Section - I

1. (d) $x^2 = 16 \Rightarrow x = \pm 4$
$x^2 - 5x + 6 = 0 \Rightarrow x = 2, 3$
$\therefore \quad A = \{-4, 4\} \cup \{2, 3\} = \{-4, 2, 3, 4\}$

2. (b)

3. (d) $\sec^2(\tan^{-1}3) + \text{cosec}^2(\cot^{-1}4)$
$= 1 + \tan^2(\tan^{-1}3) + 1 + \cot^2(\cot^{-1}4)$
$= 1 + 3^2 + 1 + 4^2$
$= 27$

4. (d) General values give infinite solution.

5. (b) If a & b are negative numbers then $G = -\sqrt{ab}$

6. (b) $n! = n!$
$(n + 1)! = (n + 1).n!$
$(n + 2)! = (n + 2)(n + 1).n!$
$\therefore \quad$ H.C.F = n!

7. (b) $\begin{vmatrix} 2 & 3 \\ 4 & -k \end{vmatrix} = 0$
$\Rightarrow \quad -2k - 12 = 0$
$\Rightarrow \quad k = -6$

8. (c) $x^2 = -a^2$
$\therefore \quad x = \pm ai$

9. (b) Formula

10. (c) For point of discontinuity, $x - 2 = 0$
$\Rightarrow \quad x = 2$

11. (d) $y = \sqrt{x + y}$
or, $y^2 = x + y$
or, $2y\dfrac{dy}{dx} = 1 + \dfrac{dy}{dx}$
$\therefore \quad \dfrac{dy}{dx} = \dfrac{1}{2y - 1}$

12. (c) Since $\sin^{11}x$ is odd function, $\int_{-11}^{11} \sin^{11}x \, dx = 0$

13. (c) Slope of normal $= -\dfrac{dx}{dy}$
Then, $-\dfrac{dx}{dy} = \tan 0 = 0$
$\therefore \quad \dfrac{dx}{dy} = 0$

14. (a) $A = \int_2^3 y\,dx = \int_2^3 4x^3 dx = \left[\dfrac{4x^4}{4}\right]_2^3 = 3^4 - 2^4 = 65$

15. (c) $\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times (\vec{c} + \vec{a}) + \vec{c} \times (\vec{a} + \vec{b})$
$= \vec{a} \times \vec{b} + \vec{a} \times \vec{c} + \vec{b} \times \vec{c} + \vec{b} \times \vec{a} + \vec{c} \times \vec{a} + \vec{c} \times \vec{b}$
$= \vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} - \vec{c} \times \vec{a} - \vec{a} \times \vec{b} - \vec{b} \times \vec{c}$
$= 0$

16. (d) $|\vec{a}| = 1, |\vec{b}| = 1$
$\therefore \quad |\vec{a}| = |\vec{b}|$, option (d) is always true.

17. (b) Distance between parallel lines
$= \left|\dfrac{c_1 - c_2}{\sqrt{a^2 + b^2}}\right| = \left|\dfrac{-11 - 23}{\sqrt{3^2 + 5^2}}\right| = \sqrt{34}$

18. (a) $c = \dfrac{a}{m}$
or, $3 = \dfrac{a}{2}$
$\therefore \quad a = 6$

19. (b) Formula

20. (c) $a^2 = 9, b^2 = 16$
$e = \sqrt{1 + \dfrac{b^2}{a^2}} = \sqrt{1 + \dfrac{16}{9}} = \dfrac{5}{3}$
Foci $= (\pm ae, 0) = \left(\pm \dfrac{5}{3}.3, 0\right) = (\pm 5, 0)$

21. (c) Speed is maximum in medium of least refractive index i.e. air

22. (b) At resonance $V_L = V_C$ so I and V are in phase.

