Section – I

1.(b) We have, $f = \frac{1}{2\pi\sqrt{LC}}$

$LC = \frac{1}{4\pi^2 f^2} = [T^2]$

2.(a) Unit vector $(\hat{n}) = \frac{\vec{A} \times \vec{B}}{|\vec{A} \times \vec{B}|}$

$= \frac{8\hat{i} - 8\hat{j} - 8\hat{k}}{8\sqrt{3}}$

$= \frac{1}{\sqrt{3}}(\hat{i} - \hat{j} - \hat{k})$

3.(b) When ice melts level of waster is same. But due to decrease in temp. to 4°C, volume decreases because density is maximum at 4°C.

4.(b) $m = V\rho$ during winter density is more so mass increases.

As $\theta\downarrow$, $m\uparrow$

5.(a) Vessel being filled with water behaves as closed organ pipe. As more and more water is filled, l decreases and frequency increases $\left(f = \frac{v}{4l}\right)$

6.(d) Use right hand palm rule.

7.(d) In equpotential surface, $\Delta V = 0$

$W = q\Delta V = 0$ and varies with potential

8.(c) $R = \frac{me^4}{8\varepsilon_0^2 h^3 c}$

As 'm' is reduced to half, R also become half.

9.(a) $P = \rho gh$

or, $h \propto g^{-1}$

or, $\frac{\Delta h}{h} = -\frac{\Delta g}{g} = -(2)\% = +2\%$

10.(a) $\frac{KE_r}{KE_T} = \frac{\frac{1}{2} mk^2 \times \frac{v^2}{r^2}}{\frac{1}{2} mv^2 \left(\frac{k^2}{r^2} + 1\right)} = \frac{k^2}{k^2 + r^2} = \frac{\frac{2}{5}}{\frac{2}{5} + 1} = \frac{2}{7}$

11.(d) Sound is mechanical wave and needs material medium to propagate.

12.(d) Electric field strength is zero inside a hollow sphere.

13.(d) $\delta = 180° - 2i$

$= 180° - 2 \times 30° = 120°$

14.(b) In TV wave frequency is modulated.

15.(a) $R - C \equiv N$ has tendency to donate as well as accept lone pair electrons. $AlCl_3$ has a vacant p-orbital so it can accept a pair of electrons.ROH and R_2NH are nucleophiles because of having lone pair electrons.

16.(a) sp hybridized carbon is acidic in nature due to having 50% s- character.

17.(c) Na_2SO_4 is salt of strong acid (i.e.H_2SO_4) & strong base (i.e.NaOH) when a neutral salt & a base is mixed to make a solution then solution become basic i.e.pH > 7

18.(a)

19.(a) For n=1, l=0 which is inconsistent in option (a)

20.(a) Weight of nitrogen = 0.2 × 14 = 2.8g

Weight of carbon = $12\times3\times10^{23}/6 \times 10^{23}$ = 6 g

Weight of Sulphur = 1×32 = 32 g

∴ Weight of silver = 7 g

21.(d) Size of anion > size of cation& size of cation or anion ↑s down the group

22.(d) Generally, for a compound acidity ↑s as its central ion's oxidation state increases

Here, oxidation no of nitrogen increases as follows:

$NH_3 < N_2H_4 < N_2H_2 < N_3H$

So, property of compound vary from basic (NH_3) to acidic(N_3H)

23.(c) Mohr's salt is double salt

24.(d) Pt., Rh is used as catalyst in Ostwald's process

25.(a)

26.(c)

27.(d)

28.(c)

29.(d) $p \Rightarrow q$ is equivalent to $\sim q \Rightarrow \sim p$.

30.(b)

