Section – I

1.(b) $g \propto \frac{1}{R^2}$

2.(c) Braking stress = $\frac{F}{A}$

Load = F = breaking stress × A

3.(c) $Q = mS\Delta\theta$

$\delta = \frac{Q}{M\Delta\theta} = \infty$

4.(a) $\frac{C}{100} = \frac{F-32}{180} \Rightarrow \frac{\Delta C}{5} = \frac{\Delta F}{9}$

$\therefore \quad \Delta F = \frac{9}{5} \times 25 = 45°F$

5.(d)

6.(d) Longitudinal wave

7.(a) Heating element high resistance high M.P.

8.(a) $V = \frac{Q}{4\pi\varepsilon_0 r}$

$V \propto \frac{1}{r}$

9.(d) $\lambda = \frac{h}{p} = \frac{h}{mv}$

10.(c) Reverse voltage is added to barrier potential.

11.(a)

12.(b)

13.(a) In series $P \propto R$, $R_{60} > R_{100}$

14.(d)

15.(a) $T = \frac{1}{2\pi}\sqrt{\frac{l}{g}} = \frac{1}{2\pi}\sqrt{\frac{l}{0}} = \infty$

So $f = \frac{1}{T} = 0$

16.(b)

17.(a)

18.(c) 10 % w/v means 10 gm in 100 cc solution

Eq. wt of CH_3COOH = 60

$\therefore \quad$ Normality = $\frac{10 \times 1000}{60 \times 100} = 1.7$ N

19.(d) Half filled orbitals of N atom are more stable due to higher value of maximum multiplicity.

20.(d) Borazole ($B_3N_3H_6$) is inorganic benzene due to similarity in its structure.

21.(d) $CuCl + CO \rightarrow CuCl.CO$

22.(c) NH_4Cl sublimes and decomposes partially to smell NH_3.

23.(a) It is known as potash alum and found in the name of 'Fitkiri'

24.(c) Carbon monoxide has one σ-bond and 2π-bonds.

25.(d) Isoelectronic species have same number of electrons.

26.(d) Electron withdrawing groups shows –I effect and hence increases the acidic strength.

27.(c) -M group must have π bonds.

28.(d) The atoms of aromatic species must be sp^2 hybridized.

29.(d) $y^2 = 16$

$y = \pm 4$ and $2y = 6$

$y = 3$

There is no common value of y.

30.(b)

31.(b) $f(y) = \sec[\log(y^2 + \sqrt{1+y^2})]$

= sec (even function)

= even function

32.(c) $f(y) = \frac{[(y+1)(y-2)(y-3)]^{\frac{1}{2}}}{(y-2)}$

Since $y \neq 2$

f(y) is defined if $(y+1)(y-2)(y-3) \geq 0$

$(y+1)(y-2)(y-3) = 0$

Then y = - 1, 2, 3 f(y) is defined for $-1 \leq y < 2$ or $3 \leq y < \infty$

i.e. The range is $[-1, 2) \cup [3, \infty)$

33.(b) $S_{10} = S_7$

or, $\frac{10}{2}[2a+9d] = \frac{7}{2}[2a+6d]$

$a = -8d$

Now,

$S_{12} = \frac{12}{2}[2a+11d] = \frac{12}{2}[2(-8d)+11d] = -30d$

$S_5 = \frac{5}{2}[2a+4d] = \frac{5}{2}[2(-8d)+4d] = -30d$

34.(c) Let, three numbers in AP are a-d, a and a+d

a-d+a+a+d = 36

a = 12

a-d+1, a+4 and a+d+43 are in GP.

$\frac{a+4}{a-d+1} = \frac{a+d+43}{a+4}$

Put a = 12

$\frac{16}{13-d} = \frac{55+d}{16}$

$d^2 + 12d - 459 = 0$

$(d+51)(d-9) = 0$

When a=12 & d=9,

The numbers are a-d, a, a+d is 3, 12, 21.

When a=12 & d=-51 = 63, 12, 39

35.(b) a,b,c are in AP.

$b = \frac{a+c}{2}$

c = 2b-a

b, c, a are in HP.

$c = \frac{2ab}{a+b}$

ca + cb = 2ab

cb = 2ab-ca = 2ab -(2b-a)

$cb = a^2$. Hence, c,a,b are in GP.