23. (b) $\dfrac{(e/m)_p}{(2e/4m)_\alpha} = 2:1$

24. (d) $r = \dfrac{P}{\rho_T} = \dfrac{10^5}{1.775 \times 300} = 188 \text{ JKg}^{-1}\text{K}^{-1}$

25. (c) $M = 2ml$ or, $2l = \dfrac{M}{m} = \dfrac{5}{25} = 0.2$ m

26. (a) $I = \dfrac{ne}{t}$
or, $\dfrac{n}{t} = \dfrac{I}{e} = \dfrac{16 \times 10^{-3}}{16 \times 10^{-19}} = 1 \times 10^{17}$/s

27. (c) KE = PE
or, $\dfrac{1}{2}m\omega^2(r^2 - y^2) = \dfrac{1}{2}m\omega^2y^2 = \dfrac{1}{2}m\omega^2y^2$
or, $r^2 - y^2 = y^2$
or, $2y^2 = r^2$
or, $y = \dfrac{r}{\sqrt{2}} = \dfrac{4}{\sqrt{2}} = 2\sqrt{2}$ cm = 2.8 cm

28. (c) $\dfrac{mg'}{mg} = \left(\dfrac{R}{R + \dfrac{R}{2}}\right)^2 = \dfrac{4}{9}$
$\therefore \quad mg' = \dfrac{4}{9} \times 90 = 40$ N

29. (d) $\Delta P = mv - (-mu)$
$= mv + mu$
$= 0.1 \times 20 + 0.1 \times 30 = 5$ NS

30. (c) Resistance of each part $R' = \dfrac{R}{3}$
In parallel
$R_{eq} = \dfrac{R'}{3} = \dfrac{R}{9} = \dfrac{90}{9} = 10\ \Omega$

31. (a) $L = 10\log\dfrac{I}{I_0}$
or, $40 = 10\log\dfrac{10^{-12}}{I_0}$
or, $\dfrac{10^{-12}}{I_0} = 10^4$
or, $I_0 = \dfrac{10^{-12}}{10^4} = 10^{-16}$ w/cm^2

32. (c) The sensitivity increases if potential gradient decreases.

33. (c) $\frac{\Delta V}{V} = 0.12\%$

or, $\gamma\Delta\theta = 0.12\%$

or, $3\alpha\Delta\theta = 0.12\%$

or, $\alpha = \frac{0.12}{100 \times 3 \times 20} = 2 \times 10^{-5}/°C$

34. (a) Potential difference between plates remain same if source is connected across it.

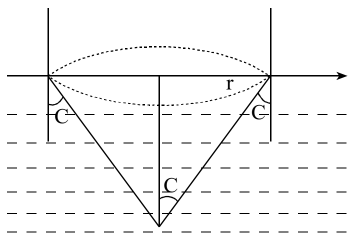
35. (b) $PE = \frac{Q_1Q_2}{4\pi\varepsilon_0 r}$

Charge of electron is –ve so

$PE = \frac{(-e)(-e)}{4\pi\varepsilon_0 r} = \frac{e^2}{4\pi\varepsilon_0 r}$

if r decreases PE increases.

36. (c)



$\tan C = \frac{r}{h}$

or, $r = h \tan C = h\frac{\sin C}{\cos C}$

$= \frac{h}{\mu\sqrt{1-\sin^2 C}}$

$= \frac{h \times \mu}{\mu\sqrt{\mu^2 - 1}} = \frac{1}{\sqrt{\mu^2 - 1}}$

37. (b) $\alpha = \frac{\Delta I_c}{\Delta I_e}$

or, $0.9 = \frac{\Delta I_c}{\Delta I_c + \Delta I_b}$

or, $0.9\,\Delta I_c + 0.9\,\Delta I_b = \Delta I_c$

or, $0.9\,\Delta I_b = 0.1\,\Delta I_c$

or, $\Delta I_c = 9 \times 2 = 18\ \mu A$

38. (c) No. of p^+s = 27 – 14 = 13

No. of p^+s = no. of e^- s : Al : 2, 8, 3, III[rd] period.

39. (b)

40. (c)

41. (b)

42. (c)

43. (d)

44. (b)

45. (b)

46. (c)

$H - C \equiv C + H_2 \xrightarrow{Pd/BaSO_4} CH_2 = CH_2$

47. (b)

48. (c) Above reaction is disproportionation reaction i.e., Br_2 is O.A. as well as R.A.

