Section – I

1.(c) $|\vec{A} \times \vec{B}| = \sqrt{3}(\vec{A}.\vec{B})$

or, $AB\sin\theta = \sqrt{3}AB\cos\theta$

or, $\tan\theta = \sqrt{3} = \tan 60°$

$\theta = 60°$

2.(c) Comes to rest means velocity decreases i.e. retardation so angle is 180°.

3.(c) Moment of inertia depends on mass and its distribution from axis.

4.(c) Convection stop in absence of gravity.

5.(d) In cyclic process work done is depends on path.

6.(c) $\frac{v_H}{v_0} = \sqrt{\frac{M_0}{M_H}} = \sqrt{\frac{32}{2}} = 4:1$

7.(a) $V_1 = V_2$

or, $\frac{Q_1}{4\pi\varepsilon_0 a} = \frac{Q_2}{4\pi\varepsilon_0 b}$

or, $\frac{Q_1 a}{4\pi a^2} = \frac{Q_2 b}{4\pi b^2}$

or, $\sigma_1 a = \sigma_2 b$

or, $\frac{\sigma_1}{\sigma_2} = \frac{b}{a}$

8.(c) $P = I^2R$, Bulb (1) & (4) glow more brighter, since I is more.

9.(a) 2V divide in BA & AC equally

i.e. 1V

10.(c) $\tan\theta = \frac{B_V}{B_H} = 1 = \tan 45°$

$\theta = 45°$

11.(c) $P = P_1 + P_2$

$= -4 + 3 = -1D$

12.(c) Longitudinal waves are not polarized.

13.(c) $\phi = \frac{hc}{\lambda_0}$

or, $\lambda_0 = \frac{hc}{\phi}$

$= \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{2.3 \times 1.6 \times 10^{-19}}$

$= 5.396 \times 10^{-7}$ m

$= 5396$ Å

14.(b) In forward biasing width of depletion layer decreases.

15.(b) $^{35}Cl_{17}$

No of n° = At. mass – At. no

$= 35 - 17 = 18$

16.(d) Copper compounds are known for producing a distinctive green flame color.

17.(c) $0.001 = 10^{-3}$

$pH = -\log[10^{-3}] = 3$

18.(a) Due to small size of cation Li^+

19.(b) Due to lack of symmetry elements like planes or centre of symmetry.

20.(c) Central atom C has no lone pair of electrons.

21.(d) All electrons of Zn^{2+} are paired.

22.(d) When we move from left to right in same period the size of atom gradually decreases.

23.(b) Having same position but only difference in their atomic mass.

24.(a) S' means group IA or 1

25.(c) $Al(OH)_3$ produces salt when reacts with acid as well as base.

26.(c) Due to loss of 3 electrons

27.(b) $\underset{(g)}{2H_2} + \underset{(g)}{O_2} \longrightarrow \underset{(e)}{2H_2O}$

28.(c) – OH = alcoholic

– CHO = aldehydic

– COOH = carboxylic

– CO – = ketonic

29.(a)

30.(d) If $\omega = -\frac{1+\sqrt{3}i}{2}$ then $\omega^2 = -\frac{1-\sqrt{3}i}{2}$

$|\omega - \omega^2| = \left| -\frac{1+\sqrt{3}i}{2} - \left(-\frac{1-\sqrt{3}i}{2}\right) \right| = |\sqrt{3}i|$

$= \sqrt{0^2 + (\sqrt{3})^2}$

$= \sqrt{3}$

31.(c) $|x|^2 - 5|x| + 4 = 0$

or, $(|x| - 4)(|x| - 1) = 0$

Either $|x| = 4 \Rightarrow x = \pm 4$

OR $|x| = 1 \Rightarrow x = \pm 1$

No. of real roots = 4

32.(d) $(1 + x + x^2)\, e^{-x}$

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

Coefficient of $x^2 = 1.\frac{1}{2!} + 1.\left(-\frac{1}{1!}\right) + 1.1$

$= \frac{1}{2}$

33.(d) $|2AB| = 2^3|A|\,|B| = 8 \times (-1) \times 2 = -16$

34.(b) $a\cos^2\frac{B}{2} + b\cos^2\frac{A}{2}$

$= a\left(\frac{1+\cos B}{2}\right) + b\left(\frac{1+\cos A}{2}\right)$

$= \frac{a + a\cos B + b + b\cos A}{2} = \frac{a+b+c}{2} = s$

35.(b) $\sin\left(2\cos^{-1}\left(\frac{1}{2}\right)\right) = \sin\left(2.\frac{\pi}{3}\right) = \frac{\sqrt{3}}{2}$

36.(a) Position vector of midpoint of AB

$= \frac{(\vec{i} + 3\vec{j} - \vec{k}) + (3\vec{i} - \vec{j} - 3\vec{k})}{2} = 2\vec{i} + \vec{j} - 2\vec{k}$

