

Section - I

1.(b) $a = -kx$
 $v^2 = u^2 - 2kx \cdot x$
 or, $v^2 = u^2 - 2kx^2$
 \therefore Loss in K.E. (ΔKE) = $\frac{1}{2}mu^2 - \frac{1}{2}mv^2$
 $= \frac{1}{2}mu^2 - \frac{1}{2}m(u^2 - 2kx^2)$
 $= \frac{1}{2}m \times 2kx^2$

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

2.(b) At highest point

$v_t = \sqrt{gl}$

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

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

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

or, $F' = 8F$

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

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

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

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

7.(a) $\lambda = 1.21 \text{ \AA}$

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) $M_R = \sqrt{M^2 + 2M^2 \cos 60^\circ + M^2} = \sqrt{3} M$

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

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

13.(b) $\beta = 40$

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

or, $40 I_b = I_c - I_b$

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 = $0.2 \times 14 = 2.8g$

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

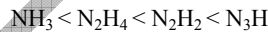
Weight of Sulphur = $1 \times 32 = 32g$

\therefore Weight of silver = 7g

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

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

Here, oxidation no of nitrogen increases as follows:



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

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

30.(c) To have a solution

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

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

31.(a) ${}^n P_r = {}^n C_r \cdot r!$

$336 = 56 \cdot r!$

$6 = r!$

$r = 3$

32.(b) Obvious

33.(d) $S = a + a + \dots + a$
 $= na$

- 34.(c) Obvious
 35.(b) Number of relations on A
 = number of subsets of $(A \times A)$
 = $2^{n(A).n(A)} = 2^{n.n}$
 36.(a) Obvious: e^{a+bx}
 37.(c) To be continuous
 $\lim_{x \rightarrow 0} \left(\frac{\sin kx}{kx} \times k \right)^2 = 1$
 $a^2 = 1 \therefore a = \pm 1$
 38.(d) $\frac{d(e^x)}{d\sqrt{x}} = \frac{e^x}{\frac{1}{2\sqrt{x}}} = 2\sqrt{x} e^x$
 39.(b) $\int \frac{3x+6-7}{(x+2)} dx$
 $= \int 3dx - \int \frac{7}{(x+2)} dx$
 $= 3x - 7\ln(x+2) + c$
 40.(a) $f(x) = \tan x - x$
 $f'(x) = \sec^2 x - 1$
 $= \tan^2 x \geq 0$ for all $x \in \mathbb{R}$
 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)
 $\frac{x^2}{36} + \frac{y^2}{9} = 1$
 45.(d) $PS + PS' = 2a = 2 \times 6 = 12$
 46.(d) $\cos(30^\circ + 150^\circ) = -1$
 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, $a = \frac{v}{m} \frac{dm}{dt} - g$

- $= \frac{1000 \times 100}{1000} - 10 = 90 \text{ m/s}^2$
 62.(c) wt = upthrust
 or, $mg = (40 \times 10^{-2})^2 \times 5 \times 10^{-2} \times \rho g$
 or, $m = 1600 \times 5 \times 10^{-6} \times 10^3$
 $= 8 \text{ kg}$
 63.(c) KE = work done
 $\frac{1}{2}mv^2 = \mu mgS$
 or, $S = \frac{4^2}{2 \times 0.2 \times 10} = 4 \text{ m}$
 64.(a) $T_2 V_2^{\gamma-1} = T_1 V_1^{\gamma-1}$
 or, $T_2 = 300 \left(\frac{V_1}{V_2}\right)^{5/3-1}$
 $= 300 (0.5)^{2/3} = 188.98 \text{ K}$
 $W = \frac{nR(T_1 - T_2)}{\gamma - 1}$
 $= \frac{2 \times 8.31 [300 - 188.98]}{\frac{5}{3} - 1} = 2768 \text{ J}$
 65.(c) 75 % of $\frac{1}{2}mv^2 = msd\theta + mL_r$
 or, $\frac{3}{4} \times \frac{1}{2}mv^2 = m(sd\theta + L_r)$
 or, $v = \sqrt{\frac{8}{3}(0.03 \times 4200 \times 300 + 6 \times 4200)}$
 $= 409.8 \text{ m/s}$
 66.(c) $f_b = 17 \text{ beats/s}$, $T_1 = 16^\circ \text{C} = 289 \text{ K}$
 $f_b' = ?$, $T_2 = 51^\circ \text{C} = 324 \text{ K}$
 Now, $\frac{f_b'}{f_b} = \sqrt{\frac{T_2}{T_1}}$
 or, $f_b' = 17 \sqrt{\frac{324}{289}} = 18 \text{ beats/s}$
 67.(b) $m = 5$, $u = 20 \text{ cm}$
 $v = mu = 100 \text{ cm}$
 $F = \frac{uv}{u+v} = \frac{20 \times 100}{120} = \frac{50}{3}$
 Here, $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$
 or, $\frac{3}{50} = \frac{1}{f_1} - \frac{1}{25}$
 or, $\frac{1}{f_1} = \frac{3}{50} + \frac{1}{25} = \frac{3+2}{50} = \frac{5}{50} = \frac{1}{10}$
 $\therefore f_1 = 10 \text{ cm}$
 68.(d) $\beta = \frac{D\lambda}{d} = \frac{1 \times 5000 \times 10^{-10}}{10^{-3}} = 5 \times 10^{-4} \text{ m}$
 $n = \frac{x}{\beta} = \frac{10^{-2}}{5 \times 10^{-4}} = 20$