As, O.A., eq. wt. of $Br_2 = \frac{M}{2}$

As, R.A., eq. wt. of $Br_2 = \frac{M}{10}$

$$\left[\overset{0}{Br_2} + NaOH \longrightarrow \overset{-1}{NaBr} + \overset{+5}{NaBrO_3} + H_2O\right]$$

English

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

Section - II

61. (d) $\sin^{-1}(x-3) \Rightarrow -1 \le x - 3 \le 1$

$\Rightarrow\ 2 \le x \le 4$ ... (i)

For denominator, $9 - x^2 > 0$

$\Rightarrow\ x^2 < 9$

$\Rightarrow\ |x| < 3$

$\Rightarrow\ -3 < x < 3$ .... (ii)

Thus, domain is $2 \le x < 3$

[intersection of (i) and (ii)]

i.e. [2, 3)

62. (b) $\frac{b^2 - c^2}{2aR} = \frac{4R^2(\sin^2 B - \sin^2 C)}{2.2R\sin A.R} = \frac{\sin(B+C)\sin(B-C)}{\sin A}$

$= \sin(B - C)$

63. (d) $\begin{vmatrix} 2 & -1 & 1 \\ 1 & 2 & -3 \\ 3 & a & 5 \end{vmatrix} = 0$

i.e. $2\begin{vmatrix} 2 & -3 \\ a & 5 \end{vmatrix} - (-1)\begin{vmatrix} 1 & -3 \\ 3 & 5 \end{vmatrix} + 1\begin{vmatrix} 1 & 2 \\ 3 & a \end{vmatrix} = 0$

$\Rightarrow\ a = -4$

64. (b) Apply $R_3 \to R_3 - xR_1 - yR_2$

$\begin{vmatrix} a & b & ax + by \\ b & c & bx + cy \\ 0 & 0 & -(ax^2 + 2bxy + cy^2) \end{vmatrix} = 0$

$\Rightarrow\ (ac - b^2)(ax^2 + 2bxy + cy^2) = 0$

$\Rightarrow\ b^2 = ac$

i.e. a, b, c are in G.P.

65. (a) $-\left\{-\frac{\left(\frac{1}{n+1}\right)}{1} - \frac{\left(\frac{1}{n+1}\right)^2}{2} - \frac{\left(\frac{1}{n+1}\right)^3}{3} - \dots\right\}$

$= -\log_e\left(1 - \frac{1}{n+1}\right) = -\log_e\left(\frac{n}{n+1}\right)$

$= \log_e\left(\frac{n+1}{n}\right) = \log_e\left(1 + \frac{1}{n}\right)$

66. (a) If two O's are taken as one letter, then the no. of arrangements = 5! = 120

If no restriction is enforced, total no. of arrangements

$= \frac{6!}{2!} = 360$

Hence if no two O's are together, then no. of arrangements = 360 – 120 = 240

67. (d) $\dfrac{(\cos\theta + i\sin\theta)^4}{i^5(\cos\theta - i\sin\theta)^5} = \dfrac{\cos4\theta + i\sin4\theta}{i(\cos5\theta - i\sin5\theta)}$
$= -i\{\cos(4\theta + 5\theta) + i(\sin(4\theta + 5\theta)\}$
$= \sin9\theta - i\cos9\theta$

68. (b) Equation of angle bisectors of $x^2 - 2pxy - y^2 = 0$
$-p(x^2 - y^2) = [1 - (-1)]\, xy$
$px^2 + 2xy - py^2 = 0$
This equation is identical to $x^2 - 2qxy - y^2 = 0$
So, $\dfrac{p}{1} = \dfrac{2}{-2q} = \dfrac{-1}{-1} \Rightarrow pq = -1$

69. (a) Given planes are $2x + y + 2z - 8 = 0$
& $2x + y + 2z + \dfrac{5}{2} = 0$
Distance $= \left|\dfrac{d_1 - d_2}{\sqrt{a^2 + b^2 + c^2}}\right| = \left|\dfrac{-8 - \dfrac{5}{2}}{\sqrt{2^2 + 1^2 + 2^2}}\right|$
$= \dfrac{21}{2 \times 3} = \dfrac{7}{2}$

70. (a) $9x^2 + 5y^2 - 30y = 0$
or, $\dfrac{x^2}{5} + \dfrac{(y-3)^2}{9} = 1$
$a^2 = 5, b^2 = 9$
$e = \sqrt{1 - \dfrac{a^2}{b^2}} = \sqrt{1 - \dfrac{5}{9}} = \dfrac{2}{3}$

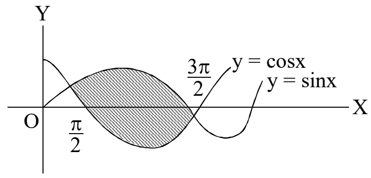
71. (a) $\lim\limits_{x \to \infty} \dfrac{\frac{1}{2}\left(\frac{2}{5}\right)^x - \left(\frac{3}{5}\right)^x}{4.\left(\frac{4}{5}\right)^x + 5^2}$
(Dividing each term by 5^x) $= \dfrac{0 - 0}{0 + 25} = 0$

