Section – I

1.(b) $v = 0 + a_1t_1 \Rightarrow v = a_1t_1$

$0 = v - a_2t_2 \Rightarrow v = a_2t_2$

$\therefore \quad a_1t_1 = a_2t_2 \quad \text{or,} \quad \frac{t_1}{t_2} = \frac{a_2}{a_1}$

2.(c) $mg(h + r) = \frac{1}{2}kr^2$

$4 \times 10\,(3 + r) = \frac{1}{2} \times 500r^2$

or, $25r^2 - 4r - 12 = 0$

$r = \frac{+4 \pm \sqrt{16 + 4 \times 25 \times 12}}{2 \times 25} = \frac{+4 \pm 34.87}{50}$

$= 0.77\text{ m}, -0.62\text{ m}$

3.(b) $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

[1 revolution = 2π]

$10 \times 2\pi = \frac{1}{2}\alpha t^2 \qquad (\because \omega_0 = 0)$

$20\pi = \frac{1}{2}6t^2 \times t^2$

$t^4 = \frac{40\pi}{6}$

$t = 2.14$ sec

4.(d) $V \propto R^3 \Rightarrow R \propto V^{1/3}$

$W \propto R^2 \Rightarrow W \propto V^{2/3}$

$\frac{W_1}{W_2} = \left(\frac{V_1}{V_2}\right)^{2/3} = \frac{1}{2^{2/3}} = \frac{1}{(2^2)^{1/3}} = \frac{1}{4^{1/3}}$

$W_2 = 4^{1/3}W$

5.(b) $I = Kr^2$

$\frac{\Delta I}{I} = \frac{2\Delta r}{r}$ and $\frac{\Delta I}{I} = 2\alpha\Delta\theta$

$\Delta I = 2\alpha I\Delta\theta$

6.(a) Work done (W) = $P\Delta V = nRdT$

$= 1 \times 8.31 \times 1$ J

$= \frac{8.31}{4.2}$ cal = 1.98 cal

7.(d) $\frac{V_H}{V_{He}} = \sqrt{\frac{\gamma_H \times M_{He}}{M_H \times \gamma_{He}}} = \sqrt{\frac{1.4\times4}{2\times1.6}} = \sqrt{7} : 2$

8.(c) K.E. = qV = e × 1KV = 1KeV

9.(c) Heat produced = Energy stored = $\frac{1}{2}CV^2$

$\frac{1}{2} \times (4 \times 10^{-6}).(400)^2 = 0.32$ J

10.(d) $q = It$

$I = \frac{q}{t} = \frac{ne}{t} = \left(\frac{n}{t}\right)e$

$I = 6.25\times10^{12}\times1.6\times10^{-19} = 10^{-6}A = 1\mu A$

11.(c) $I_g = \frac{1}{2}I \quad ; S = 40\Omega \qquad G = ?$

$G = \frac{I - I_g}{I_g} \times S = \frac{I - \frac{I}{2}}{\frac{I}{2}} \times 40 = 40\ \Omega$

12.(d)

13.(c) $P = IE\cos\phi$

since $\phi = \frac{\pi}{2}$, $\cos\frac{\pi}{2} = 0$

$\therefore \quad P = 0$

14(c) $\mu \propto \frac{1}{\lambda}$

$\frac{\mu_w}{\mu_a} = \frac{\lambda_a}{\lambda_w}$

$\frac{1.33}{1} = \frac{420}{\lambda_w} \Rightarrow \lambda = 315$ nm

15.(a) $v = \sqrt{\frac{2qV}{m}} \propto \sqrt{\frac{q}{m}}$

$\frac{v_{He}}{v_H} = \sqrt{\frac{q_{He}}{q_H} \times \frac{m_H}{m_{He}}} = \sqrt{\frac{2e}{e} \times \frac{m}{4m}} = \frac{1}{\sqrt{2}}$

16.(b) $r \propto \frac{n^2}{z} \Rightarrow \frac{r_2}{r_1} = \frac{z_1}{z_2}$

$r_1 = \frac{1}{2}r_1 = \frac{a_0}{2}$

17.(a) The diode is reverse biased. So, offer infinite resistance, thus current is zero.

18.(a) P.Q.N (n) = 1 then $l = 0$ always.

19.(c)

$:N \equiv N:$

6 electrons

20.(a) Among lowest possible oxidation number less electronegative is more powerful reducing agent.

S^{--} lowest & less electronegative

21.(b)

$$\underset{\text{Acid}}{HS^-} \xrightarrow[\text{(give)}]{-H^+} \underset{\text{C. base}}{S^{--}}$$

22.(b) F > O > N > C

or

F > N < O > C

23.(a) Nascent hydrogen is atom with excess of energy.

