Section - I

1.(b) Displacement $(\vec{\Delta S}) = 2r\sin\frac{\theta}{2} = 2r\sin\frac{180°}{2} = 2r$

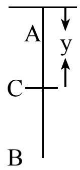
Distance $= r\theta = \pi r$

2.(c) $R_{max} = \frac{u^2}{g}$

or, $u^2 = R_{max} \times g$

Again $H = \frac{u^2}{2g} = \frac{80 \times 10}{2 \times 10} = 40$ m

3.(b)



Tension = wt. of part BC

$T = \frac{M}{L}(L - y)g = \frac{Mg(L - y)}{L}$

4.(a) $\Delta P = \frac{4T}{R} \propto \frac{1}{R}$

$\frac{\Delta P_1}{\Delta P_2} = \frac{R_2}{R_1} = \frac{1}{2}$

5.(c) Since cubical expensivity = 3 × linear expasivity

$= 3 \times \frac{\alpha}{3} = \alpha$

So remains stationary

6.(d) $mgh = ms\Delta\theta$

or, $\Delta\theta = \frac{gh}{s} = \frac{10 \times 21}{4200} = 0.05°C$

7.(c) $Q = \sigma AtT^4$

$\frac{Q_1}{Q_2} = \left(\frac{T_1}{T_2}\right)^4 = \frac{1}{16}$

8.(b) We know, volumetric stain $= -\frac{\Delta V}{V} = \frac{\Delta\rho}{\rho} = \frac{0.2}{100}$

$= 2 \times 10^{-3}$

Now pressure = bulk modulus × stain (volumetric)

$= 2 \times 10^9 \times 2 \times 10^{-3} = 4 \times 10^6$ N/m^2

9.(a) $\frac{\theta}{100} = \frac{R_\theta - R_0}{R_{100} - R_0}$

or, $\frac{\theta}{100} = \frac{6.53 - 6.74}{7.74 - 6.74}$ or, $\frac{\theta}{100} = -0.21$

or, $\theta = -21°C$

10.(b) Here water contacts from 0°C to 4°C.

Then, on contraction, work is done on the system.

So $dQ = du + dw$

or, $du = dQ - dw$

Here, dw is –ve so $C_v > C_p$

11.(c) $E_1 = E$

$E_2 = 2E$

Now, $\frac{2E}{E} = \left(\frac{T_2}{T_1}\right)^4 \Rightarrow (2)^{1/4} = \frac{T_2}{T_1}$

$\therefore$ $T_2 = (2)^{1/4} \times 1000 = 1189$ K

12.(d) Here, we know,

$C_0 = \sqrt{\frac{\gamma.p}{\rho}}$ ……. (i)

and $C = \sqrt{\frac{3.p}{\rho}}$ ……..(ii)

Dividing (i) & (by) (ii) then we get

$\Rightarrow \frac{C_0}{C} = \sqrt{\frac{\gamma.p}{3.p}} = \sqrt{\frac{\gamma}{3}} = \left(\frac{\gamma}{3}\right)^{1/2}$

$\therefore$ $C_0 = C\left(\frac{\gamma}{3}\right)^{1/2}$

13.(b) Then, $\frac{I_{max}}{I_{min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \left(\frac{5+3}{5-3}\right)^2 = \left(\frac{8}{2}\right)^2$

$\therefore$ $\frac{I_{max}}{I_{min}} = 16:1$

14.(b) $f = \frac{v}{4l} \Rightarrow f \propto \frac{1}{l}$

$\therefore$ $\frac{f'}{f} = \frac{l}{l'} = \frac{l}{2l}$

$\therefore$ $f' = \frac{f}{2}$

15.(c) $\frac{t}{2\mu_1} + \frac{t}{2\mu_2} = \frac{t}{\mu}$

or, $\mu = \frac{2\mu_1\mu_2}{\mu_1 + \mu_2} = \frac{2 \times 3 \times 2}{3 + 2} = 2.4$

16.(a) $E = \frac{I}{r^2}$

or, $\frac{E'}{E} = \left(\frac{r}{r'}\right)^2 = \left(\frac{3}{4}\right)^2 = \frac{9}{16}$

% decrease $= \left(1 - \frac{E'}{E}\right) \times 100\%$

$= \left(1 - \frac{9}{16}\right) \times 100\% = 43.7\%$

17.(c) Here, $x_L \propto f$

$\therefore$ $\frac{X_L'}{X_L} = \frac{f'}{f}$

$\Rightarrow$ $X_L' = \frac{f'}{f} \times X_L = \frac{80}{50} \times 200$

$X_L' = 320\Omega$

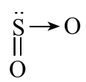
18.(d)

19.(b)

20.(d) $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

21.(a)

22.(a)



23.(b) Exactly tetrahedral in geometry.