36.(c) No. of ways = $^5C_3 \times ^5C_2 = 100$

37.(c) $\left(a^2 + \frac{1}{a^2} - 2\right)^n = \left(a^2 - 2 + \frac{1}{a^2}\right)^n = \left[\left(a - \frac{1}{a}\right)^2\right]^n$

Total no of terms = 2n+1

Number of terms independent of a = 1

Therefore, Number of terms dependent of a = (2n+1)-1 = 2n

38.(b) $\frac{(1-3y)^2}{(1-2y)} = (1-6y+9y^2)(1-2y)^{-1}$

$= (1-6y+9y^2)(1+2y+(2y)^2+(2y)^3+(2y)^4+\ldots)$

Coefficient of $y^4 = 2^4 - 6.2^3 + 9.2^2 = 4$

39.(b) $1 + \frac{3}{1!} + \frac{5}{2!} + \frac{7}{3!} + \cdots + \infty = \frac{(2n-1)}{(n-1)!}$

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

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

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

Now, taking summation

$\sum_{n=1}^{\infty} t_n = \sum_{n=1}^{\infty} \frac{2}{(n-2)!} + \sum_{n=1}^{\infty} \frac{1}{(n-1)!} = 2e + e = 3e$

40.(c) Let $\alpha = 2 + \sqrt{3}$ and $\beta = 2 - \sqrt{3}$

Then equation is

$x^2 - (\alpha+\beta)x + \alpha\beta = 0 \Rightarrow x^2 - 4x + 1 = 0$

41.(c) Use Hit and trial method.

at x = 1, $x^{\frac{2}{3}} + x^{\frac{1}{3}} - 2 = 1 + 1 - 2 = 0$

at x = - 8, $(-8)^{\frac{2}{3}} + (-8)^{\frac{1}{3}} - 2 = 4 - 2 - 2 = 0$

42.(b) Here, $\sqrt{i} = \frac{1+i}{\sqrt{2}}$ and $\sqrt{-i} = \frac{1-i}{\sqrt{2}}$

$\sqrt{i} + \sqrt{-i} = \left(\frac{1+i}{\sqrt{2}}\right) + \left(\frac{1-i}{\sqrt{2}}\right)$

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

43.(d) Here, $i^{107} + i^{112} + i^{122} + i^{117}$

$= i^{107}(1+i^5+i^{10}+i^{15})$

$= i^{107}(1+i-1-i)$

$= 0$

44.(d)

45.(a) $\begin{vmatrix} 6i & -3i & 1 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x+iy$

Applying $R_1 \longrightarrow R_1 + R_2$

$\begin{vmatrix} 6i+4 & 0 & 0 \\ 4 & 3i & -1 \\ 20 & 3 & i \end{vmatrix} = x+iy$

$(6i+4)(-3+3) = x+iy$

$\Rightarrow 0 = x + iy$

$\Rightarrow x = 0, y = 0$

46.(b) $5x + 7y = 2$, $15x + 21y = \mu$

Here, $\frac{5}{15} = \frac{7}{21} \neq \frac{2}{\mu}$

Hence for no solution i.e Solution $\mu \neq 6$.

47.(a) $\lim_{x\to\infty} \frac{5x^2+7x+20}{6x^3+15x+22} = \lim_{x\to\infty} \frac{5+\frac{7}{x}+\frac{20}{x^2}}{6x+\frac{15}{x}+\frac{22}{x^2}} = 0$

48.(d) $\lim_{k\to0} f(k) = \lim_{k\to0} \frac{1-\cos\beta k}{k\left(\frac{\sin k}{k}\right)k}$

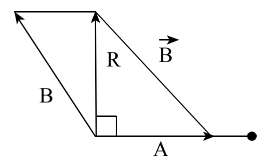
$= \lim_{k\to0} \frac{2\sin^2\frac{\beta k}{2}}{k^2} = 2\lim_{k\to0}\left(\frac{\sin\beta k/2}{\frac{\beta k}{2}}\right)^2 \frac{\beta^2}{4} = \frac{2\beta^2}{4} = \frac{\beta^2}{2}$