24.(d) $4NH_3 + SO_2 \xrightarrow[800°C]{Pt} 4NO + 6H_2O$

25.(a) Gangue + flux $\longrightarrow$ slag

(Infusible mass) (Fusible mass)

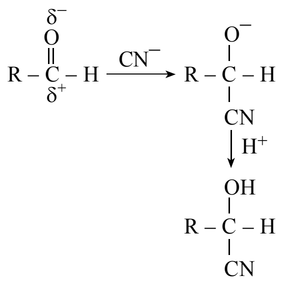
26.(c) $NH_3 + H_2O + CO_2 \rightarrow NH_4HCO_3$

$NH_4HCO_3 + NaCl \rightarrow \boxed{NaHCO_3 + NH_4Cl}$

$NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

$NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + H_2O + NH_3$

27.(a)



Cyarrohydrin

28.(c)

29.(b) $5 \le x \le 8$
$\Rightarrow$ $5 \le x$ and $x \le 8$
$\Rightarrow$ $0 \le (x - 5)$ and $(x - 8) \le 0$
$\Rightarrow$ $(x - 5)(x - 8) \le 0$

30.(c) $A \subset B \Rightarrow A \cup B = B$
$\therefore$ $n(A \cup B) = n(B) = 6$

31.(d) Here, $A = \begin{pmatrix} 3 & 2 \\ -1 & 6 \end{pmatrix}$
$|A| = \begin{vmatrix} 3 & 2 \\ -1 & 6 \end{vmatrix} = 18 + 2 = 20$
$\therefore$ $\text{Adj}(A) = \begin{pmatrix} 6 & -2 \\ 1 & 3 \end{pmatrix}$
$\therefore$ $A^{-1} = \dfrac{\text{adj}(A)}{|A|} = \dfrac{1}{20}\begin{pmatrix} 6 & -2 \\ 1 & 3 \end{pmatrix}$

32.(b) $f(-x) = \sqrt{1 - x + x^2} - \sqrt{1 + x + x^2}$
$= -[\sqrt{1 + x + x^2} - \sqrt{1 - x + x^2}]$
$= -f(x)$
$\therefore$ $f(-x) = -f(x)$ odd function.

33.(c) Here, $\sin 2\theta = 0 \Rightarrow \sin 2\theta = \sin n\pi$
$\Rightarrow$ $2\theta = n\pi$
$\therefore$ $\theta = \dfrac{n\pi}{2}$

34.(b) Let $\tan^{-1}x = \theta$
$\Rightarrow$ $x = \tan\theta$
$\therefore$ $\cos(\tan^{-1}x) = \cos\theta$
$= \dfrac{1}{\sqrt{1 + x^2}}$

35.(a) $\lim\limits_{x \to -1} \dfrac{\sqrt{\cos^{-1}x}}{\sqrt{x + 1}} = \dfrac{\sqrt{\cos^{-1}(-1)}}{\sqrt{-1 + 1}} = \dfrac{\sqrt{\pi}}{0} = \infty$

36.(c) $y = \tan^{-1}\left(\dfrac{\sin x}{1 + \cos x}\right)$
$= \tan^{-1}\left(\dfrac{2\sin\frac{x}{2}\cos\frac{x}{2}}{2\cos^2\frac{x}{2}}\right) = \tan^{-1}\left(\tan\frac{x}{2}\right) = \dfrac{x}{2}$
$\therefore$ $\dfrac{dy}{dx} = \dfrac{1}{2}$

37.(a) $f(x) = 2 - 3x$
diff. w.r.t. 'x'
$f'(x) = -3 < 0$ (decreasing)

38.(a) $\int e^{-\log x}\,dx = \int e^{\log(1/x)}\,dx = \int \frac{1}{x}\,dx$
$= \log|x| + c$

39.(d) Area $= \int_1^3 y\,dx = \int_1^3 3x^2\,dx$
$= \left[\dfrac{3x^3}{3}\right]_1^3$
$= 3^3 - 1^3$
$= 26$ sq. unit

40.(d) There are 8 different letters which can be arranged in P(8, 8) ways.

