Section – I

1.(d) The time-period is independent of amplitude.

2.(d) $\frac{K.E._{trans}}{K.E._T} = \frac{1}{1+\frac{K^2}{R^2}} = \frac{1}{1+\frac{2}{5}} = \frac{5}{7}$

3.(c) $R = \frac{u^2 \sin^2 90°}{g} = \frac{u^2}{g}$ $(\because \theta = 45°)$

$H_{max} = \frac{u^2 \sin 90°}{2g} = \frac{u^2}{2g} = \frac{R}{2}$ $(\because \theta = 90°)$

4.(d) Apparent weight (W') = Actual Weight (W) - Upthrust (U)

For flotation, W = U

$\therefore$ W' = 0

5.(a) $C_{rms} = \sqrt{\frac{C_1^2 + C_2^2 + C_3^2 + C_4^2}{4}} = \sqrt{\frac{2^2+3^2+4^2+5^2}{4}}$

$= \frac{\sqrt{54}}{2}$ cm/s

6.(a) $\frac{C}{5} = \frac{F-32}{9}$

$\therefore \frac{1}{5}\Delta C = \frac{1}{9}\Delta F$

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

If ΔF = 1°F, then $\Delta C = \frac{5}{9}$ °C

$\therefore$ Coefficient of linear expansion $= \frac{\alpha}{°F} = \frac{\alpha}{\frac{5}{9}°C} = \frac{9\alpha}{5}$

7.(b) Width of maxima (W) $\propto \lambda$

As $\lambda_R > \lambda_B$, then $W_R > W_B$

8.(c) $f = \frac{1}{ld}\sqrt{\frac{T}{\pi\rho}}$ i.e. $f \propto \frac{1}{d}$

then $\frac{f'}{f} = \frac{d}{d'}$

or, $f' = \frac{d}{3d} \times f$

or, $f' = \frac{f}{3}$

9.(c) Electron is accelerated along field direction.

10.(c) E = kl

or, $l = \frac{E}{K} = \frac{2}{0.5} = 4m$

11.(a)

12.(d) Photocurrent only depends upon intensity of radiation but not upon its frequency that it can cause photoelectric emission.

13.(a) $\frac{(\frac{q}{m})_p}{(\frac{q}{m_\alpha})} = \frac{\frac{e}{m_p}}{\frac{2e}{4m_p}} = 2:1$

14.(b) $E = \frac{1}{4\pi\varepsilon_0}\frac{2Q}{r^2}$

$E' = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2} = \frac{E}{2}$

15.(a) Metals have positive temperature coefficient of resistance while semiconductors have negative temperature coefficient of resistance.

16.(b) $E = \alpha\theta + \frac{1}{2}\beta\theta^2$

$\therefore \frac{dE}{d\theta}|_{\theta=\theta_n} = 0$

or, $\alpha + \beta\theta_n = 0$

or, $\theta_n = -\frac{\alpha}{\beta}$

17.(c) $mg - T_{max} = ma_{min}$

or, $mg - \frac{3}{4}mg = ma_{min}$

or, $\frac{1}{4}mg = ma_{min}$

or, $a_{min} = \frac{g}{4}$

18.(a) For 0.1 M HCl, $[H^+] = 10^{-1} \Rightarrow pH = 1$

$\Rightarrow pOH = 13 \Rightarrow [OH^-] = 10^{-13}$ mol/dm^3

19.(b) Lymann series:UV region

Balmer series: – Visible region

Paschen and Brackett series:- IR region

20.(c) Wt. in gm of solute

$= \frac{N x V_{(me)} \text{ x Eq.wt}}{1000} = \frac{0.1x1000}{1000} \times \frac{294}{6}$

21.(d)

22.(a) No. of gr. eq^v. of Oxygen = 8/8 = 1

So, No. of gr. eq^v.of metals to react = 1

$\therefore$ wt .of metal = gr. eqv. wt. = 31.75 g

23.(d) In group atomic size increases with increasing atomic number.

24.(b) H_2O is liquid while H_2S is gas, because hydrogen bond in H_2O

25.(b) The bond order of O_2, O_3 and H_2O_2 is :

$O_2 > O_3 > H_2O_2$

26.(d) Boron trihalides are Lewis acid due to having tendency to accept electron pair. The order of their acidic strength is as $BF_3 < BCl_3 < BBr_3 < BI_3$. Less acidic nature of BF_3 is due to $\pi-$ back bonding between p-p orbitals of B and F having comparable size.

27.(c) Alkyne, alkadiene and cycloalkene have same general formula.