$\Rightarrow f(0) = \frac{1}{2} \Rightarrow \lim_{k\to0} f(k) = f(0) \Rightarrow \frac{\beta^2}{2} = \frac{1}{2} \Rightarrow \beta = \pm1$

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

Section – II

61.(a)



A + B = 18

$R^2 = B^2 - A^2$

Check from option

62.(a) wt = upthrust

or, $\frac{4\pi}{3}(R^3 - r^3)\rho g = \frac{4\pi}{3}R^3\sigma g$

or, $\left(\frac{R^3 - r^3}{R^3}\right) = \frac{1}{9}$

or, $1 - \frac{r^3}{R^3} = \frac{1}{9}$

$\frac{r^3}{R^3} = 1 - \frac{1}{9}$

or, $r^3 = \frac{8}{9}R^3$

63.(a) $\Delta PE = mg\frac{l}{2} - mg\frac{l}{2}\cos\theta$

$= mg\frac{l}{2}(1 - \cos\theta)$

= 2J

64.(d) $\cos\theta = \frac{r}{R}$

or, $R = \frac{r}{\cos\theta}$

65.(b) $K_{eq} = \frac{l_{eq}}{R_{eq}.A}$

$= \frac{l + l}{(R_1 + R_2)\,A}$

$= \frac{2l}{\left(\frac{l}{K_1A} + \frac{l}{K_2A}\right)}A = \frac{2K_1K_2}{K_1 + K_2}$

66.(a) f, f – 3, f – 6 …. $\frac{f}{2}$

Now $\frac{f}{2} = f - (28 - 1) \times 3$

or, $f - \frac{f}{2} = 81$

$\Rightarrow$ f = 162 Hz

$f_{15} = f - (15 - 1) \times 3$

= 162 – 42 = 120 Hz

67.(d) $\frac{f}{f'} = \left(\frac{d}{d'}\right) = \frac{0.9}{0.93} = 0.96$

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

= (0.96 – 1) × 100%

= –3.2%

68.(a) For deuteron $eV = \frac{1}{2} 2mv_d^2$

For α-particle $2eV = \frac{1}{2} 4mv_\alpha^2$

$v_\alpha = \sqrt{\frac{eV}{m}}$ & $v_d = \sqrt{\frac{eV}{m}}$

$v_d : v_\alpha = 1:1$

69.(d) $\frac{R_1}{R_2} = \left(\frac{r_2}{r_1}\right)^4 = \left(\frac{2}{1}\right)^4 = 16:1$

70.(a) $t(\mu - 1) = \lambda$

$t(1.5 - 1) = \lambda$

$t = 2\lambda$

71.(a) For 100W, 250V

$I = \frac{100}{250} = \frac{2}{5}$ A = 0.4 A

$R = \frac{V^2}{P} = \frac{250}{100} = 625\ \Omega$

For 2nd 200 W, 250

$I = \frac{200}{250} = 0.8$ A

$R = \frac{V^2}{P} = \frac{250^2}{200} = 312.5$

In line of 500 V

$I = \frac{500}{R_1 + R_2} = \frac{500}{625 + 312.5} = 0.53$ A

∴ 100W bulb will fuse

72.(a) $\frac{B_1}{B_2} = \frac{\mu_0 \frac{l}{2\pi r_1} \times \frac{I_1}{2r_1}}{\mu_0 \frac{l}{2\pi r_2} \frac{I_2}{2r_2}} = \frac{I_1}{I_2} \times \left(\frac{r_2}{r_1}\right)^2$

Current remain same so

$\frac{B_1}{B_2} = \left(\frac{40}{20}\right)^2 = 4:1$

73.(c) $P = \frac{nhf}{t} \Rightarrow \frac{n}{t} = \frac{P}{hf}$

74.(d) $\lambda = 1°$

$E = \frac{hc}{\lambda} = \frac{6.64 \times 10^{-34} \times 3 \times 10^8}{10^{-10}}$

$= 20 \times 10^{-16}$ J

$= 12.45 \times 10^3$ eV

75.(a) $CH_3 - C(CH_3) = CH_2$ is 2-methylpropene.

76.(d) When the substituent -CHO is included in parent chain, it is written as 'oxo'. When carbon atoms of –CN groups are not included in parent chain then carbonitrile can be used for those groups.