41.(a) Here, $n = 12$
$\therefore$ $n + 1 = 12 + 1$ (odd), one middle term
$\therefore$ Middle term $= t_{12/2 + 1}$
$= t_{6+1}$
$= c(12, 6)\left(\dfrac{a}{x}\right)^6.(6x)^6$
$= {}^{12}c_6\, a^6\, b^6$

42.(a) $\dfrac{1}{1.2} + \dfrac{1}{3.4} + \dfrac{1}{5.6} + \ldots$
$= \dfrac{1}{1} - \dfrac{1}{2} + \dfrac{1}{3} - \dfrac{1}{4} + \dfrac{1}{5} - \dfrac{1}{6} + \ldots$
$= ln(1 + 1)$
$= ln(2)$

43.(c) $i = \cos\frac{\pi}{2} + i\sin\frac{\pi}{2}$
$= e^{i\pi/2}$

44.(b) Since two roots are common then
$\dfrac{3}{a} = \dfrac{7}{b} = \dfrac{2}{4} \Rightarrow \dfrac{3}{a} = \dfrac{2}{4}$ and $\dfrac{7}{b} = \dfrac{2}{4}$
$\Rightarrow$ $a = 6$ and $b = 14$

45.(b) Here, $t_n = n^2$
$\therefore$ $S_n = \Sigma t_n = \Sigma n^2$
$= \dfrac{n(n + 1)(2n + 1)}{6}$

46.(c) Here, $A^2 - A + I = 0$
Taking A^{-1} on both sides
$A - I + A^{-1} = 0$
$\therefore$ $A^{-1} = I - A$

47.(d) Distance between the parallel lines $3x + 4y + 5 = 0$ and $3x + 4y + 15 = 0$ is $\left|\dfrac{5 - 15}{\sqrt{3^2 + 4^2}}\right| = \dfrac{10}{5} = 2$, which is the length of sides of the square. So its area $= 2^2 = 4$ sq. unit

48.(b) $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$
Squaring, $(\vec{a} + \vec{b})^2 = (\vec{a} - \vec{b})^2$
$\Rightarrow$ $a^2 + b^2 + 2\vec{a}.\vec{b} = a^2 + b^2 - 2\vec{a}.\vec{b}$
$4\vec{a}.\vec{b} = 0$
$\vec{a}.\vec{b} = 0$ (Perpendicular)

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

Section – II

61.(d) $\alpha = 5\ m/s^2,\ \beta = 10ms^{-2}$

$$t = \sqrt{\frac{2(X_1 + X_2)(\alpha + \beta)}{\alpha\beta}}$$
$$= \sqrt{\frac{2 \times 1.5 \times 1000 \times 15}{5 \times 10}}$$
$$= \sqrt{900} = 30\ \text{sec}$$

62.(c) $p = mgh$

$$\frac{50}{100} \times p = \frac{v\rho gh}{60}$$
$$\frac{1}{2}p = \frac{0.5\times1000\times10\times30}{60} \Rightarrow p = 5000W$$

63.(a) $P_0 = \frac{nm}{3v}c^2$

$$\text{then, } P = \frac{n(\frac{m}{2})}{3v}(2c)^2 = 2\left(\frac{nm}{3v}c^2\right) = 2P_0$$

64.(d) For adiabatic process,

$T^{\gamma}\ P^{1-\gamma}$ = constant

$P^{\gamma-1} \propto T^{\gamma}$

$P \propto T^{\gamma/\gamma-1}$

By question, $P \propto T^3$

$$\frac{\gamma}{\gamma-1} = 3 \Rightarrow \gamma = \frac{3}{2}$$

65.(b) $V = \sqrt{\frac{T}{\mu}}$

$$\frac{\omega}{k} = \sqrt{\frac{T}{\mu}}$$
$$\frac{200}{5} = \sqrt{\frac{T}{10^{-2}}}$$

$T = 16\ N$

66.(a) $W = q(v_i - v_f)$

$= -1(-1000 - 1000) = +2000\ J$

67.(a) $R = \frac{v_0^2}{P_0} = \frac{6^2}{6} = 6\Omega$

$$I = \frac{\text{Total emf}}{\text{Total resistance}} = \frac{6}{6+1} = \frac{6}{7}A$$
$$P = I^2R = \left(\frac{6}{7}\right)^2 6 = \frac{216}{49}W$$

68.(c) $I_g = \frac{10}{100}I \Rightarrow I_g = \frac{I}{10}$

$$\frac{I}{I_g} = 10 = n$$
$$S = \frac{G}{n-1} = \frac{90}{10-1} = 10\Omega$$

69.(a) $\frac{B_2}{B_1} = n^2 = \left(\frac{4}{2}\right)^2 = 4 : 1$

70.(a) $E = E_0\sin\omega t$

$$= E_0\sin2\pi ft = 120 \times \sqrt{2}\sin2\pi \times 60 \times \frac{1}{720}$$
$$= 120\sqrt{2}\sin\frac{\pi}{6} = 60\sqrt{2} = 84.8V$$