24.(d)

25.(c) Al, Fe and Cr make passivity with conc^n HNO_3

26.(c)

27.(a)

28.(b) NH_4Cl is acidic salt and gets cationic hydrolysis

29.(b) Since $A \cap B = \phi$, $A - B = A$

30.(d) $\cos^{-1}x + \cos^{-1}y = \left(\frac{\pi}{2} - \sin^{-1}x\right) + \left(\frac{\pi}{2} - \sin^{-1}y\right)$

$= \pi - \frac{\pi}{3} = \frac{2\pi}{3}$

31.(c) $i^n + i^{n+1} + i^{n+2} + i^{n+3}$

$= i^n(1 + i + i^2 + i^3) = i^n(1 + i - 1 - i) = 0$

32.(b) Adj (KI) $= K^{3-1}I = K^2I$

33.(a) $B^2 - 4AC = 0$
$(-p)^2 - 4.5.45 = 0$
$\Rightarrow p = \pm 30$

34.(d) $e^{2x} = 1 + \frac{(2x)}{1!} + \frac{(2x)^2}{2!} + \ldots\ldots + \frac{(2x)^7}{7!} + \ldots\ldots.$
Coefficient of $x^7 = \frac{2^7}{7!}$

35.(b) Here, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$
So, the system has unique solution.

36.(a) Formula

37.(a) Projection of $\vec{b}$ on $\vec{a} = \frac{\vec{a}.\vec{b}}{|\vec{a}|} = \frac{10 - 3 + 2}{3} = 3$

38.(c) Let $\vec{a} = \vec{i} - \vec{j}, \vec{b} = \vec{j} + \vec{k}$
By triangle law, $\vec{a} + \vec{b} + \vec{c} = 0$
$\Rightarrow \vec{c} = -\vec{i} - \vec{k}$

39.(d) We have
$c_0 + c_1x + c_2x^2 + \ldots.. + c_nx^n\ (1 + x)^n$
Putting x = 3
$c_0 + 3c_1 + 9c_2 + \ldots\ldots.. + 3^nc_n = 4^n$

40.(d) Number selection $= {}^5C_3 \times {}^5C_2$
$= 10 \times 10 = 100$

41.(a) $\frac{\vec{a}.\vec{b}}{|\vec{b}|} = \frac{-4 - 6 - 6}{\sqrt{4 + 4 + 1}} = -\frac{16}{\sqrt{9}} = -\frac{16}{3}$

42.(b) Here a, b, c are in A.P.
$\Rightarrow b = \frac{a + c}{2}$
$\Rightarrow a - 2b + c = 0$
$\therefore$ (1 – 2) lines on the line ax + by + c = 0
Hence, ax + by + c = 0 represents a family of lines passing trough (1, –2)

43.(b) Here $h^2 - ab = 6^2 - 4.9 = 0$
$\therefore$ lines are real and coincident.

44.(d) $(x - 5)^2 + (y - 7)^2 = 3^2(\cos^2\theta + \sin^2\theta) = 9$
$\therefore$ It is a circle

45.(d) $c = \frac{a}{m} = \frac{4}{2} = 2$

46.(a) $l = m = n$
$\therefore l^2 + m^2 + n^2 = 1$
$3l^2 = 1 \qquad \therefore l = m = n = \pm\frac{1}{\sqrt{3}}$

47.(b) $\frac{b\cos C + b\cos A + \cos B + a\cos B}{b(c + a)}$
$= \frac{c + a}{b(c + a)} = \frac{1}{b}$

48.(b) Here comparing with asinx + bcosx = c
a = 1, b = 1, c = 2
$\therefore c > \sqrt{a^2 + b^2} = \sqrt{2}$
$\therefore$ There is no solution.

