Section – I

1.(b) $a = -kx$

$v^2 = u^2 - 2kx.x$

or, $v^2 = u^2 - 2kx^2$

$\therefore$ Loss in K.E.$(\Delta KE) = \frac{1}{2}mu^2 - \frac{1}{2}mv^2$

$= \frac{1}{2}mu^2 - \frac{1}{2}m(u^2 - 2kx^2)$

$= \frac{1}{2}m \times 2kx^2$

$\therefore$ $\Delta KE \propto x^2$

2.(b) At highest point

$v_t = \sqrt{gl}$

3.(c) Orbital velocity is independent of mass of satellite

4.(d) $F = 6\pi\eta rv$ & $v \propto r^2$

$\frac{F'}{F} = \left(\frac{2r}{r}\right)^3$

or, $F' = 8F$

5.(b) $\Delta F = (212 - 140)\ °F = 72\ °F$

Now, $\frac{\Delta F}{9} = \frac{\Delta C}{5}$

or, $\Delta C = \frac{5}{9} \times \Delta F = \frac{5}{9} \times 72 = 40\ °C$

6.(a) In adiabatic compression dw is –ve so du = –dw = +dw i.e. temperature increases.

7.(a) $\lambda = 1.21$ Å

8.(b) In open pipe, pressure is maximum at middle.

9.(c) First Case, $F = k\frac{Q^2}{r^2}$

With A,

$Q' = \frac{Q}{2}$, change on A, $Q_A' = \frac{Q}{2}$

With B,

$\frac{Q}{2} + Q = 2Q''$

or, $Q'' = \frac{3Q}{4}$, change on B, $Q_B' = \frac{3Q}{4}$

or, $F' = k\frac{Q_A'Q_B''}{r^2} = \frac{3}{8}F$

10.(b) $I = \frac{2E}{R+2r} = \frac{E}{R+\frac{r}{2}}$

or, $\frac{2}{2+2r} = \frac{1}{2+\frac{r}{2}}$

or, $4 + r = 2 + 2r$

or, $r = 2\Omega$

11.(c) $M_R = \sqrt{M^2 + 2M^2\cos60° + M^2} = \sqrt{3}\ M$

12.(c) $\frac{I_1}{I_2} = \frac{a_1^2}{a_2^2} = \frac{9}{4} \Rightarrow \frac{a_1}{a_2} = \frac{3}{2}$

$\frac{I_{max}}{I_{max}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \left(\frac{3+2}{3-2}\right)^2 = 25 : 1$

13.(b) $\beta = 40$

or, $\beta = \frac{I_c}{I_b}$

or, $40\ I_b = I_e - I_b$

or, $41\ I_b = 8.2$

or, $I_b = \frac{8.2}{41} = 0.2A$

14.(a) S wave can travel through solid.

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 = $12 \times 3 \times 10^{23}/6 \times 10^{23}$ = 6 g

Weight of Sulphur = 1×32 = 32 g

$\therefore$ 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.(a) By L-Hospital's rule

$= \lim_{x \to 1} \frac{\frac{1}{x}}{1 - 0} = 1$

30.(c) To have a solution

$|C| \leq \sqrt{a^2 + b^2}$

$|K| \leq \sqrt{3^2 + 4^2} = 5$

31.(a) ${}^nP_r = {}^nC_r.r!$

336 = 56.r!

6 = r!

$\boxed{r = 3}$

32.(b) Obvious

33.(d) S = a + a + ... + a

= na

34.(c) Obvious

35.(b) Number of relations on A
= number of subsets of (A × A)
$= 2^{n(A).n(A)} = 2^{n.n}$

36.(a) Obvious: e^{a+bx}

37.(c) To be continuous
$$\lim_{x \to 0} \left(\frac{\sin kx}{kx} \times k\right)^2 = 1$$
$a^2 = 1 \therefore a = \pm 1$

38.(d) $\frac{d(e^x)}{d\sqrt{x}} = \frac{e^x}{\frac{1}{2\sqrt{x}}} = 2\sqrt{x}\, e^x$

39.(b) $\int \frac{3x + 6 - 7}{(x + 2)} dx$
$= \int 3dx - \int \frac{7}{(x+2)} dx$
$= 3x - 7ln(x + 2) + c$

40.(a) $f(x) = \tan x - x$
$f'(x) = \sec^2 x - 1$
$= \tan^2 x \geq 0$ for all $x \in R$

41.(a) $(\vec{a} \times \vec{b})$ is perpendicular to $\vec{a}$ and $\vec{b}$ and also perpendicular to the plane containing $\vec{a}$ and $\vec{b}$ and hence perpendicular to $\vec{c}$.