71.(d) $\frac{v}{u} = m \Rightarrow v = mu$

Using lens formula

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$
$$\frac{1}{u} + \frac{1}{nu} = \frac{1}{f}$$
$$\frac{1}{u}\left(\frac{n+1}{n}\right) = \frac{1}{f}$$
$$u = \left(\frac{n+1}{n}\right)f$$

72.(b) $\lambda_p = \lambda_\alpha$

$$\frac{h}{\sqrt{2m_p.q_p.V_p}} = \frac{h}{\sqrt{2m_\alpha q_\alpha V_\alpha}}$$

$m_p.q_p.V_p = m_\alpha q_\alpha V_\alpha$

$m_p(e)\ V_p = (4m_p)\ 2e\ V_\alpha$

$$V_\alpha = \frac{V}{8}$$

73.(a) $f_{max} = \frac{eV}{h} = \frac{1.6 \times 10^{-18} \times 120 \times 10^3}{6.6\times10^{-34}}$

$= 2.9 \times 10^{19}\ Hz$

74.(d) Undisintegrated part $= 1 - \frac{3}{4} = \frac{1}{4}$

$$\frac{m}{m_0} = \left(\frac{1}{2}\right)^n$$
$$\left(\frac{1}{2}\right)^n = \frac{1}{4} = \left(\frac{1}{2}\right)^2 \Rightarrow n = 2$$

Time taken for 2 half life $= n \times T_{1/2}$

$= 2\times30 = 60$ days

75.(a) $\overset{\substack{+4\\+2\times2}}{2Na_2S_2O_3} \longrightarrow \overset{\substack{+5\\+2.5\times2}}{Na_2S_4O_6}$

Change in O.N. = 1 (per mole)

$$\text{eq. wt} = \frac{M}{1} = M$$

76.(d) 5F deposite 5gm eq.

So, 5 × 9 = 45 gm

77.(b) $m = \frac{w \times 100}{M \times \text{wt of solvent}}$

$$\% = \frac{\text{molarity} \times \text{mol. wt}}{10} = 16\%$$
$$= \frac{16 \times 1000}{40 \times 84} = 4.76\ m$$

78.(d) $S_{Ag^+} = \frac{K_{sp}}{Cl^-\ \text{(from strong)}} = \frac{1 \times 10^{-10}}{0.1} = 1 \times 10^{-4}$

79.(a) $CH_3CH_2OH + RMgX \longrightarrow \underbrace{R - H}_{\textbf{Alkane}} + Mg\begin{matrix}X\\OCH_2CH_3\end{matrix}$

(Alcohol contains acidic hydrogen)

80.(b) $Cl^- + AgNO_3 \longrightarrow AgCl\downarrow$

$AgCl + NH_4OH \longrightarrow Ag(NH_3)_2Cl$

$Ag(NH_3)_2Cl + HNO_3 \longrightarrow AgCl + (NH_4)_2NO_3$

ppt reappear

81.(d)

82.(c) $\cos\theta = \dfrac{2.1 - 1.1 + 1.2}{\sqrt{2^2 + (-1)^2 + 1}\sqrt{1^2 + 1^2 + 2^2}}$

$= \dfrac{2 - 1 + 2}{\sqrt{6}.\sqrt{6}} = \dfrac{3}{6} = \dfrac{1}{2}$

$\therefore \quad \theta = 60°$

83.(c) The circle meets the x-axis
So, put y = 0
$x^2 + 0 - 3x - 0 + 2 = 0$
$\Rightarrow \quad x^2 - 3x + 2 = 0$
$\Rightarrow \quad (x - 1)(x - 2) = 0$
$\therefore \quad x = 1, 2$
So, points are (1, 0) (2, 0)

84.(a) For domain, $D(f) \geq 0$
Here, $x^2 - 3x + 2 > 0$
$\Rightarrow \quad (x - 2)(x - 1) > 0$
This is true for
$x < 1$ or $2 < x$
$\therefore \quad x \in (-\infty, 1) \cup (2, \infty)$