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

Section – II

61.(d) $g = \frac{GM}{R^2}$
$\frac{g_{planet}}{g_{earth}} = \frac{M_p}{M_e} \times \left(\frac{R_e}{R_p}\right)^2 = \frac{1}{2} \times (2)^2 = 2$
$\therefore g_p = 2g$

62.(b) $F_{max} = m\omega^2A = m\left(\frac{2\pi}{T}\right)^2 A = \frac{4\pi^2}{T^2} mA$
$= \frac{4\pi^2 \times 50 \times 10^{-3} \times 0.1}{0.1^2} = 20N$

63.(b) Total weight = wt. of water displaced
$m_1g + m_2g = (v_1 + v_2)\ \rho_wg$
$m_1 + 10 = \left(\frac{m_1}{11} + \frac{10}{0.2}\right) \times 1$
$m_1 = 44$ gm

64.(c) Tension (= 150) < weight
So acceleration down ward
mg – T = ma
or, $20 \times 9.8 - 150 = 20a$
or, $a = 2.3\ m/s^2$

65.(a) $\frac{\Delta l}{l_1\alpha} = \Delta\theta$
$\frac{0.0005\text{ mm}}{1\text{ mm} \times 1.32 \times 10^{-5}} = \Delta\theta$
$\Rightarrow \Delta\theta = 37.8°C$

66.(a) Here, F = qE
$E = \frac{F}{q} = \frac{3000}{3} = 1000$ N/C
Then, $E = \frac{V}{d} \Rightarrow V = 1000 \times (1 \times 10^{-2})$ V
or, V = 10V

67.(a) Here, $\frac{1}{C_{eq}} = \frac{1}{C} + \frac{1}{nC}$
$\frac{1}{C_{eq}} = \frac{n + 1}{nC} \Rightarrow C_{eq} = \frac{nC}{n + 1}$

68.(c) Here, $E_{10} = -\frac{13.6}{10^2}$ eV = –0.136 eV
$E_\infty = 0$
$\therefore \Delta E = E_\infty - E_{10} = (0 - (-0.136)$ eV)
$\therefore \Delta E = 0.136$ eV

69.(d) Here, $n = \frac{T}{T_{1/2}} = \frac{30}{5} = 6$
$\therefore$ n = 6
Now, $\left(\frac{N}{N_0}\right) = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^6 = \frac{1}{64}$
$\therefore \frac{N}{N_0} = \frac{1}{64}$

70.(b) Here, number of atoms in one gram of uranium is $\frac{6.02 \times 10^{23}}{235}$
Now, energy released
$= \left(\frac{6.02 \times 10^{23}}{235} \times 200\right)$ MeV
$= 5 \times 10^{23}$ MeV

71.(c) Here, energy released = m_0C^2

If $C' = \frac{2}{3}C$

Energy released = $m_0\left(\frac{2}{3}C\right)^2 = \frac{4}{9}m_0C^2$

Decrease in energy (ΔE) = $m_0C^2 - \frac{4}{9}m_oC^2$

$= \frac{5}{9}(m_0C^2)$

$= \frac{5}{9}$ (initial energy)

72.(a) Here, $eV = \frac{hC}{\lambda}$

$V = \frac{hc}{e\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 3 \times 10^{-10}} = 4137.5\ V$

73.(a) $a = \frac{0^2 - 100^2}{2 \times 4} = \frac{0^2 - v^2}{2 \times 9}$

or, $-\frac{100^2}{4} = -\frac{v^2}{9}$

or, $v = \sqrt{\frac{9}{4} \times 100^2} = 1.5 \times 100 = 150$ m/s

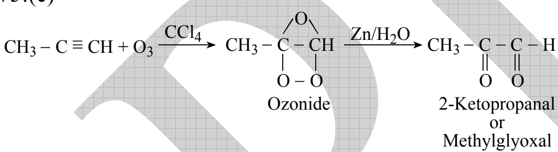
74.(b) $20\beta = 8.62 \times 10^{-3}$

or, $20\frac{D\lambda}{d} = 8.62 \times 10^{-3}$

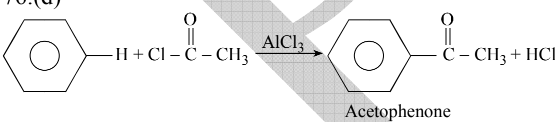
or, $d = \frac{20 \times 2 \times 5893 \times 10^{-10}}{8.62 \times 10^{-3}}$