31.(b) $4\sin^{-1}x + \cos^{-1}x = \pi$

or, $3\sin^{-1}x + \sin^{-1}x + \cos^{-1}x = \pi$

or, $3\sin^{-1}x + \frac{\pi}{2} = \pi$

or, $\sin^{-1}x = \frac{\pi}{6}$

∴ $x = \sin\frac{\pi}{6} = \frac{1}{2}$

32.(a) From sine law, $\frac{a}{\sin A} = \frac{b}{\sin B}$

$\frac{6\sqrt{2}}{\sin 30°} = \frac{b}{\sin 45°}$ ∴ $b = 12$

33.(b) Total no. of ways = ${}^5c_1 + {}^5c_2 + {}^5c_3 = 25$

34.(b) $\log_e(1 - 2x)$ is valid if $-1 \le 2x < 1$

$\Rightarrow -\frac{1}{2} \le x < \frac{1}{2}$

35.(c) $1 + 2 + ... + n = 55 \Rightarrow \frac{n(n+1)}{2} = 55$

$1^3 + 2^3 + ... + n^3 = \left(\frac{n(n+1)}{2}\right)^2 = 55^2 = 3025$

36.(a) $A^2 = I$

$\begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

or, $\begin{bmatrix} x^2+1 & x \\ x & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\Rightarrow \quad x^2 + 1 = 1 \Rightarrow x = 0$

37.(c) $\lim_{x \to 1} 2x = 2, \lim_{x \to 1} x^3 + 1 = 1 + 1 = 2$

By squeeze theorem, $\lim_{x \to 1} f(x) = 2$

38.(c) By continuity, $f(0) = \lim_{x \to 0} \frac{2x - \sin^{-1}x}{2x + \tan^{-1}x}$

$= \lim_{x \to 0} \frac{2 - \frac{\sin^{-1}x}{x}}{2 + \frac{\tan^{-1}x}{x}} = \frac{2-1}{2+1} = \frac{1}{3}$

39.(d) $f'(x) = e^x g'(x) + g(x)\, e^x$ [Product rule]

$\therefore \quad f'(0) = g'(0) + g(0) = 1 + 2 = 3$

40.(d) $\int \frac{dx}{1 - \cos x} = \int \frac{dx}{2\sin^2\frac{x}{2}} = \frac{1}{2}\int \text{cosec}^2\frac{x}{2}\, dx$

$= \frac{1}{2}\left(-\frac{\cot\frac{x}{2}}{\frac{1}{2}}\right) + c = -\cot\frac{x}{2} + c$

41.(d) Solving $\frac{x^2}{2} + \frac{y^2}{2} = c$

$x^2 + y^2 = 2c$ (Family of concentric circles)

42.(a) $\begin{vmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ -1 & 0 & -1 \end{vmatrix} = -\begin{vmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 0 & 1 \end{vmatrix}$

$= 0\ [\because R_2 = R_3]$

43.(c) $(\vec{a} \times \vec{b})^2 = (|\vec{a}|\,|\vec{b}|\,\sin\theta)^2$

$= (4.2 \sin 30^\circ)^2 = \left(8.\frac{1}{2}\right)^2 = 16$

44.(c) For horizontal line, slope = 0

i.e. $-\frac{(2-k)}{-3+k} = 0$

$\therefore \quad k = 2$

45.(b) For circle, coeff. of x^2 = coeff. of y^2

i.e. $\frac{k}{3} = \frac{1}{4}$

$\therefore \quad k = \frac{3}{4}$

46.(d)

47.(c) We have, $l^2 + m^2 + n^2 = 1$

$\therefore \quad \frac{1}{c^2} + \frac{1}{c^2} + \frac{1}{c^2} = 1$

$c^2 = 3 \Rightarrow c = \pm\sqrt{3}$

48.(d) Arithmetic mean $= \frac{1 + 2 + 3 + ...\, n}{n}$

$= \frac{1}{n}\,\frac{n(n+1)}{2} = \frac{n+1}{2}$

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

Section – II

61.(d) $V = nV_e = 2V_e \quad \therefore \quad n = 2$

Velocity in free space (V) $= \sqrt{n^2 - 1}\, V_e$

$= \sqrt{2^2 - 1}\, V_e$

$= \sqrt{3}\, V_e$

62.(a) $\frac{x}{L} = \frac{\mu}{\mu + 1} \times 100\%$

$= \frac{0.25}{0.25 + 1} \times 100\% = 20\%$

63.(d) $u\cos\theta = \frac{u}{2} \Rightarrow \theta = 60^\circ$

$R = \frac{u^2 \sin 2 \times 60^\circ}{g} = \frac{\sqrt{3}}{2}\,\frac{u^2}{g}$

64.(c) $Q = ms\Delta\theta = \rho V s\Delta\theta$

$= \rho.\left(\frac{4}{3}\pi r^3\right) s\Delta\theta$

$Q \propto r^3$

65.(d) As beaker appears half-filled, apparent height of water = height of air column

$= 21 - h$

Where h = actual height of water filled in beaker.