85.(d) a, b, c are in H.P.
$\Rightarrow \quad b = \dfrac{2ac}{a + c}$

Now, $\dfrac{a + b}{b - a} + \dfrac{b + c}{b - c}$

$= \dfrac{ab - ac + b^2 - bc + b^2 - ab - ac + bc}{b^2 - b(a + c) + ac}$

$= \dfrac{2b^2 - 2ac}{b^2 - b.\dfrac{2ac}{b} + ac}$

$= \dfrac{2(b^2 - ac)}{(b^2 - ac)}$

$= 2$

86.(b) Here $2b = 8 \Rightarrow b = 4$ and $e = \dfrac{\sqrt{5}}{3}$

$\therefore \quad b^2 = a^2(1 - e^2)$

$\Rightarrow \quad 4^2 = a^2\left(1 - \dfrac{5}{9}\right)$

$\Rightarrow \quad 16 \times 9 = 4a^2$

$a^2 = 36 \qquad \therefore \quad a = 6$

$\therefore$ Length of major axis = 2a = 12

87.(a) $\dfrac{d(\sin^{-1}x)}{d(\cos^{-1}x)} = \dfrac{\dfrac{d}{dx}(\sin^{-1}x)}{\dfrac{d}{dx}(\cos^{-1}x)} = \dfrac{\dfrac{1}{\sqrt{1 - x^2}}}{\dfrac{-1}{\sqrt{1 - x^2}}} = -1$

88.(c) $\lim\limits_{x \to 0}\left[\dfrac{1 + px}{1 + qx}\right]^{1/x} = e^{p-q}$

$\therefore \quad \lim\limits_{x \to 0}\left(\dfrac{1 + 2x}{1 - x}\right)^{1/x} = e^{2+1} = e^3$

89.(b) $\displaystyle\int_0^a \frac{dx}{a^2 + x^2} = \frac{1}{a}\left[\tan^{-1}\frac{x}{a}\right]_0^a$

$= \dfrac{1}{a}[\tan^{-1}1 - \tan^{-1}0]$

$= \dfrac{1}{a}\left[\dfrac{\pi}{4} - 0\right] = \dfrac{\pi}{4a}$

90.(a) $f(x) = 2x^3 - 6x^2 + 5$
$f'(x) = 6x^2 - 12x$
$f''(x) = 12x - 12$
Point of inflection,
$f''(x) = 0 \Rightarrow 12x - 12 = 0 \Rightarrow x = 1$
For $x > 1$, $f''(x) > 0$ (concave upward)
$x < 1$, $f''(x) < 0$ (concave downward)

91.(c) Let $\alpha = 2 + \sqrt{3}$ and $\beta = 2 - \sqrt{3}$ (Conjugate of α)
then equation is $x^2 - (\alpha + \beta)x + \alpha\beta = 0$
$\Rightarrow \quad x^2 - 4x + 1 = 0$

92.(c) The direction cosine of AB are
$\dfrac{x_2 - x_1}{|AB|}, \dfrac{y_2 - y_1}{|AB|}, \dfrac{z_2 - z_1}{|AB|}$

$-\dfrac{1}{3}, \dfrac{2}{3}, -\dfrac{2}{3}$

93.(a) $r_1 > r_2 > r_3$

$\Rightarrow \quad \dfrac{\Delta}{s - a} > \dfrac{\Delta}{s - b} > \dfrac{\Delta}{s - c}$

$\Rightarrow \quad \dfrac{s - a}{\Delta} < \dfrac{s - b}{\Delta} < \dfrac{s - c}{\Delta}$

$\Rightarrow \quad s - a < s - b < s - c$
$\Rightarrow \quad -a < -b < -c$
$\Rightarrow \quad a > b > c$

94.(c) Here, $\vec{i} + 2\vec{j} + 3\vec{k} = (1, 2, 3)$
$3\vec{i} + \lambda\vec{j} + 2\vec{k} = (3, \lambda, 2) - 2\vec{i} + 3\vec{j} + \vec{k} = (-2, 3, 1)$
Since, (1, 2, 3) is parallel with $(3, \lambda, 2) + (-2, 3, 1) = (1, \lambda + 3, 3)$

So, $\dfrac{1}{1} = \dfrac{1}{\lambda + 3} = \dfrac{3}{3}$

$\therefore \quad \dfrac{2}{\lambda + 3} = 1$

$\Rightarrow \quad 2 = \lambda + 3 \quad \therefore \lambda = -1$

95.(c) For no solution determinant = 0

$\Rightarrow \quad \begin{vmatrix} \alpha & 3 \\ 1 & 2 \end{vmatrix} = 0$

$\Rightarrow \quad 2\alpha - 3 = 0$

$\alpha = \dfrac{3}{2}$

96.(b) $(0, 1)^{35} = (0 + i)^{35}$
$= i^{35} = (i^2)^{17}.i = (-1)^{17}.i = -i$

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

…The End…