$= 2.73 \times 10^{-3}$ m = 2.7 mm

75.(c)



76.(d)



77.(a) $Ca(OH)_2 + Cl_2 \xrightarrow{\text{Warm/40°C}} CaOCl_2 + H_2O$

78.(a) $2K\overset{+7}{Mn}O_4 + H_2O \longrightarrow 2KOH + 2\overset{+4}{Mn}O_2 + 3[O]$

Change in oxidation of number of Mn = +7 – (+4) = 3

1 mole MnO_4^- = 3 mole charge

= 3F

= (3 × 96500)C

79.(d) Due to increase the effective nuclear charge.

80.(a)

$\overset{+3}{As_2}\overset{-2}{S_3} + HNO_3 \longrightarrow H_3\overset{+5}{As}O_4 + \overset{0}{S} + NO_2 + H_2O$

Change in O.N. of As = S – (+3) = 2 × 2 = 4

Change in O.N. of S = O – (–2) = +2 × 3 = 6

Total change = 10

Eq. wt. = $\frac{\text{Mol. wt.}}{\text{Change in O.N.}} = \frac{M}{10}$

81.(b) Total no. of H^+ = No. of H^+ from HCl + No. of H^+ from water

$= 10^{-7} + 10^{-7}$

$= 2 \times 10^{-7}$

$pH = -\log[H_3O^+]$

$= -\log[2 \times 10^{-7}] = 6.7$

82.(b) Here $y = \cos^{-1}\frac{1 - (\log x)^2}{1 + (\log x)^2}$

$= 2\tan^{-1}(\log x)$

$\therefore \frac{dy}{dx} = 2\frac{d}{dx}\tan^{-1}(\log x)$

$= 2\frac{d}{d(\log x)}\tan^{-1}(\log x)\frac{d}{dx}\log x$

$= 2\frac{1}{1 + (\log x)^2} \times \frac{1}{x}$

At h = e, $\frac{dy}{dx} = \frac{2}{1 + 1^2} \cdot \frac{1}{e} = \frac{1}{e}$

83.(b) $\int \sin^{-1}x\, dx$

$= x\sin^{-1}x - \int\left(\frac{d}{dx}\sin^{-1}x \int dx\right)dx$

$= x\sin^{-1}x - \int\frac{x}{\sqrt{1 - x^2}}dx$

$= x\sin^{-1}x + \frac{1}{2}\int\frac{-2x}{\sqrt{1 - x^2}}dx$

$= x\sin^{-1}x + \frac{1}{2} \cdot 2\sqrt{1 - x^2} + c$

$= x\sin^{-1}x + \sqrt{1 - x^2} + c$

84.(d) $f(x) = \cos x - \cos^2x + \cos^3x - \ldots\ldots\ldots + \infty$

$= \frac{\cos x}{1 + \cos x}$

$\int f(x)\,dx = \int\frac{\cos x\,dx}{1 + \cos x}$

$\int\frac{1 + \cos x - 1}{1 + \cos x}dx$

$= \int dx - \int\frac{1}{1 + \cos x}dx = x - \frac{1}{2}\int\frac{dx}{\cos^2\frac{x}{2}}$

$= x - \frac{1}{2}\int\sec^2\frac{x}{2}dx = x - \tan\frac{x}{2} + c$

85.(a) At certain time t,

A = area, r = radius, p = perimeter

$A = \pi r^2$, $p = 2\pi r$

$\frac{dA}{dt} = K \qquad 2\pi r\frac{dr}{dt} = K$

$\frac{dr}{dt} = \frac{K}{2\pi r} \qquad \Rightarrow \frac{dr}{dt} \propto \frac{1}{r}$

86.(a) Let $\sqrt{5 + 12i} = x + iy$ then

$x^2 = \frac{\sqrt{a^2 + b^2} + a}{2}, \qquad y^2 = \frac{\sqrt{a^2 + b^2} - a}{2}$

$= \frac{\sqrt{5^2 + 12^2} + 5}{2} \qquad = \frac{\sqrt{5^2 + 12^2} - 5}{2}$

$= 9 \qquad = 4$

$x = \pm 3 \qquad y = \pm 2$

Since b = 12 > 0, so square roots are ± (3 + 2i)

87.(c) a, b, c are in H.P.

