Section – I

1.(b) Average Speed $= \dfrac{x}{\dfrac{x}{2\times40}+\dfrac{x}{2\times60}} = \dfrac{2\times40\times60}{40+60}$

$= 48$ km/hr

2.(c) In circular path speed is constant so KE is same

3.(c) Moment of inertia of disc about axis on plane & passing through centre is $I_{CM} = \frac{1}{4}MR^2$

So, $I = I_{CM} + MR^2$

$= \frac{1}{4}MR^2 + MR^2 = \frac{5}{4}MR^2$

4.(b) $g = \dfrac{GM}{R^2}$

Again, $g' = \dfrac{GM}{(\frac{R}{2})^2} = 4\dfrac{GM}{R^2} = 4g$

5.(b) During adiabatic expansion temperature and pressure fall.

6.(d) $ms_1(32 - 20) = ms_2(40 - 32)$

or, $12s_1 = 8s_2$

or, $\dfrac{s_1}{s_2} = \dfrac{2}{3}$

7.(a) $a_0 = A\omega^2$, $v_0 = A\omega$

or $w = \sqrt{\dfrac{a_0}{A}}$ or, $v_0 = A\sqrt{\dfrac{a_0}{A}}$

or, $v_0 = \sqrt{Aa_0}$

or, $A = \dfrac{v_0^2}{a_0}$

8.(a) $f = \dfrac{v}{\lambda} = \dfrac{4v}{\lambda'}$

or, $\lambda' = 4\lambda$

9.(a) $V_1 = V_2$

or, $\dfrac{Q_1}{4\pi\varepsilon_0 r_1} = \dfrac{Q_2}{4\pi\varepsilon_0 r_2}$

or, $\dfrac{Q_1}{Q_2} = r_1 : r_2$

10.(a) $Q = CV_1$ on inserting dielectric C increases so Q also increases

11.(c) $\dfrac{R'}{R} = \left(\dfrac{1.25l}{l}\right)^2 = 1.5625$

% increase $= \left(\dfrac{R'}{R} - 1\right) \times 100$ %

$= (1.5625 - 1)\times100\%$

$= 56.25$ %

12.(c) act as ideal voltmeter

13.(b) $M = ml$

for L shape

Each part $M' = \dfrac{M}{2}$

$M_R = \sqrt{(\frac{M}{2})^2 + (\frac{M}{2})^2} = \dfrac{M}{2}\sqrt{2} = \dfrac{M}{\sqrt{2}}$

14(c) $\dfrac{I_{max}}{I_{min}} = \left(\dfrac{a_1 + a_2}{a_1 - a_2}\right)^2$

or, $\dfrac{9}{1} = \left(\dfrac{a_1 + a_2}{a_1 - a_2}\right)^2$

or, $3a_1 - 3a_2 = a_1 + a_2$

or, $2a_1 = 4a_2$

or, $\dfrac{a_1}{a_2} = 2 : 1$

15.(a) $m = \dfrac{1}{n} = \dfrac{v}{u}$

or, $v = \dfrac{u}{n}$

Now, $-\dfrac{1}{f} = \dfrac{1}{u} + \dfrac{1}{v} = \dfrac{1}{u} - \dfrac{n}{u}$

or, $-\dfrac{1}{f} = \dfrac{1 - n}{u} = -\dfrac{(n - 1)}{u}$

or, $u = (n - 1)f$

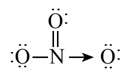
16.(b) $hf = \phi + KE$

17.(a) $I_c = I_e - I_b = 90 - 1 = 89mA$

$\beta = \dfrac{I_c}{I_b} = \dfrac{89\times10^{-3}}{1\times10^{-3}} = 89$

18.(d) $8\overset{0}{Al} + 3Fe_3O_4 \longrightarrow 4\overset{+3\times8}{Al_2}O_3 + 9Fe$ (+24)

Al loose 24 & Fe gain 24 electron

19.(d) 
4-bond pair
8 lone pair

20.(d)

	A = K^+	B = Ca^{++}	C = Cl^-	D = S^{--}
e	18	18	18	18
p	19	20	17	16

↓ electrons are less effectively attracted by the nucleus so large size. Thus low ionization energy.

21.(d) Electron in same energy orbital filled singly to have maximum spin multiplicity.

22.(c) a, b and d are salt of strong acid & strong base does not hydrolyze.

23.(d)

24.(d) neopentane $CH_3 - C(CH_3)_2 - CH_3$ has only one degree carbon and hence gives only monochloro derivative.

25.(a) Larger cation develops less polarization in anion and thus KI has more ionic nature & more soluble.