28.(b) Reductive ozonolysis of alkene gives mixture of carbonyl compounds.

29.(c) $\int \frac{x^5 - x^4}{x^3 - x^2} dx$ $[\because e^{5lnx} = e^{lnx^5} = x^5]$

$= \int \frac{x^4 (x-1)}{x^2 (x-1)} dx = \frac{x^3}{3} + c$

30.(d) $\lim_{x \to 0} \frac{1}{x} . 3\tan^{-1}x$

$= 3. \lim_{x \to 0} \frac{\tan^{-1}x}{x} = 3.1 = 3$

31.(b) $y_1 = ae^{ax+b}$

$y_2 = a^2 e^{ax+b}$

$(y_2)_0 = a^2.e^b$

32.(a) $(\omega)^{66} = (\omega^3)^{22} = 1$

33.(d) $ax^2 + bx + c = 0$ (α, β)

$cx^2 + bx + a = 0$ $\left(\frac{1}{\alpha}, \frac{1}{\beta}\right)$

34.(c) AB = AC implies B = C

i.e. A^{-1} exist

A is non-singular matrix

35.(a) Obvious

36.(b) $2\vec{a} = 2\vec{b}$

$\vec{a} = \vec{b}$

37.(c) Centre: X = 0 & Y = 0

$x + y - 2 = 0$ & $x - y = 0$

On solving: x = 1 & y = 1

i.e. (1, 1)

38.(c) Obvious

39.(c) Obvious

40.(b) $\frac{a}{\sin 30°} = \frac{8}{\sin B}$

$\frac{7}{\frac{1}{2}} = \frac{8}{\sin B}$ $\Rightarrow \sin B = \frac{4}{7}$

Two solutions: $B = \sin^{-1}\frac{4}{7}$ & $\pi - \sin^{-1}\frac{4}{7}$

41.(c) $0 \le |\sin x| \le 1$

min. value = 0

and $|\sec x| \ge 1$

min. value = 1

42.(b) Total number of ways = (7 – 1)! = 720 ways

43.(a) $(5 + 4x)^{-1/2} = \left[5\left(1 + \frac{4x}{5}\right)\right]^{-1/2}$

This is valid if $\left|\frac{4x}{5}\right| < 1$

$|x| < \frac{5}{4}$

44.(c) $(x_1, y_1) = (3, 4)$

Equation ofthe normal:

$xy_1 = yx_1$

$x.4 = 3y$

$3y - 4x = 0$

45.(c) $A = \int_0^{\pi/4} \sec^2 x dx$

$= [\tan x]_0^{\pi/4} = \tan\frac{\pi}{4} - \tan 0 = 1$

46.(c) Normal is parallel to x-axis i.e. tangent line is parallel to y-axis.

$\frac{dy}{dx} = \infty$

$\frac{dx}{dy} = 0$

47.(a) $\cos^{-1}\left(-\frac{\sqrt{2}}{2}\right) = \cos^{-1}\left(-\frac{1}{\sqrt{2}}\right)$

$= \pi - \cos^{-1}\left(\frac{1}{\sqrt{2}}\right) = \pi - \frac{\pi}{4} = \frac{3\pi}{4}$

48.(d) Taking option (d)

$1^2 + (-1)^2 + (1)^2 \neq 1$

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

Section – II

61. (d) $\tau = I\alpha$

or, $TR = \frac{1}{2} MR^2 \times \frac{a}{R}$ $(\because a = R\alpha)$

or, $T = \frac{Ma}{2}$

Again, mg - T = ma

or, $mg - \frac{Ma}{2} = ma$

or, $mg = (m + \frac{M}{2})a$

or, $a = \frac{mg}{m + \frac{M}{2}} = \frac{2\times 10}{2 + \frac{6}{2}} = 4 \text{ m/s}^2$

62.(a) Net Work done = change in KE

or, $\int_{x=20}^{x=30} F dx = K.E._f - K.E._i$

or, $-0.1[\frac{x^2}{2}]_{20}^{30} = K.E._f - 500$

or, $-\frac{0.1}{2}(30^2 - 20^2) = KE_f - 500$

$\therefore$ $KE_f = 475$ J

63.(d) $T^2 \propto r^3$

$$\frac{T'}{1} = \left(\frac{R + \frac{5R}{2}}{R + 6R}\right)^{3/2} = \left(\frac{1}{2}\right)^{3/2}$$