42.(a) Option (a) is satisfied by (1, 2)

43.(b) Passes through (–3, 2)
4 = 4a.(–3)
$4a = \left(-\frac{4}{3}\right)$
Length of latus rectum $(4a) = \frac{4}{3}$

44.(d) dr's of the normal to the plane are a, b, 0
dr's of the normal to the plane XOY are 0, 0, 1
= a.0 + b.0 + 0.1
= 0 (XOY – plane)

45.(d) $\frac{x^2}{36} + \frac{y^2}{9} = 1$
PS + PS' = 2a = 2 × 6 = 12

46.(d) cos(30° + 150°) = –1

47.(d) It is sure to occur 4 Saturdays in 28 days and two days are remained.
Probability $= \frac{2}{7}$

48.(a) $\left(\frac{d^2y}{dx^2} - x^{1/4}\right)^3 = \frac{dy}{dx}$

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

Section – II

61.(b) F - mg = ma
or, $a = \frac{v}{m}\frac{dm}{dt} - g$
$= \frac{1000 \times 100}{1000} - 10 = 90\ m/s^2$

62.(c) wt = upthrust
or, $mg = (40 \times 10^{-2})^2 \times 5 \times 10^{-2} \times \rho g$
or, $m = 1600 \times 5 \times 10^{-6} \times 10^3$
= 8 kg

63.(c) KE = work done
$\frac{1}{2} mv^2 = \mu mgS$
or, $S = \frac{4^2}{2 \times 0.2 \times 10} = 4m$

64.(a) $T_2V_2^{\gamma-1} = T_1V_1^{\gamma-1}$
or, $T_2 = 300\left(\frac{v}{2v}\right)^{5/3-1}$
$= 300\ (0.5)^{2/3} = 188.98K$
$W = \frac{nR[T_1 - T_2]}{\gamma - 1}$
$= \frac{2 \times 8.31[300 - 188.98]}{\frac{5}{3} - 1} = 2768$ J

65.(c) 75 % of $\frac{1}{2} mv^2 = msd\theta + mL_f$
or, $\frac{3}{4} \times \frac{1}{2} mv^2 = m(sd\theta + L_f)$
or, $v = \sqrt{\frac{8}{3}(0.03 \times 4200 \times 300 + 6 \times 4200)}$
= 409.8 m/s

66.(c) $f_b = 17$ beats/s, $T_1 = 16\ °C = 289$ K
$f_b' = ?$, $T_2 = 51°C = 324$ K
Now, $\frac{f_b'}{f_b} = \sqrt{\frac{T_2}{T_1}}$
or, $f_b' = 17\sqrt{\frac{324}{289}} = 18$ beats/s

67.(b) m = 5, u = 20 cm
v = mu = 100 cm
$F = \frac{uv}{u+v} = \frac{20 \times 100}{120} = \frac{50}{3}$
Here, $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$
or, $\frac{3}{50} = \frac{1}{f_1} - \frac{1}{25}$
or, $\frac{1}{f_1} = \frac{3}{50} + \frac{1}{25} = \frac{3+2}{50} = \frac{5}{50} = \frac{1}{10}$
$\therefore f_1 = 10$ cm

68.(d) $\beta = \frac{D\lambda}{d} = \frac{1 \times 5000 \times 10^{-10}}{10^{-3}} = 5 \times 10^{-4}$m
$n = \frac{x}{\beta} = \frac{10^{-2}}{5 \times 10^{-4}} = 20$

69.(c) $Q = \frac{CV_1}{d} = \frac{\varepsilon_r CV_2}{d}$

or, $\varepsilon_r = \frac{3000}{1000} = 3$

70.(c) $V - L\frac{dI}{dt} = IR$

or, $200 - 0.54\frac{dI}{dt} = 5\times20$

or, $\frac{dI}{dt} = \frac{100}{0.54} = 185.2$ A/s

71.(c) First Case,

$\frac{hc}{\lambda_1} = \phi + 3eV_0$ …………(1)

Second Case,

$\frac{hc}{\lambda_2} = \phi + eV_0$ ……………(2)

Subtracting (2) from (1)

or, $\frac{hc}{\lambda_1} - \frac{hc}{\lambda_2} = 2eV_0$

or, $eV_0 = \frac{hc}{2}\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right)$ …….(3)

From (2)

$\frac{hc}{\lambda_2} = \frac{hc}{\lambda_0} + \frac{hc}{2}\left(\frac{1}{\lambda_2} - \frac{1}{\lambda_2}\right)$

or, $\frac{1}{\lambda_0} = \frac{1}{\lambda_2} - \frac{1}{2}\left(\frac{1}{\lambda_2} - \frac{1}{\lambda_2}\right)$

$= \frac{1}{\lambda_2} - \frac{1}{2\lambda_1} + \frac{1}{2\lambda_2}$

$= \frac{3}{2\lambda_2} - \frac{1}{2\lambda_1} = \frac{3\lambda_1 - \lambda_2}{2\lambda_1\lambda_2}$