$\mu = \frac{RD}{AD} = \frac{h}{21 - h}$

$\frac{4}{3} = \frac{h}{21 - h}$

h = 12 cm

66.(d) $\frac{1}{f} = \frac{1}{D} - \frac{1}{d} = \frac{1}{25} - \frac{1}{30} = \frac{1}{150}$

f = 150 cm

$P = \frac{100}{f} = \frac{100}{150} = +\frac{2}{3}$ D

67.(b) $L = 10\log_{10}\left(\frac{I}{I_0}\right)$

$100 = 10\log_{10}\left(\frac{I}{10^{-12}}\right)$

$I = 10^{-2}$

$P = IA = 10^{-2} \times 0.5 \times 2 = 10^{-2}$ W

68.(c) Length of diagonal of cube = $\sqrt{3}b$ distance of each charge from the centre = $\frac{d}{2} = \frac{\sqrt{3}}{2}b$

∴ Total potential at centre

$(V) = 8.\frac{q}{4\pi\varepsilon_0.\frac{\sqrt{3}}{2}b} = \frac{4q}{\sqrt{3}\,\pi\varepsilon_0 b}$

69.(d) $F = qE = q.\frac{V}{l} = e\frac{V}{l}$

$V = \frac{Fl}{e} = \frac{4.8 \times 10^{-19} \times 5}{1.6 \times 10^{-19}} = 15$ volt

70.(a) $\varepsilon = \left|L\frac{dI}{dt}\right| = \frac{40 \times 10^{-3}\,(11-1)}{4 \times 10^{-3}} = 100$ V

71.(b) $I = I_0e^{-\mu x}$

$\frac{I_0}{2} = I_0e^{-\mu x}$

$e^{\mu x} = 2$

$\mu x = 0.693$

$\mu = \frac{0.693}{x} = \frac{0.693}{2.303\text{ mm}} = 0.3$

72.(b) No. of half lives $(n) = \frac{t}{T_{1/2}} = \frac{6400}{800} = 8$

$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^8$

Fraction that have been decayed $= 1 - \frac{N}{N_0}$

$= 1 - \frac{1}{256} = \frac{255}{256}$

73.(a) Some ejected photoelectrons don't have K.E. so minimum K.E. is 0 eV.

74.(b) In the organic species having unipositive charge, 1, 2, 3, 4, and 5 carbons represent 1, 1, 2, 4 and 8 isomers respectively.

75.(a) It is also known as (4+2) cycloaddition reaction.

76.(c) $Al^{3+} + 3e^- \rightarrow Al$, E_{Al}= At.Wt/3

$Cu^{2+} + 2e^- \rightarrow Cu$, E_{cu}= At.Wt/2

$Na^+ + e^- \rightarrow Na$; E_{Na}= At.Wt/1

When 3 "Faraday is passed;

Mole atom of Al deposited =1

Mole atom of Na deposited = 1 × 3/2 = 1.5

Mole atom of Na deposited = 1 × 3 = 3

77.(c) The balanced equation is

$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$

78.(d)

79.(d) A + 2B ⟶ AB_2

1 mole 2 mole 1 mole

2 mole 4 mole

So, B is limiting reactant thus 1 mole

80.(b) pH = 5 & diluted to 100 times then new conc^n is 10^{-5} N

So, 10^{-7}N H^+ ion is also consider from H_2O

Thus final conc^n is 2×10^{-7}N

Hence pH = 6.7

81.(d)

82.(b) Here, $f(x) = \frac{1}{\sqrt{|x| - x}}$

∴ f(x) is defined when $|x| - x > 0$

i.e. $|x| > x$

It is possible if $x < 0$

∴ $x \in (-\infty, 0)$

83.(c) $\frac{1}{ab} + \frac{1}{bc} + \frac{1}{ca}$

$= \frac{c + a + b}{abc}$

$= \frac{2s}{4R\Delta}$ $\left[\because R = \frac{abc}{4\Delta}\right]$

$= \frac{1}{2R.\frac{\Delta}{s}}$

$= \frac{1}{2Rr}\left[\because r = \frac{\Delta}{s}\right]$

84.(a) $\vec{a} + \vec{b} + \vec{c} = 0$

Squaring,

$|\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 - 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

or, $2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = -(9 + 16 + 25)$

∴ $\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = -25$

85.(d) $|x|^2 - |x| - 6 = 0$

$(|x| - 3)(|x| + 2) = 0$

Either, $|x| = 3 \Rightarrow x = \pm 3$

or, $|x| = -2$ (no real roots)

