option 'c' is suitable

78. (a)

Middle term $= t_{2n/2 + 1}$

$= t_{n+1}$

$= c(2n, n)\,(x^2)^{2n-n}\left(\frac{1}{x^2}\right)^n$

$= c(2n, n)$

79. (a)

No. of permutation of the word $= \frac{6!}{3!\,2!}$

$= 2 \times 5 \times 6 = 60$

When two N's come together, no. of permutation

$= \frac{5!}{3!} = 20$

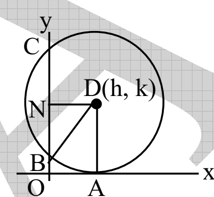
Required permutation $= 60 - 20 = 40$

80. (c)

$(4)^2 + p\times4 + 12 = 0 \Rightarrow p = -7$

Now, $p^2 - 4q = 0 \Rightarrow 4q = 49 \Rightarrow q = \frac{49}{4}$

81. (d)



$BD^2 = BN^2 + DN^2$

$k^2 = l^2 + h^2$

$\therefore$ The equation of locus of (h, k) is

$y^2 = x^2 + l^2$

82. (c)

$$\Delta = \frac{3}{2}\begin{vmatrix} 1 - 0 & 2 - 0 \\ -3 - 0 & 4 - 0 \end{vmatrix} = \frac{3}{2}\begin{vmatrix} 1 & 2 \\ -3 & 4 \end{vmatrix}$$

$= \frac{3}{2} \times 10 = 15$

83. (a)

Area of $\Delta = \frac{1}{2} \times 2ae \times b\sin\theta = \sqrt{a^2 - b^2} \times b\sin\theta$

$\therefore \sqrt{5} \times 2\sin\theta = \sqrt{10} \Rightarrow \theta = 45^o$

$\therefore (x, y) = (a\cos\theta, b\sin\theta)$

$= (3\cos45^o, 2\sin45^o) = \left(\frac{3}{\sqrt{2}}, \sqrt{2}\right)$

84. (a)

The equation of the plane is

$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$

$\frac{x}{4} + \frac{y}{b} + \frac{z}{3} = 1$

d.c's of y axis are 0, 1, 0

$\therefore \frac{1}{4}.0 + \frac{1}{b}.1 + \frac{1}{3}.0 = 0 \Rightarrow \frac{1}{b} = 0$

$\therefore$ The equation of the plane is

$\frac{x}{4} + \frac{z}{3} = 1$

$3x + 4z = 12$

85. (d)

$f'(x) = 2x - \frac{a}{x^2}$, $f''(x) = 2 + \frac{2a}{x^3}$

$f'(2) = 4 - \frac{a}{4} = 0 \Rightarrow a = 16$

86. (c)

$y^2 = \frac{1+x}{1-x}$

$2y\frac{dy}{dx} = \frac{2}{(1-x)^2}$

$y^2\frac{dy}{dx} = \frac{y}{(1-x)^2}$

$\frac{1+x}{1-x}\frac{dy}{dx} = \frac{y}{(1-x)^2}$

$\frac{dy}{dx} = \frac{y}{1-x^2}$

87. (a)

$I = \int_0^{\pi/2} \frac{\cos\theta\, d\theta}{\sqrt{1-\sin\theta}}$ [put $1 - \sin\theta = y$]

$= -\int_1^0 y^{-1/2}\, dy = [-2y^{1/2}]_1^0 = 2$

88. (a)

$\text{Area} = \int_0^{3/5} y\, dx = \int_0^{3/5} (3x - 5x^2)\, dx$

$= \left[\frac{3x^2}{2} - \frac{5x^3}{3}\right]_0^{3/5} = \frac{9}{50}$

89. (c)

$(p, q) = \lambda(5, 1)$

$\Rightarrow p = 5\lambda, \quad q = \lambda$

$p = 5q$

90. (c) 91. (d) 92. (b) 93. (a)

94. (b)

$\frac{E_{\text{metal chloride}}}{E_{\text{silver chloride}}} = \frac{W_{\text{metal chloride}}}{W_{\text{silver chloride}}}$

$\frac{x + 35.5}{108 + 35.5} = \frac{1}{2.11}$

$x = 32.5$

95. (b)

$E = \frac{W \times 1000}{V \times N} = \frac{1.18 \times 1000}{40 \times 0.5} = 59$

$\therefore$ Mol. wt $= 59 \times 2 = 118$

96. (c)

$M = \frac{E\, I\, t}{F}$

$E = \frac{MF}{It} = \frac{3 \times 96500}{9.65 \times 10 \times 60} = 50$

$\therefore$ at. wt = Eq. wt × valency = 50 × 1 = 50

97. (d)

$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

The change in O.N. of $K_2Cr_2O_7$ in acidified $K_2Cr_2O_7$ is 6.

98. (a)

In redox reaction, H_2S is oxidized to S by oxidizing agents.

99. (b)

Acetylene adds H_2O forming vinyl alcohol which rearranges forming acetaldehyde.

100. (c)

$O \Rightarrow 1s^2\, 2s^2\, 2p^4$

After velax of one 'e' $O^+ \Rightarrow 1s^2\, 2s^2\, 2p^3$

Hence it is stable form and has high $I.E_2$

$N \Rightarrow 1s^2\, 2s^2\, 2p^3$, $N^+ \Rightarrow 1s^2\, 2s^2\, 2p^2$

…The End…