$\therefore \quad T' = \left(\frac{1}{2}\right)^{3/2} \times 24 = 6\sqrt{2}$ hr

64.(b) $P = e\sigma AT^4 = e\sigma 4\pi R^2T^4$

i.e $P \propto R^2T^4$

$\therefore \frac{P_1}{P_2} = \frac{R_1^2T_1^4}{R_2^2T_2^4} = \left(\frac{1}{4}\right)^2 \times \left(\frac{4000}{2000}\right)^4 = 1 : 1$

65.(b) $dW = PdV = nRdT = 100J$

$\therefore dQ = nC_pdT$

$= n \times \frac{7}{2} RdT$

$= \frac{7}{2} dW = \frac{7}{2} \times 100 = 350J$

66.(d) $\frac{m}{m_0} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

$m = 10\left(\frac{1}{2}\right)^{\frac{2T}{T_{1/2}}}$

$= 10\left(\frac{1}{2}\right)^{\frac{2 \times 1.44\ T_{1/2}}{T_{1/2}}}$

$= 1.35g$

67.(a) $r_n = (0.53 \times n^2)$ Å

For ground state, $r_1 = 0.53$Å $\quad (\because n = 1)$

Then $\lambda_n = \frac{2\pi r_n}{n}$

or, $\lambda_1 = 2\pi r_1$

or, $\lambda_1 = 2\pi \times 0.53 = 3.33$Å

68.(a) $F = BIl$

$= B \times \frac{E}{R} \times l \quad$ (E = induced emf)

$= B \times \frac{Bvl}{R} \times l$

$= \frac{B^2l^2v}{R}$

$= \frac{0.850^2 \times 0.85^2 \times 0.858}{0.750} = 0.598$ N

69.(c) $I_g = \frac{150}{15} = 10mA = 10 \times 10^{-3}A$

$G = 5\Omega$

$\therefore \ S = \frac{I_g \times G}{I - I_g} = \frac{10 \times 10^{-3} \times 5}{2 - 10 \times 10^{-3}} = 0.025\Omega$

70.(a) $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

i.e. $f \propto \sqrt{T}$

$\therefore \frac{\Delta f}{f} = \frac{1}{2} \times \frac{\Delta T}{T}$

or, $\frac{\Delta f}{200} = \frac{1}{2} \times 1\%$

or, $\Delta f = \frac{1}{200} \times 200 = 1$

71.(c) $\mu = \frac{1}{\sin C}$

or, $\mu = \frac{1}{\sin(\sin^{-1}\frac{3}{5})}$

or, $\mu = \frac{5}{3}$

Again,

$\mu = \tan\theta_p$

or, $\theta_p = \tan^{-1}\left(\frac{5}{3}\right)$

72.(c) $K_{eq} = \frac{2K_1K_2}{K_1 + K_2} = \frac{2 \times 3 \times 6}{3+6} = 4$

$\therefore \ C' = \frac{k_{eq}\varepsilon_0 A}{d} = k_{eq}\, C_{air} = 4 \times 1 = 4\mu F$

73.(b) $R = 3\Omega$

$X = 4\Omega$

$\therefore Z = \sqrt{R^2 + x^2} = \sqrt{3^2 + 4^2} = 5\Omega$

Then, $\cos\theta = \frac{R}{Z} = \frac{3}{5} = 0.6$

74.(d) Apparent distance = (5 + 2) = 7 cm

$\therefore \quad \mu = \frac{\text{Real distance}}{\text{Apparent distance}}$

or, Real distance = 1.5 × 7 = 10.5 cm

75.(d) 1°-amine show position isomerism, 2°-amine show metamerism, 1°, 2° and 3° amines are functional isomers.

76.(b) Longest chain is the parent chain and functional group always gives the lowest possible number.

77.(a) Since the number of molecules of each gases are same due to identical conditions of P, V, T so its directly asking for the number of atoms in each ,molecule.

78.(a) $W = \frac{E.i.t}{96500} = \frac{1 \times 0.4 \times 30 \times 60}{96500}$

$= 7.46 \times 10^{-3}$ g

Volume $= \frac{7.46 \times 10^{-3} \times 22.4}{2} = 0.083$ L

79.(d)

80.(a) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$

81.(c) $\left(\frac{N_1}{N_o}\right) = \left[\frac{1}{2}\right]^{\frac{t}{T}}$

$= \frac{67}{100} = \left(\frac{1}{2}\right)^{t_1/20}$ …………(i)

$= \frac{33}{100} = \left(\frac{1}{2}\right)^{t_2/20}$ …………(ii)

Dividing (ii) by (i)

$\therefore \quad t_1 - t_2 = 20$ min.