Product = 3 × (–3) = –9

86.(d) $\frac{(4 + 3i)^3}{i - 1} = \frac{161}{2} - \frac{73}{2}i$ i.e. 4th quadrant

87.(d) |adj. A| = |C|

or, $|A|^{3-1} = |C|$

or, $4^2 = \begin{vmatrix} 1 & k & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{vmatrix}$

or, 16 = 2k – 6 (By expanding determinant)

∴ k = 11

88.(b) Number of rectangles $= {}^{10}C_4 - {}^{4}C_4 - {}^{4}C_3 \times {}^{6}C_1$

$= 210 - 1 - 24 = 185$

89.(c) $\lim_{x \to 0} \frac{x - \sin x}{x^3} \left[\frac{0}{0} \text{ form}\right]$

Using L Hospital's rule

$\lim_{x \to 0} \frac{1 - \cos x}{3x^2} \left[\frac{0}{0} \text{ form}\right]$

$= \lim_{x \to 0} \frac{\sin x}{6x} \left[\frac{0}{0} \text{ form}\right] = \lim_{x \to 0} \frac{\cos x}{6} = \frac{1}{6}$

90.(a) Total no. of cases $= {}^{40}C_2 = 780$

Sum of two integers is odd if one of them is odd and other is even.

No. of favourable cases $= {}^{20}C_1 \times {}^{20}C_1 = 400$

Required probability $= \frac{400}{780} = \frac{20}{39}$

91.(b) $\frac{dy}{dx} = \frac{1}{1 + x^3}$

$\left(\frac{dy}{dx}\right)_{x=1} = \frac{1}{1 + 1^3} = \frac{1}{2}$

92.(a) $\frac{dy}{dx} - \frac{t}{1 + t} y = \frac{1}{1 + t}$

Which is a linear diff. eq^n. with

I.F. $= (t + 1)\, e^{-t}$

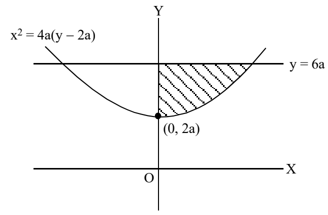
$y(1 + t)\, e^{-t} = \int \frac{1}{1 + t} (1 + t)\, e^{-t}\, dt$

$y(1 + t)\, e^{-t} = -e^{-t} + c$

When $t = 0$, $y = -1$, So, $-1 = -1 + c \Rightarrow c = 0$

When $t = 1$, $y.2.e^{-1} = -e^{-1} \Rightarrow y = -\frac{1}{2}$

93.(c)



$A = \int_{2a}^{6a} x\,dy$

$= \int_{2a}^{6a} 2\sqrt{a}\,\sqrt{y - 2a}\, dy$

$= 2\sqrt{a} \left[\frac{(y - 2a)^{3/2}}{\frac{3}{2}}\right]_{2a}^{6a} = \frac{32a^2}{3}$ sq. units

94.(a) $h = 1$, $k = -2$

$a^2 = 4$, $b^2 = 9$

Vertices $= (h \pm a, k)$

$= (1 \pm 2, -2)$

$= (3, -2)$ & $(-1, -2)$

95.(a) D.r's of OP $= (a - 0, b - 0, c - 0)$

$= (a, b, c)$

Eq^n of plane through P(a, b, c) is

$A(x - a) + B(y - b) + C(z - c) = 0$ ....(i)

Since (i) is $\perp^r$ to OP, $\frac{A}{a} = \frac{B}{b} = \frac{C}{c} = k$ (suppose)

$\therefore$ $A = ak$, $B = bk$, $C = ck$

Using in (i), $a(x - a) + b(y - b) + c(z - c) = 0$

$ax + by + cz - a^2 - b^2 - c^2 = 0$

96.(d) $x^2 - 4x - 8y + 12 = 0$

i.e. $(x - 2)^2 = 8(y - 1)$

Comparing with $(x - h)^2 = 4a(y - k)$, $4a = 8$

Length of latus rectum $= 4a = 8$

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

…The End…