26.(c) $Ag_2S + KCN \longrightarrow 2Na[Ag(CN)_2] + Na_2S$

27.(d)

28.(b)

29.(b) $A - B = \{x : x \in A \text{ and } x \notin B\} = A \cap B^c$

30.(c) $A \Delta B = (A \cup B) - (A \cap B) = \{1, 3, 6\}$

31.(b) e^x is defined for all x.
$\therefore$ Its domain = $(-\infty, \infty)$

32.(b) $f(-1) = \frac{-1 - |-1|}{|-1|} = \frac{-1 - 1}{1} = -2$

33.(d) For domain, $|x| - x > 0$
$\Rightarrow |x| > x$
$\Rightarrow x < |x|$
This is true if $x < 0$
$\therefore D_f = (-\infty, 0)$

34.(c) There are 9 parallel Horizontal lines and 9 parallel vertical lines. To form rectangle we take two lines from each set. So, total no. of rectangles $^9c_2 \times {^9c_2} = 1296$.

35.(c) Total number of arrangement of letters of 'BANANA' with out any restriction $= \frac{6!}{2!\,3!} = 60$.
Total number of arrangment in which two N's come together $= \frac{5!}{3!} = 20$.
Req. no. of arrangments = 60 – 20 = 40.

36.(d) $\sum_{r=0}^{10} C(10, r)\, 2^{10-r}\, 3^r = (2 + 3)^{10} = 5^{10}$

37.(b) Focal radius = focal distance.

38.(b) $(1 - 2x + 3x^2)\, e^{-x}$
$= (1 - 2x + 3x^2)\left(1 - \frac{x}{1!} + \frac{x^2}{2!} - \frac{x^3}{3!} + \frac{x^4}{4!} - \frac{x^5}{5!} \ldots\right)$
$\therefore$ Coefficient $x^5 = -\frac{1}{5!} - \frac{2}{4!} - \frac{3}{3!}$
$= -\frac{71}{120}$

39.(c) If $A = \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{bmatrix}$ and $abc \neq 0$
Then $A^{-1} = \begin{bmatrix} \frac{1}{a} & 0 & 0 \\ 0 & \frac{1}{b} & 0 \\ 0 & 0 & \frac{1}{c} \end{bmatrix}$

40.(c) Here, $x + 2y + 2z = 1$
and $2x + 4y + 4z = 9$ are parallel
So, No solution

41.(c) Since $\omega = \frac{-1 + i\sqrt{3}}{2} \Rightarrow -i\omega = \frac{i + \sqrt{3}}{2} = z$
$\therefore -i\omega = z \Rightarrow z^{69} = (-i\omega)^{69}$
$= (-i)^{69}.\omega^{68}.(i\omega^{69})$
$= (-1)^{69} . (i\omega)^{68} . (i\omega)$
$= -1.i^{68}.w^{69}.(i)$
$= -1.(\omega^3)^{23}.i = -i$

42.(c) The multiplicative inverse of 7 + 24i is
$\frac{1}{7 + 24i} = \frac{1}{7 + 24i} \times \frac{7 - 24i}{7 - 24i} = \frac{7 - 24i}{625}$

43.(d) $\lim_{x \to \infty} \left(1 + \frac{4}{x}\right)^{3x} = \left\{\lim_{x \to \infty} \left(1 + \frac{4}{x}\right)^x\right\}^3$
$= (e^4)^3 = e^{12}$

44.(b) $\lim_{n \to \infty} \left[\left(\frac{1}{2} - \frac{1}{3}\right) + \left(\frac{1}{3} - \frac{1}{4}\right) + \ldots + \left(\frac{1}{n} - \frac{1}{n+1}\right)\right]$
$= \lim_{n \to \infty} \left(\frac{1}{2} - \frac{1}{n+1}\right) = \frac{1}{2} - \frac{1}{\infty} = \frac{1}{2}$

45.(a) $f'(x) = \frac{|2 + x|}{2 + x}$ $\left[\because \frac{d}{dx}|x| = \frac{|x|}{x}\right]$
$\therefore f'(-3) = \frac{|2 - 3|}{2 - 3} = \frac{1}{-1} = -1$

46.(c) $\frac{d}{dx}(x^6 + 6^x) = 6x^5 + 6^x \log 6$

47.(a) $\frac{d}{dx}|x| = \frac{|x|}{x}$
Integrating,
$\int \frac{|x|}{x} dx = |x| + c$

48.(a) $\int a^{3x+3} dx = \int a^{3x}.a^3 dx = a^3 \int a^{3x} dx$
$= a^3.\frac{a^{3x}}{3\log a} + c = \frac{a^{3x+3}}{3\log a} + c$