37.(b) $\vec{a}\times\vec{b}$ is a vector $\perp^r$ to both $\vec{a}$ and $\vec{b}$.

$$\vec{a}\times\vec{b} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & -2 & 4 \\ 3 & 1 & 2 \end{vmatrix}$$

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

$= (-4 - 4)\vec{i} - (4 - 12)\vec{j} + (2 + 6)\vec{k}$

$= -8\vec{i} + 8\vec{j} + 8\vec{k}$

38.(b) $P(\overline{A\cup B}) = 1 - P(A\cup B)$

$= 1 - \{P(A) + P(B) - P(A\cap B)\}$

$= 1 - \left(\frac{2}{5} + \frac{1}{4} - \frac{1}{10}\right) = \frac{9}{20}$

39.(c) Given parallel lines are

$2x - y + 4 = 0 \Rightarrow 6x - 3y + 12 = 0$

and $6x - 3y - 5 = 0$

Distance $= \left|\frac{C_1 - C_2}{\sqrt{A^2 + B^2}}\right| = \left|\frac{12 + 5}{\sqrt{6^2 + (-3)^2}}\right| = \frac{17}{3\sqrt{5}}$

40.(d) Length of y-intercept $= 2\sqrt{f^2 - c}$

$= 2\sqrt{\left(\frac{1}{2}\right)^2 + 20}$

$= 9$

41.(a) $\frac{x^2}{9} + \frac{y^2}{16} = (1 + \sin 2t) + (1 - \sin 2t) = 2$

It represents an eq^n of ellipse.

42.(d) The d.c's normal to the plane are

$$\frac{1}{\sqrt{1^2 + 2^2 + (-3)^2}}, \frac{2}{\sqrt{1^2 + 2^2 + (-3)^2}}, \frac{-3}{\sqrt{1^2 + 2^2 + (-3)^2}}$$

i.e. $\frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{-3}{\sqrt{14}}$

43.(c) $\lim_{x\to 0^+} \frac{3|x| + 5\tan x}{x} = \lim_{x\to 0^+} \frac{3x + 5\tan x}{x}$

$= \lim_{x\to 0^+}\left(3 + 5.\frac{\tan x}{x}\right)$

$= 3 + 5 \times 1 = 8$

44.(d) LHL $= \lim_{x\to a^-} f(x) = \lim_{x\to a^-} -\frac{(x - a)}{x - a} = -1$

RHL $= \lim_{x\to a^+} f(x) = \lim_{x\to a^+} \frac{(x - a)}{x - a} = 1$

i.e. LHL $\neq$ RHL

So, $\lim_{x\to a} f(x)$ does not exist.

45.(c) $\frac{d}{dx}[\log_e(\log_e x)] = \frac{1}{x}\cdot\frac{1}{\log_e x}$

$= (x\log_e x)^{-1}$

46.(a) $dr = 5.1 - 5 = 0.1$

Approximate change in area = dA

$= \frac{dA}{dr}\cdot dr$

$= 2\pi r.dr$

$= 2\pi \times 5 \times 0.1$

$= \pi$ cm^2

47.(b) $\int_{-\pi/3}^{\pi/3} \cos x\,dx = [\sin x]_{-\pi/3}^{\pi/3} = 2\sin\frac{\pi}{3} = \sqrt{3}$

48.(c) IF $= e^{\int P dx} = e^{\int \tan x dx} = e^{\ln \sec x} = \sec x$

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

Section – II

61.(d) $R = \frac{u^2}{g}$

or, $u^2 = Rg = 100 \times 10$

Again $H = \frac{u^2}{2g} = \frac{100 \times 10}{2 \times 10} = 50$m

62.(c) In air

$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20$ m/s

In water

$0 = u^2 + 2\left(1 - \frac{\sigma}{\rho}\right) gh'$

or, $0 = 20^2 + 2\left(1 - \frac{\sigma}{\sigma/2}\right) gh'$

or, $0 = 400 - 2gh'$

or, $2gh' = 400$

or, $h' = \frac{400}{20} = 20$m

63.(c) $t \propto (\sqrt{h_1} - \sqrt{h_2})$

So, $\frac{t_2}{t_1} = \frac{\sqrt{h} - \sqrt{\frac{h}{2}}}{\sqrt{\frac{h}{2}} - \sqrt{0}}$