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

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

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

or, $200 - 0.54 \frac{dI}{dt} = 5 \times 20$

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

71.(c) First Case,

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

Second Case,

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

Subtracting (2) from (1)

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

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

From (2)

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

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

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

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

$\therefore \lambda_0 = \frac{2\lambda_1\lambda_2}{3\lambda_1 - \lambda_2} = \frac{2 \times 900 \times 1800}{3 \times 900 - 1800} = 3600 \text{ \AA}$

72.(b) $I^2 R t = ms d \theta$

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

$= \left(\frac{6}{4+2} \right)^2 \times \frac{2 \times 3 \times 60}{1 \times 4200}$

$= 0.085 \text{ }^\circ\text{C}$

73.(b) $C_0 = 360 \text{ counts/s}$

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

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

$= 45 \text{ counts/s}$

$C = 45 \text{ counts/s} \quad d = 4 \text{ m}$

$C' = 5 \text{ counts/s} \quad d = ?$

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

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

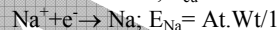
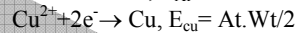
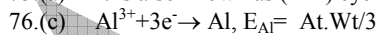
or, $d' = 12 \text{ m}$

$\Delta d = d' - d$

$= 12 - 4 = 8 \text{ m}$

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.



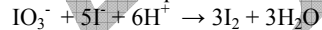
When 3 Faraday is passed;

Mole atom of Al deposited = 1

Mole atom of Na deposited = $1 \times 3/2 = 1.5$

Mole atom of Na deposited = $1 \times 3 = 3$

77.(c) The balanced equation is



78.(d)



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 concⁿ is 10^{-5} N

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

Thus final concⁿ is $2 \times 10^{-7} \text{ N}$

Hence pH = 6.7

81.(d)

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

$5^{5^{5^x}} \cdot 5^{5^x} \cdot 5^x (\log 5)^3 dx = dy$

Now, $I = \int \frac{dy}{(\log 5)^3} = \frac{y}{(\log 5)^3} + c$

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

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) $\cos\theta = \frac{\vec{a} \cdot (\vec{a} + \vec{b} + \vec{c})}{|\vec{a}| |\vec{a} + \vec{b} + \vec{c}|}$
 $= \frac{1+0+0}{1 \cdot \sqrt{3}}$
 $= \frac{1}{\sqrt{3}}$

87.(d) $|\omega| = \left| \frac{x+iy}{x+iy-\frac{1}{3}i} \right|$
 $1 = \frac{\sqrt{x^2+y^2}}{\sqrt{x^2+(y-\frac{1}{3})^2}}$

$y = \frac{1}{6}$ (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) $S_n = 1^3 + 2^3 + 3^3 + \dots + n^3 = \left[\frac{n(n+1)}{2}\right]^2$

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

91.(b) $-1 \leq \sin 3x \leq 1$

$1 \geq -\sin 3x \geq -1$

$3 \geq 2 - \sin 3x \geq 1$

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

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

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

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...