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

Section – II

61.(b) $h = \frac{1}{2}(g + a)t^2$
or, $t = \sqrt{\frac{2h}{g+a}} = \sqrt{\frac{2 \times 3}{10 + 1.5}} = 0.72s$

62.(a) $\Delta PE = w_f + KE$
or, $w_f = mgr - \frac{1}{2}mv^2$
$w_f = 2 \times 10 \times 1 - \frac{1}{2} \times 2 \times 4^2 = 4J$

63.(b) (PE + KE) at surface = (PE + KE) at height
$-\frac{GMm}{R} + \frac{1}{2}m\left(\frac{v_e}{2}\right)^2 = -\frac{GMm}{R + h} + 0$
or, $\frac{1}{2}m \times \frac{1}{4} \times 2gR = GMm\left[\frac{1}{R} - \frac{1}{R+h}\right]$
or, $\frac{mgR}{4} = gR^2 m\left[\frac{R + h - R}{R(R+h)}\right]$
or, $R + h = 4h$
or, $h = \frac{R}{3}$

64.(c) **1st case**

$I = \frac{V}{R} = \frac{11}{11} = 1A$

$I = \frac{E}{R + r}$

or, $11 + r = 12$

or, $r = 1\Omega$

2nd case

$V = E - Ir$

$= 12 - \frac{E}{R + r} .r$

$= 12 - \frac{12}{5 + 1} \times 1 = 10 \text{ V}$

65.(b) $T_2V_2^{\gamma-1} = T_1V_1^{\gamma-1}$

or, $T_2 = T_1 \left(\frac{V}{\frac{V}{8}}\right)^{5/3-1}$

or, $T_2 = 290\ (8)^{2/3}$

$= 1160 \text{ K}$

$= 887°C$

66.(b) f_t:

$f_s = f_t + 5 \quad l = 20 \text{ cm}$

$f_s' = f_t - 5 \quad l' = 21 \text{ cm}$

$\frac{f_s}{f_s'} = \frac{l'}{l}$

or, $\frac{f_t + 5}{f_t - 5} = \frac{21}{20}$

or, $20 f_t + 100 = 21 f_t - 105$

or, $f_t = 205 \text{ Hz}$

67.(b) $C_1V_1 = (C_1 + C_2)V$

or, $V = \frac{12 \times 10^{-6} \times 100}{12 \times 10^{-6} + 3 \times 10^{-6}}$

$= \frac{12 \times 100}{15} = 80 \text{ V}$

68.(c) Lose in time in a day

$= \frac{1}{2} \alpha\Delta\theta \times 1 \text{ day}$

$= \frac{1}{2} \times 10^{-5} \times 2 \times 86400 \text{ s}$

$= 0.864 \text{ s}$

69.(b) $\frac{P_2}{P_1} = \left(\frac{V_1}{V_1}\right)^2 = \left(\frac{200}{220}\right)^2 = 0.83$

% decrease $= \left(1 - \frac{P_2}{P_1}\right) \times 100\%$

$= (1 - 0.83) \times 100\%$

$= 17\%$

70.(b) $E = B_v l v$

$= B_H l v \tan\delta$

$= 1.6 \times 10^{-5} \times 40 \times \frac{1000 \times 1000}{3600} \times \tan 71.6°$

$= 0.53 \text{ V}$

71.(a) $\beta_a = 0.4 \text{ mm}$

$\frac{\beta_w}{\beta_a} = \frac{\frac{D\lambda_w}{d}}{\frac{D\lambda_a}{d}} = \frac{\lambda_w}{\lambda_a} = \frac{1}{\mu_w}$

or, $\beta_w = \frac{\beta_a}{\mu_w} = \frac{0.4}{4} \times 3 = 0.3 \text{ mm}$

72.(b) Near pt = 10 cm

u = 30 cm, v = –10 cm

$f = \frac{uv}{u + v} = \frac{30(-10)}{30 - 10} = -\frac{300}{20} = -15 \text{ cm}$

73.(c) $KE = \frac{hc}{\lambda} = -\phi$

$= \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{331 \times 10^{-9}} - 1.75 \times 1.6 \times 10^{-19}$