$\therefore \lambda_0 = \frac{2\lambda_1\lambda_2}{3\lambda_1 - \lambda_2} = \frac{2\times900\times1800}{3\times900 - 1800} = 3600$ Å

72.(b) $I^2Rt = msd\theta$

or, $d\theta = \left(\frac{E}{R+r}\right)^2 \frac{Rt}{ms}$

$= \left(\frac{6}{4+2}\right)^2 \times \frac{2\times3\times60}{1\times4200}$

$= 0.085$ °C

73.(b) $C_0 = 360$ counts/s

$\frac{C}{C_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

or, $C = 360\left(\frac{1}{2}\right)^{1.5/0.5}$

$= 45$ counts/s

C = 45 counts/s   d = 4m

C' = 5 counts/s   d = ?

$\frac{C}{C'} = \left(\frac{d'}{d}\right)^2$

or, $\frac{45}{5} = \left(\frac{d'}{4}\right)^2$

or, d' = 12 m

$\Delta d = d' - d$

$= 12 - 4 = 8$m

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 $\longrightarrow$ 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.(a) Put $5^{5^{5^x}} = y$

$5^{5^{5^x}} . 5^{5^x} . 5^x (\log5)^3 dx = dy$

Now, $I = \int \frac{dy}{(\log5)^3} = \frac{y}{(\log5)^3} + c$

$= \frac{5^{5^{5^x}}}{(\log5)^3} + c$

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

$= \tan^{-1}\left(\tan\frac{x}{2}\right)$

$y = \frac{x}{2}$

$\frac{dy}{dx} = \frac{1}{2}$

84.(a) $\frac{a+b+c}{2} = \frac{3b}{2}$

$\boxed{a + c = 2b}$ A.P.

85.(c) Mid point of AC = mid point of BD

$\left(\frac{1-3}{2}, \frac{3+1}{2}, \frac{4+0}{2}\right) = \left(\frac{x-4}{2}, \frac{y+3}{2}, \frac{z+6}{2}\right)$

(x, y, z) = (2, 1, 2)

86.(a) $\cos\theta = \frac{\vec{a}.(\vec{a}+\vec{b}+\vec{c})}{|\vec{a}|\,|\vec{a}+\vec{b}+\vec{c}|}$

$= \frac{1+0+0}{1.\sqrt{3}}$

$= \frac{1}{\sqrt{3}}$

87.(d) $|\omega| = \left|\frac{x+iy}{x+iy-\frac{1}{3}i}\right|$

$1 = \frac{\sqrt{x^2+y^2}}{\sqrt{x^2+\left(y-\frac{1}{3}\right)^2}}$

$y = \frac{1}{6}$ (st. line)

88.(c) $f'(x) = 0$

$6x^2 - 6x - 12 = 0$

$x = 2, -1$

At x = 2, $f''(2) = 18 > 0$ (minimum)

At x = –1, $f''(-1) = -18 < 0$ (maximum)

89.(c) $S_n = 1^3 + 2^3 + 3^3 + ... + n^3 = \left[\frac{n(n+1)}{2}\right]^2$

90.(d) $D = \begin{vmatrix} 1 & 1 & -1 \\ 3 & -1 & -1 \\ 1 & -3 & 1 \end{vmatrix} = 0$ (Infinite solution)

91.(b) $-1 \le \sin3x \le 1$

$1 \ge -\sin3x \ge -1$

$3 \ge 2 - \sin3x \ge 1$

$\frac{1}{3} \le f(x) \le 1$

92.(d) $l\text{n}x^2 - \ln(x^2-1)$

$= \ln\frac{x^2}{x^2-1} = -\ln\frac{x^2-1}{x^2}$

$= -\ln\left(1-\frac{1}{x^2}\right)$

$= \frac{1}{x^2} + \frac{1}{2x^4} + \frac{1}{3x^6} + ...$

93.(b) $-4x^2 + 3xy + y^2 = 0$

$4x^2 - 3xy + y^2 = 0$

94.(a) When two N's are together

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

Total arrangements $= \frac{6!}{2!\,3!} = 60$

Required ways = (60 – 20) = 40 ways

95.(c) On solving:

$(2x+\lambda)^2 = 2x$

$4x^2 + 2x(2\lambda - 1) + \lambda^2 = 0$

Now, $b^2 - 4ac < 0$

$1 - 4\lambda < 0$

$\boxed{\lambda > \frac{1}{4}}$

96.(c) $A = \int_0^1 (e^x - e^{-x})dx = (e^x + e^{-x})_0^1$

$= (e + e^{-1} - (e^0 + e^0)) = e + \frac{1}{e} - 2$

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

…The End…