72. (a) $f'(x) = \dfrac{(1 + |x|).1 - x\dfrac{d}{dx}(1 + |x|)}{(1 + |x|)^2}$
$= \dfrac{(1 + |x|) - x.\dfrac{|x|}{x}}{(1 + |x|)^2} = \dfrac{1}{(1 + |x|)^2}$

73. (b) $\displaystyle\int_0^{\frac{\sqrt{3}}{2}} \frac{dx}{\sqrt{1 - x^2}} = [\sin^{-1}x]_0^{\frac{\sqrt{3}}{2}}$
$= \sin^{-1}\left(\dfrac{\sqrt{3}}{2}\right) - \sin^{-1}(0)$
$= \dfrac{\pi}{3} - 0$
$= \dfrac{\pi}{3}$

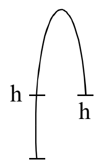
74. (b) $y = 2x^2 - x + 1 \Rightarrow \dfrac{dy}{dx} = 4x - 1$
For the tangent to be parallel with $y = 3x + 9$,
$4x - 1 = 3$
$x = 1$
When $x = 1$, $y = 2 \times 1^2 - 1 + 1 = 2$
Thus the required point is (1, 2)

75. (b)



Point of intersection of $y = \sin x$ and $y = \cos x$ are $\dfrac{\pi}{4}$ and $\dfrac{3\pi}{4}$. Also, $\sin x \ge \cos x$ on the interval $\left[\dfrac{\pi}{4}, \dfrac{5\pi}{4}\right]$.
Also of one such region
$= \displaystyle\int_{\pi/4}^{5\pi} (\sin x - \cos x)dx$
$= 2\sqrt{2}$

76. (b)



$h = u \times 2 - \dfrac{1}{2}g \times 2^2 = u \times 10 - \dfrac{1}{2}g \times 10^2$
or, $2u - 20 = 10u - 500$
or, $8u - 480$
or, $u = 60$ m/s
Again $h = 60 \times 2 - \dfrac{1}{2} \times 10 \times 2^2$
$= 120 - 20 = 100$ m

77. (d) $mr\omega^2 = \mu mg$
or, $\mu = \dfrac{r(2\pi f)^2}{g}$
$= \dfrac{0.1 \times 4\pi^2 \times 1^2}{10} = 0.4$

78. (a) $\tau = I\alpha$
or, $\alpha = \dfrac{500}{100} = 5$ rad/s^2
Again $\omega = \omega_0 + \alpha t$
$= 0 + 5 \times 2 = 10$ rad/s

79. (d) $\dfrac{P_2V}{P_1V} = \dfrac{m_2rT_2}{m_1rT_1}$
or, $\dfrac{m_2}{m_1} = \dfrac{10A}{9.5A} \times \dfrac{280}{300} = 0.98$
or, $m_2 = 0.98 \times 19 = 18.66$ kg
$\therefore$ Mass escape $= 19 - 18.66$
$= 0.33$ kg

80. (b) $\eta = \left(1 - \dfrac{T_1 - 75}{T_1}\right) \times 100\%$
or, $\dfrac{22}{100} = 1 - 1 + \dfrac{75}{T_1}$
or, $T_1 = \dfrac{7500}{22} = 341$ K

81\. (c) $i = e = \frac{3}{4}$ of $A = \frac{3}{4} \times 60 = 45°$

$\delta = 2i - A = 2 \times 45 - 60 = 30°$

82\. (b) $\frac{\beta_r}{\beta_y} = \frac{\lambda_r}{\lambda_y}$

or, $\beta_r = \frac{6.5 \times 10^{-7}}{5.2 \times 10^{-7}} \times 0.2 = 0.25$ mm

83\. (c) $f_0 = \frac{1}{2l}\sqrt{\frac{Tl}{M}}$

$= \frac{1}{2 \times 0.5}\sqrt{\frac{800 \times 0.5}{0.01}} = 200$ Hz

84\. (d) $E = Blv$

$= 0.3 \times 10^{-4} \times 10 \times 5$

$= 1.5 \times 10^{-3}$ V = 1.5 mV

85\. (c) $R_p = \frac{R_1R_2}{R_1 + R_2}$

or, $3.43 = \frac{R_1R_2}{R_1 + R_2}$ ... (1)