$= 3.2 \times 10^{-19} \text{ J}$

$KE = eV_s$

or, $V_s = \frac{KE}{e} = \frac{3.2 \times 10^{-19}}{1.6 \times 10^{-19}} = 2V$

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

or, $m = m_0 \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

$= 10.38\left(\frac{1}{2}\right)^{\frac{19}{3.8}}$

$= 0.32g$

75.(b) $2H_2O_2 \longrightarrow 2H_2 + O_2$

2 mole   1 mole

5 mole $\frac{1}{2} \times 5$

$= 2.5$ mole

76.(b) NHCl (mix) $= \frac{10 \times 0.1}{100} = 0.01 \text{ N}$

77.(c) $S_{SO_4^{--}} = \frac{K_{sp}}{S_{Ba^{++}}}$

$= \frac{1.5 \times 10^{-9}}{0.1}$

$= 1.5 \times 10^{-8}$

78.(d) moles of I $= \frac{254}{127} = 2$

moles of O $= \frac{80}{16} = 5$

(I_2O_5)

79.(d)

$H-C\equiv C-H \xrightarrow[Hg^{++}/H^+]{H_2O} H_2C=CH(OH) \longrightarrow CH_3CHO$ (acetaldehyde)

80.(c)

81.(d)

82.(a) $f(4) = \int_0^x x^3\,dx = \frac{4^4}{4} = 4^3 = 64$

83.(c) $-1 \le \sin x \le 1$

$\therefore$ Min value of $\sin x = -1$

84.(b) Here, given curves $y = \sqrt{x} \Rightarrow y^2 = x$

$x = \sqrt{y} \Rightarrow x^2 = y$

Area common to these curve

$= \frac{\text{Coeff. of x} \times \text{coeff. of y}}{3} = \frac{1}{3}$

85.(a) For x-intercept

Put $y = 0$, $2x + 0 = 6$

$x = 3$

86.(d) Bisector of $\angle XOY$ is $y = x$

The equation of required line is

$y = 1.x - 2$ $[\therefore\ y = mx + c]$

$\Rightarrow\ x - y - 2 = 0$

87.(a) Here, $S_n = 3n^2 + 5n$

But $t_n = S_n - S_{n-1}$

$164 = 3n^2 + 5n - [3(n-1)^2 + 5(n-1)]$

$\Rightarrow\ 164 = 3n^2 + 5n - [3n^2 - 6n + 3 + 5n - 5]$

$\Rightarrow\ 164 = 6n + 2$

$\Rightarrow\ n = 27$

88.(a) Calculate: $r = \frac{15 \times 4 - 39}{4 + 3} = \frac{21}{7} = 3$

Coefficient of $x^{39} = C(15, 3)$

$= 455$

89.(c) We know,

$\cos B = \frac{a^2 + c^2 - b^2}{2ac} = \frac{9 + 25 - 16}{2.3.5} = \frac{3}{5}$

$\therefore\ \sin B = \sqrt{1 - \left(\frac{3}{5}\right)^2} = \sqrt{\frac{16}{25}} = \frac{4}{5}$

$\therefore\ \sin 2B = 2\sin B \cos B = 2.\frac{3}{5}.\frac{4}{5} = \frac{24}{25}$

90.(b) $4\sin^{-1}x + \cos^{-1}x = \pi$

$\Rightarrow\ 4\sin^{-1}x + \frac{\pi}{2} - \sin^{-1}x = \pi$

$\Rightarrow\ 3\sin^{-1}x = \frac{\pi}{2}$

$\Rightarrow\ \sin^{-1}x = \frac{\pi}{6}$

$\therefore\ x = \sin\left(\frac{\pi}{6}\right) = \frac{1}{2}$

91.(c)

92.(b) Distance $= \left|\frac{\frac{1}{2} + 1}{\sqrt{9 + 16 + 144}}\right| = \frac{3}{2\sqrt{169}} = \frac{3}{26}$ unit

93.(b) $\tan 2\theta \tan\theta = 1$

$\Rightarrow\ \tan 2\theta = \cot\theta$

$\Rightarrow\ \tan 2\theta = \tan\left(\frac{\pi}{2} - \theta\right)$

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

$\Rightarrow\ 3\theta = \left(n + \frac{1}{2}\right)\pi$

$\therefore\ \theta = \left(n + \frac{1}{2}\right)\frac{\pi}{3}$

94.(c) Eccentricity $= \sqrt{1 + \frac{a^2}{a^2}} = \sqrt{1 + 1} = \sqrt{2}$

95.(a) $k\hat{a} = \vec{a} \Rightarrow k = \frac{\vec{a}}{\hat{a}} = \frac{\vec{a}}{\frac{\vec{a}}{\vec{a}}} = |\vec{a}|$

96.(d) Projection of $\vec{b}$ on $\vec{a} = \frac{\vec{b}.\vec{a}}{|\vec{a}|}$

$= \frac{10 - 3 + 2}{\sqrt{2^2 + 1^2 + 2^2}}$

$= \frac{9}{\sqrt{9}} = 3$

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

…The End…