77.(d) $[Cl^-]$ due to $CaCl_2 = 0.04 \times 2 = 0.08$ M

Solubility of AgCl = [Ag+]

$= \frac{Ksp}{[Cl^-]} = \frac{4 \times 10^{-10}}{0.08} = 5 \times 10^{-9}$ M

78.(c) N × E.W = gm/lit

% w/v = $\frac{gm/lit}{10}$

79.(a)

80.(b) IE_1 of Mg is greater than Al but lesser than Si.

81.(d) $Cr_2O_7^{--} + 14H^+ + 6e^- \rightarrow 2Cr^{++} + 7H_2O$

82.(c) $y = \log |x|$

$\frac{dy}{dx} = \frac{1}{|x|}\frac{d|x|}{dx} = \frac{1}{|x|}.\frac{x}{|x|}$

$= \frac{x}{|x|^2} = \frac{x}{x^2} = \frac{1}{x}$

83.(a) $f(y) = 2y^3 - 9y^2 + 12y + 20$

$f^1(y) = 6y^2 - 18y + 12$

$f^1(y) = 6(y - 1)(y - 2)$

$f^1(y) = 0, \Rightarrow y = 1$ and $y = 2$

for y = –1 f(y) = –3 √ (minimum)

y = 1 f(y) = 24

y = 2 f(y) = 72

y = 5 f(y) = 105 √ (maximum)

84.(c) $\int \frac{d\theta}{4-5\sin^2\theta} = \int \frac{\sec^2\theta d\theta}{\sec^2\theta\,(4-5\sin^2\theta)}$

$= \int \frac{\sec^2\theta d\theta}{4\sec^2\theta - 5\tan^2\theta}$

$= \int \frac{\sec^2\theta d\theta}{4(1+\tan^2\theta) \quad -5\tan^2\theta}$

$= \int \frac{\sec^2\theta d\theta}{4 - \tan^2\theta}$

$At, \tan\theta = y$

$\sec^2\theta d\theta = dy$

$\int \frac{dy}{4 - y^2} = \frac{1}{2.2}\log\left(\frac{2+y}{2-y}\right) + c$

$= \frac{1}{4}\log\left(\frac{2+\tan\theta}{2-\tan\theta}\right) + c$

85.(a) $A = \int_0^h y dx$

$A = \int_0^h \left(\frac{x^2}{4a} + 2a\right) dx$

$A = \frac{h}{12a}(h^2 + 24a^2)$

86.(b) Bisectors: $\frac{3x + 4y - 11}{\sqrt{9+16}} = \pm \frac{12x - 5y - 2}{\sqrt{144+25}}$

⇒ $3x - 11y + 19 = 0$, $11x + 3y = 17$

If θ be the angle between $3x + 4y = 11$ and $11x + 3y = 17$, then

$\tan\theta = \frac{\frac{-3}{4} + \frac{11}{3}}{1 + \left(\frac{-3}{4}\right)\left(\frac{-11}{3}\right)} = \frac{7}{9} < 1 \Rightarrow \theta < 45^o$

∴ $11x + 3y = 17$ is a acute angle bisector.

87.(b) The slopes will be reciprocals to each other if,

$m_1.m_2 = 1$

i.e. if $\frac{a}{b} = 1 \Rightarrow a = b$

88.(d) Here $f = \frac{1}{2}$, c = -20

y-intercept = $2\sqrt{f^2 - c}$

$= 2\sqrt{\frac{1}{4} + 20} = 9$ unit

89.(b) The equation of tangent to the parabola $y^2 = 4x$ is $y = mx + \frac{1}{m}$

If $y = mx + \frac{1}{m}$ touches the parabola $x^2 = -3^2y$ then $x^2 = -32\left(mx + \frac{1}{m}\right)$

⇒ $mx^2 + 32m^2x + 32 = 0$

Discriminant = 0

⇒ $(32\ m^2)^2 = 4.32.m$

⇒ $8m^3 = 1 \Rightarrow m = \frac{1}{2}$

∴ The required equation of tangent is $y = \frac{1}{2}x + 2$

⇒ $2y - x - 2 = 0$

90.(d) Let a line makes 45^o angles with positive x – axis makes β, β angles with positive y and z axes, then by the relation, $\cos^2 45^o + \cos^2\beta + \cos^2\beta = 1$