82.(a) $y = \sqrt{x - 3}$

y is defined for $(x - 3) \geq 0$

$x \geq 3$

$D_f = [3, \infty)$

and: $y^2 = (x - 3)$

$(x - 3) \geq 0$

$y^2 \ge 0 \Rightarrow y \ge 0$
Range = $[0, \infty)$

83.(b) Area = $2\int_0^1 (x - x^2)\,dx$
$= 2\left[\frac{x^2}{2} - \frac{x^3}{3}\right]_0^1$
$= \frac{1}{3}$

84.(b) $\cos^{-1}x\left(\frac{\pi}{2} - \cos^{-1}y\right) = \sin^{-1}y$
$\sin^{-1}\sqrt{1 - x^2} = \sin^{-1}y$
$\sqrt{1 - x^2} = y^2$
$1 - x^2 = y^2$
$\boxed{1 = x^2 + y^2}$

85.(b) $y_1 = ame^{mx} - bme^{-mx}$
$y_2 = am^2 e^{mx} + bm^2 e^{-mx}$
$= m^2(ae^{mx} + be^{-mx})$
$= m^2y$

86.(b) Putting x = 2
$f(2) = 5$
$2^2 - 2p + 3 = 5$
$p = 1$

87.(c) Put $x - 2 = t^2$
$dx = 2t\,dt$
$I = \int\frac{2t\,dt}{(t^2 + 2 + 1).t}$
$= \int\frac{dt}{t^2 + 3} = \frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{t}{\sqrt{3}}\right) + c$
$= \frac{2}{\sqrt{3}}\tan^{-1}\left(\sqrt{\frac{x-2}{3}}\right) + c$

88.(a) $\frac{dv}{dt} = \frac{dr}{dt}$
$\frac{d\left(\frac{4}{3}\pi r^3\right)}{dt} = \frac{dr}{dt}$
$r = \frac{1}{2\sqrt{\pi}}$

89.(b) $\vec{a} \times \vec{b} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & -2 & 4 \\ 3 & 1 & 2 \end{vmatrix}$
$= -8\vec{i} + 8\vec{j} + 8\vec{k}$
$\sin\theta = \frac{|\vec{a} \times \vec{b}|}{|\vec{a}|\,.\,|\vec{b}|} = \frac{2}{\sqrt{7}}$

90.(a) Plane: $\frac{x}{a} + \frac{y}{a} + \frac{z}{a} = 1$
$x + y + z = a$ ... (i)
Passes the rough (2, 3, 4): $2 + 3 + 4 = a$
i.e. $a = 9$
Required plane: $x + y + z = 9$

91.(b) On solving: two points are (0, 0) and (4a, 4a)
Length of the common chord
$= \sqrt{(4a - 0)^2 + (4a - 0)^2}$
$= 4a\sqrt{2}$

92.(c) $r_1r_2 + r_2r_3 + r_3r_1$
$= \frac{\Delta}{s-a}\frac{\Delta}{s-b} + \frac{\Delta}{s-b}\cdot\frac{\Delta}{s-c} + \frac{\Delta}{s-c}\cdot\frac{\Delta}{s-a}$
$= \Delta^2\left[\frac{s-c+s-a+s-b}{(s-a)(s-b)(s-c)}\right] \times \frac{s}{5} = s^2$

93.(a)

Bowlers (5)	Non-bowlers (9)	Selection
4	7	${}^5c_4 \times {}^9c_7 = 180$
5	6	${}^5c_5 \times {}^9c_6 = 84$

Total = 180 + 84 = 264

94.(a) $\log_e(1 + x) = \frac{x}{1} - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} - \frac{x^6}{6} + \ldots\ldots \infty$
Putting x = 1
$\log_e 2 = \left(1 - \frac{1}{2}\right) + \left(\frac{1}{3} - \frac{1}{4}\right) + \left(\frac{1}{5} - \frac{1}{6}\right) + \ldots.$
$= \frac{1}{1.2} + \frac{1}{3.4} + \frac{1}{5.6} + \ldots\ldots$

95.(c) $m_1 + m_2 = -\frac{2h}{b} = \frac{k}{3}$ and $m_1m_2 = \frac{a}{b} = -\frac{1}{3}$
Now, $m_1 + m_2 = 2m_1m_2$
$\frac{k}{3} = -\frac{2}{3} \quad \Rightarrow k = -2$

96.(c) Putting n = 1, in option (c), we get
1 (1st term of 1st group)
Putting n = 2, we get
2 (1st term of 2nd group)

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

…The End…