$= \frac{\sqrt{2} - 1}{\sqrt{2}} \times \frac{\sqrt{2}}{1}$

$= (\sqrt{2} - 1)$

64.(d) $(\Delta V)_{Hg} = (\Delta V)_{flask}$

or, $V_m\gamma_m = V_g\gamma_g$

or, $V_m = \frac{2000 \times 3 \times 9 \times 10^{-6}}{1.8 \times 10^{-4}}$

$= \frac{2000 \times 27 \times 10^{-6}}{180 \times 10^{-6}} = 300$ cc

65.(b) $\eta = 0.6 = 1 - \frac{Q_2}{Q_1}$

or, $\frac{Q_2}{Q_1} = 1 - 0.6 = 0.4$

or, $Q_1 = \frac{20}{0.4} = 50$J

$W = Q_1 - Q_2 = 50 - 20 = 30$ J

66.(a) $2f = f + (56 - 1)4$
or, $f = 55 \times 4 = 220$ Hz

67.(d) For first $Q_1 = C_1V_1$
$= 10^{-6} \times 6 \times 10^3$
$= 6 \times 10^{-3}$ C
For 2nd $Q_2 = C_2V_2 = 10^{-6} \times 4$
$= 4 \times 10^{-6}$C
In series, $C_{eq} = \frac{C}{2} = \frac{10^{-6}}{2}$
$\therefore$ $Q_2 = C_{eq}$ V
or, $V = \frac{4 \times 10^{-6}}{\frac{10^{-6}}{2}} = 8V$

68.(b) Potential difference (V_p)
$= 0.1 \times 1000$ mV
$= 100$ mV $= 0.1$V
$I = \frac{V_p}{R_p} = \frac{E}{R + R_p}$
or, $R + 40 = \frac{2 \times 40}{0.1}$
or, $R + 40 = 800$
or, $R = 760\ \Omega$

69.(c) $E = L\frac{dI}{dt}$
$= 0.5 \times \frac{10}{2} = 2.5$ V

70.(b) $\mu = \frac{1}{\text{sinc}} = \frac{1}{\sin 45°} = \sqrt{2}$
$e = 0$ so $r_2 = 0$
$r_1 + r_2 = A$
or, $r_1 = A = 30°$
Here $\mu = \frac{\sin i_1}{\sin r_1}$
or, $\sqrt{2} \times \sin 30° = \sin i_1$
or, $\sin i_1 = \sin 45°$
$i_1 = 45°$

71.(c) $\theta = \frac{\beta}{D} = \frac{D\lambda}{dD}$
or, $1 \times \frac{\pi}{180} = \frac{\lambda}{d}$
or, $d = \frac{\lambda_N 80}{\pi} = \frac{6280 \times 180 \times 10^{-10}}{\pi}$
$= 3.6 \times 10^{-5}$ m
$= 3.6 \times 10^{-2}$ mm
$= 0.036$ mm

72.(d) $I \propto \frac{1}{r^2}$
or, $\frac{I'}{I} = \left(\frac{r}{r'}\right)^2$
$= \left(\frac{4}{1}\right)^2$
or, $I' = 16 \times 5 = 80$ mA

73.(b) $\frac{A}{A_0} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$
or, $\frac{5.25}{100} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$
or, $\frac{1}{16} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$
or, $\left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$
or, $t = 4T_{1/2}$
$= 4 \times 10$ yrs
$= 40$ yrs

74.(c) Due to presence of 4 6 bonding pair of electrons, VSEPR theory gives the sec-saw structure or square planner bipyridimal.

75.(c) n = 3, M-shell and l = 2, d. Sub shell, the maximum no. of electrons in 3d is 10.

76.(b) Change in O.N. of element is N which is present in reactant is HNO_3

77.(b) $\frac{W}{E} = \frac{N \times V_{ml}}{1000}$
$\frac{4.9}{49} = \frac{N \times 500}{1000}$
N = 0.2 N

78.(b) Bond strength increases with bond order.

79.(c) Both oxidized and reduced simultaneously.

80.(c) SN_1 reactions proceed through carbonation intermediates. The rate depends on carbocation stability, which follows the order 3° > 2° > 1° > methyl.

81.(c) C_4H_8 can exists as alkenes (with C = C) or cycloalkane, draw all possible structures including different positions of the double bond and ring structures.

82.(d) Here, $y = e^{\sqrt{5x - 3 - 2x^2}}$
$\Rightarrow$ $5x - 3 - 2x^2 \geq 0$
$\Rightarrow$ $(x - 1)\left(x - \frac{3}{2}\right) \leq 0$
$\Rightarrow$ $x \in \left[1, \frac{3}{2}\right]$
$\therefore$ Domain $= \left[1, \frac{3}{2}\right]$

83.(d) 4th term from end = (8 – 4 + 2)th term from the beginning
= 6th term
$t_6 = t_{5+1} = {}^8C_5 \left(\frac{x}{2}\right)^{8-5}\left(-\frac{2}{x}\right)^5$
$= {}^8C_5 \cdot \frac{2^2}{x^2}$