$\Rightarrow \frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P.

$\Rightarrow \frac{a+b+c}{a}, \frac{a+b+c}{b}, \frac{a+b+c}{c}$ are in A.P.

$\Rightarrow 1+\frac{b+c}{a}, 1+\frac{a+c}{b}, 1+\frac{a+b}{c}$ are in A.P.

$\Rightarrow \frac{b+c}{a}, \frac{c+a}{b}, \frac{a+b}{c}$ are in A.P.

$\Rightarrow \frac{a}{b+c}, \frac{b}{c+a}, \frac{c}{a+b}$ are in H.P.

88.(a) $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix} = \begin{vmatrix} \alpha+\beta+\gamma & \beta & \gamma \\ \alpha+\beta+\gamma & \gamma & \alpha \\ \alpha+\beta+\gamma & \alpha & \beta \end{vmatrix}$

$= \begin{vmatrix} 0 & \beta & \gamma \\ 0 & \gamma & \alpha \\ 0 & \alpha & \beta \end{vmatrix} = 0$

as $\alpha+\beta+\gamma = 0$

89.(d) $a = \left|\frac{-8}{\sqrt{1+1}}\right| - \left|\frac{-12}{\sqrt{1+1}}\right| = \frac{4}{\sqrt{2}}$

Length of latus rectum $= 4a = 4 \times \frac{4}{\sqrt{2}} = 8\sqrt{2}$

90.(c) Distance $= 2\sqrt{\frac{g^2-ac}{a(a+b)}} = 2\sqrt{\frac{4-1}{1(1+2)}} = 2$

91.(b) $\frac{2b^2}{a} = b$

$\Rightarrow \frac{b}{a} = \frac{1}{2}$

$\Rightarrow \frac{b^2}{a^2} = \frac{1}{4}$

$e = \sqrt{1-\frac{b^2}{a^2}}$

$= \frac{\sqrt{3}}{2}$

92.(c) Let r be the length of line

Then projection of the line on x-axis = $rl = 3$

Similarly projection of the line on y-axis = $rm = 4$

Projection of the line on z-axis = $rn = 5$

Now, $r^2l^2 + r^2m^2 + r^2n^2 = 3^2 + 4^2 + 5^2$

or, $r^2(l^2 + m^2 + n^2) = 50$

$\Rightarrow r = 5\sqrt{2}$

93.(a) $f(x) = \sqrt{x^2+9}$

$f'(x) = \frac{1}{2}(x^2+9)^{\frac{1}{2}-1} 2x = \frac{x}{\sqrt{x^2+9}}$

$\lim_{x\to 4} \frac{f(x)-f(4)}{x-4} = f'(4)$

$= \frac{4}{\sqrt{4^2+9}} = \frac{4}{5}$

94.(c) Put $\ln x = t$

$\Rightarrow x = e^t$

$\Rightarrow dx = e^t\,dt$

Now, $I = \int\left(\frac{1}{t}-\frac{1}{t^2}\right) e^t dt = e^t.\frac{1}{t} + c$

$= \frac{x}{\ln x} + c$

95.(c) Let $f(x) = \sin x + \sqrt{3}\cos x$

$f'(x) = \cos x - \sqrt{3}\sin x$

For maximum value, $f'(x) = 0$

$\cos x - \sqrt{3}\sin x = 0$

$\Rightarrow \cos x = \sqrt{3}\sin x$

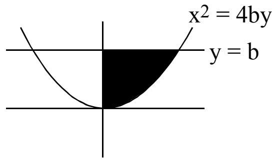
$\Rightarrow \tan x = \frac{1}{\sqrt{3}}$

$\Rightarrow x = \frac{\pi}{6}$

96.(a) $A = \int_{y=0}^{y=b} x\,dy$

$= \int_0^b \sqrt{4by}\,dy$

$= \frac{4}{3}b^2$ sq. units.



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

…The End…