$\Rightarrow \left(\frac{1}{\sqrt{2}}\right)^2 + 2\cos^2\beta = 1$

$\Rightarrow 2\cos^2\beta = 1 - ½$

$\Rightarrow \cos^2\beta = \frac{1}{4}$

$\Rightarrow \cos\beta = \frac{1}{2}$

$\therefore \beta = 60^o$

Now, the sum of angles = $45^o + 60^o + 60^o = 165^o$

91.(c) Put $\alpha = \sin^{-1}x$ and $\beta = \sin^{-1}(1 - x)$

$\Rightarrow \sin\alpha = x$ and $\sin\beta = 1 - x$

Now, $\beta = 2\alpha + \frac{\pi}{2} \Rightarrow 2\alpha = \beta - \frac{\pi}{2}$

$\Rightarrow \cos2\alpha = \cos(\beta - \frac{\pi}{2}) = \sin\beta$

$\therefore 1 - 2\sin^2\alpha = \sin\beta$

$\Rightarrow 1 - 2x^2 = 1 - x$

$\Rightarrow x(2x - 1) = 0$

$\Rightarrow x = 0$ or $x = \frac{1}{2}$

$\therefore$ x = 0 only satisfies the equations.

92.(a) Here, sinx – 3sin2x + sin3x = cosx – 3cos2x + cos3x

or, (sinx + sin3x) – 3sin2x = (cosx + cos3x) – 3cos2x

or, 2sin2x.cosx – 3sin2x = 2cos2x.cosx – 3cos2x

or, sin2x(2cosx -3) = cos2x(2cosx -3)

or, sin2x = cos2x

or, tan2x = 1

$\therefore 2x = n\pi + \frac{\pi}{4}$

$x = (4n + 1)\frac{\pi}{8}$

93.(b) $\overrightarrow{OA} = \vec{i} - 2\vec{j} + 3\vec{k}$, $\overrightarrow{OB} = -2\vec{i} + 3\vec{j} - \vec{k}$, $\overrightarrow{OC} = 4\vec{i} - 7\vec{j} + 7\vec{k}$

Then $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = 3\vec{i} + 5\vec{j} + 4\vec{k}$

$\overrightarrow{AC} = \overrightarrow{OC} - \overrightarrow{OA} = 3\vec{i} - 5\vec{j} + 4\vec{k}$

Then the area of Δ ABC = $\frac{1}{2}\overrightarrow{AB} \times \overrightarrow{AC}$

$$= \frac{1}{2}\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -3 & 5 & -4 \\ 3 & -5 & 4 \end{vmatrix} = 0$$

94.(d) $\vec{p}.\vec{\imath} = p_1 \vec{p}.\vec{\jmath} = p_2 \vec{p}.\vec{k} = p_3$

$= (\vec{p}.\vec{\imath})\vec{\imath} + (\vec{p}.\vec{\jmath})\vec{\jmath} + ((\vec{p}.\vec{k})\vec{k}$

$= p_1\vec{\imath} + p_2\vec{\jmath} + p_3\vec{k}$

$= \vec{p}$

95.(a) Here, $\frac{\cos11^o + \sin11^o}{\cos11^o - \sin11^o} = \frac{1 + \tan11^o}{1 - \tan 11^o}$

$= \frac{\tan45^o + \tan11^o}{1 - \tan45^o \tan11^o}$

$= \tan(45^o + 11^o) = \tan 56^o$

96.(a) For the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$,

We have $b^2 = a^2(e^2 - 1)$ ….. (1) and for the conjugate hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

We have $a^2 = b^2((e^l)^2 - 1)$ ….. (2)

Adding (1) and (2)

$$\frac{1}{e^2} + \frac{1}{(e^l)^2} = \frac{1}{\frac{b^2}{a^2} + 1} + \frac{1}{\frac{a^2}{b^2} + 1}$$

$= \frac{a^2}{a^2 + b^2} + \frac{b^2}{a^2 + b^2}$

$= \frac{a^2 + b^2}{a^2 + b^2} = 1$

$\therefore \frac{1}{e^2} + \frac{1}{(e^l)^2} = 1$

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

…Best of Luck…