84.(a) No. of ways ${}^{16}C_3 - {}^8C_3 = 504$

85.(c) x, y, z are in GP
$\Rightarrow$ $l$nx, $l$ny, $l$nz are in AP
$\Rightarrow$ 1 + $l$nx, 1 + $l$ny, 1 + $l$nz are in AP
$\Rightarrow$ $\frac{1}{1 + l\text{nx}}, \frac{1}{1 + l\text{ny}}, \frac{1}{1 + l\text{nz}}$ are in HP

86.(d) $\tan3\theta = \cot\theta$

or, $\tan3\theta = \tan\left(\frac{\pi}{2} - \theta\right)$

or, $3\theta = n\pi + \left(\frac{\pi}{2} - \theta\right)$

$\therefore$ $\theta = (2n+1)\frac{\pi}{8}$

87.(d) $\vec{a}.\vec{b} = \vec{b}.\vec{c} = \vec{c}.\vec{a} = 0$

$|\vec{a}| = |\vec{b}| = |\vec{c}| = 1$

We have, $|\vec{a} + \vec{b} + \vec{c}|^2 = a^2 + b^2 + c^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a})$

$= 1 + 1 + 1 + 0$

$\therefore$ $|\vec{a} + \vec{b} + \vec{c}| = \sqrt{3}$

88.(d) Given, $4X - 5Y + 33 = 0$

$\Rightarrow$ $Y = \frac{4}{5}X + \frac{33}{5}$

i.e. $b_{YX} = \frac{4}{5}$

and $20X - 9Y - 107 = 0$

$\Rightarrow$ $X = \frac{9}{20}Y + \frac{107}{20}$

i.e. $b_{XY} = \frac{9}{20}$

$r = \sqrt{b_{XY}.b_{YX}} = \sqrt{\frac{9}{20} \times \frac{4}{5}} = \frac{3}{5} = 0.6$

89.(a) $a = 1, b = -2, c = 2$

D.C's $l = \frac{1}{\sqrt{6}}, m = -\frac{2}{\sqrt{6}}, n = \frac{2}{\sqrt{6}}$

Required projection $= (x_2 - x_1)\,l + (y_2 - y_1)\,m + (z_2 - z_1)n$

$= 2 \times \frac{1}{\sqrt{6}} + (-6)\left(-\frac{1}{\sqrt{6}}\right) + 2 \times \frac{2}{\sqrt{6}}$

$= 2\sqrt{6}$

90.(c) $m + 2m = -\frac{2h}{b}$

$3m = -\frac{2h}{b}$

i.e. $m = -\frac{2h}{3b}$

and $m.2m = -\frac{a}{b}$

$2\left(-\frac{2h}{3b}\right)^2 = \frac{a}{b}$ $\therefore$ $8h^2 = 9ab$

91.(a) Eq^n of parabola: $y^2 = 4ax$

It passes through the point $(-3, 2)$

So, $4 = 4a(-3)$

$\Rightarrow$ $4a = -\frac{4}{3}$

Length of latus rectum $= |4a| = \frac{4}{3}$

$\therefore$ Length of semi rectum $= \frac{2}{3}$

92.(a) $\lim_{n \to \infty} \frac{1 + 2 + 3 + ... + n}{n^2}$

$= \lim_{n \to \infty} \frac{\frac{n(n+1)}{2}}{n^2}$

$= \lim_{n \to \infty} \frac{n(n+1)}{2n^2}$

$= \lim_{n \to \infty} \frac{1}{2}\left(1 + \frac{1}{n}\right) = \frac{1}{2}$

93.(d) $Rf'(2) = \lim_{h \to 0} \frac{f(2+h) - f(2)}{h}$

$= \lim_{h \to 0} \frac{2(2+h) - 1 - (4-1)}{h} = 2$

$Lf'(2) = \lim_{h \to 0} \frac{f(2-h) - f(2)}{-h}$

$= \lim_{h \to 0} \frac{2 - h + 1 - 3}{-h} = 1$

$Rf'(2) \neq Lf'(2)$

i.e. $f'(2)$ doesnot exist.

94.(b) Let $m = \frac{dy}{dx}$

Then $m = -3x^2 + 6x + 9$

$\frac{dm}{dx} = -6x + 6$

$\frac{d^2m}{dx^2} = -6 < 0$ (max.)

For max. or min, $\frac{dm}{dx} = 0 \Rightarrow x = 1$

95.(a) Put $x^x = t$

Then, $x^x(1 + ln x)\,dx = dt$

$I = \int dt = t + c = x^x + c$

96.(d) Total area

$= A_1 + A_2$

$= \int_0^{\pi} ydx + \left|\int_{\pi}^{2\pi} ydx\right|$

$= 4$ sq. units.

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

...Best of Luck...