$R_s = R_1 + R_2 = 14$ ... (2)

Now $R_1R_2 = 3.43 \times 14 = 48\ \Omega$

or, $R_2 = \frac{48}{R_1}$ So, $R_1 + \frac{48}{R_1} = 14$

or, $R_1^2 - 14R_1 + 48 = 0$

or, $R_1^2 - 6R - 8R_1 - 48 = 0$

or, $(R_1 - 6)(R_1 - 8) = 0$

$\therefore$ $R_1 = 6\Omega$ or 8Ω

$\therefore$ Greater resistors is 8Ω

86\. (b) $I = \frac{V}{Z} = \frac{100}{\sqrt{R_T^2 + X_L^2}}$

$= \frac{100}{\sqrt{(450 + 50)^2 + (2\pi fL)^2}} = 0.124$ A

Voltage across coil

$V' = IZ'$

$= 0.124\sqrt{r^2 + X_L^2}$

$= 0.124\sqrt{50^2 + (2\pi fL)^2} = 78.2$V

87\. (b) PE = 2KE

or, $KE = 9 \times 10^9 \frac{e^2}{r} \times \frac{1}{2}$

$= 9 \times 10^9 \frac{(1.6 \times 10^{-19})^2}{10^{-10} \times 2}$

$= 11.5 \times 10^{-19}$ J

88\. (c) **1st case**

$\frac{hc}{\lambda} = \phi + 3ev_0$

or, $\frac{hc}{2\lambda} - \phi = 3ev_0$ ... (1)

2nd case

$\frac{hc}{2\lambda} = \phi + ev_0$

or, $\frac{hc}{2\lambda} - \phi = ev_0$ .... (2)

From (1) & (2)

$\frac{hc}{\lambda} - \phi = 3\left(\frac{hc}{2\lambda} - \phi\right)$

or, $\frac{hc}{\lambda} - \phi = \frac{3hc}{2\lambda} - 3\phi$

or, $2\phi = \frac{hc}{2\lambda}$

or, $2\frac{hc}{\lambda_0} = \frac{hc}{2\lambda}$

or, $\lambda_0 = 4\lambda$

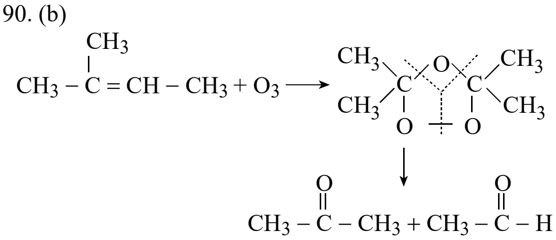
89\. (b) $\frac{A}{A_0} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

or, $\frac{19 - 10}{82 - 10} = \left(\frac{1}{2}\right)^{\frac{210}{T_{1/2}}}$

or, $\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{\frac{210}{T_{1/2}}}$

$T_{1/2} = \frac{210}{3} = 70$s

90\. (b)



91\. (b) $Sb_2S_3 + HCl \longrightarrow 2SbCl_3 + 3H_2S$

$3H_2S + 2HNO_3 \longrightarrow 2NO + 4H_2O + 3S$

↓

Colloidal sulphur

92\. (a) Equivalent volume of chlorine is same in all three cases as valency of chlorine is same. Hence volume becomes same.

93\. (d) HCl and H_3O^+ give acid solution and does $CuSO_4$, when it hydrolyzes in water.

94\. (c) For CaF_2, $K_{sp} = 4S^3$

$S = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{3.2 \times 10^{-11}}{4}\right)^{1/3}$

$= 2 \times 10^{-4}$ moles/litre

$= 2 \times 10^{-4} \times 78$ g/l

or, 1.56×10^{-2} g/l

95\. (b) $N_{min}\ \frac{100 \times 0.2 - 150 \times 0.1}{500} = 0.01$ N of H_2SO_4

$= 0.005$ M of H_2SO_4

$= 0.01$ M of H^+

pH = –log [0.01] = 2

96\. (c) $S_2O_3^{--} + I_2 \longrightarrow S_4O_6^{--} + I^-$

↓

Tetrathionate ions

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

...The End...