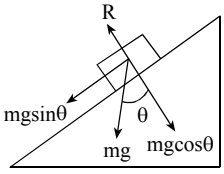
Section - I

1. (c) $t = \sqrt{\frac{2h}{g}}$, remain same for both

2. (c)



Force by plane on block is equal to reaction
i.e. $R = mg\cos\theta$

3. (a) $mg - F_f = ma$

or, $a = \frac{80 \times 10 - 720}{80} = 1\ m/s^2$

4. (b) $\Delta P = \frac{4T}{r}$

or, $r = \frac{4T}{\Delta P} = \frac{4 \times 25 \times 10^{-3}}{20}$

$= 5 \times 10^{-3}$ m

$= 5$ mm

5. (b) Upthrust of liquid decreases on increasing temperrature.

6. (d) Specific heat capacity of matter depends on nature of matter.

7. (b) Convex lens is placed in medium of refractive index greater than material of lens then it act as diverging lens.

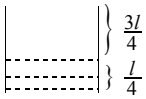
8. (d) Refractive index $(\mu) = \frac{\text{Real depth}}{\text{Apparent depth}}$

$= \frac{12}{5+3} = \frac{12}{8} = 1.5$

9. (d) The Doppler's effect is independent to distance between source and observer.

10. (b) **First case**

$f_0 = \frac{v}{2l}$



2nd case

$f' = \frac{v}{4 \times \frac{3l}{4}} = \frac{2f_0}{3}$

11. (d) $PE = \frac{Q_1Q_2}{4\pi\varepsilon_0 r}$

$= \frac{9 \times 10^9 \times (2 \times 10^{-6})^2}{1} = 0.036$ J

12. (b) $Bq = 2\pi fm$

or, $Bq = \frac{2\pi m}{T}$

or, $T = \frac{2\pi m}{Bq}$

Now $\frac{T_p}{T_\alpha} = \frac{m \times 2e}{e \times 4m} = \frac{1}{2}$

or, $T_\alpha = 2T_p$

13. (b)

14. (d) Characteristic x-ray is due to transition of electron from higher energy level to lower energy level of target atom.

15. (c) $\frac{R'}{R} = \left(\frac{l+2l}{l}\right) = 9$

$\therefore R' = 9 \times 5 = 45\Omega$

16. (c) $P_e = \frac{h}{\lambda}$

or, $mv = \frac{h}{\lambda}$

or, $v = \frac{6.62 \times 10^{-34}}{5200 \times 10^{-10} \times 9.1 \times 10^{-31}} = 1398.9$ m/s

17. (a) $V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{100\sqrt{2}}{\sqrt{2}} = 100V$

$\omega = 100$

$\therefore I = \frac{V_{rms}}{X_c} = \frac{V_{rms}}{\frac{1}{\omega c}}$

$= 100 \times 100 \times 10^{-6}$

$= 0.01$ A

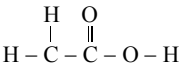
$= 10$ mA

18. (a)

19. (b)

20. (a) PH_3 contains lone pair of electrons

21. (b)



22. (a) $NaNO_3 \xrightarrow{\Delta} NaNO_2 + O_2$

23. (b)

24. (c)

25. (c)

26. (a)

27. (c)

28. (a)

29. (a) $x^2 = 9 \Rightarrow x = \pm 3$

$2x = 4 \Rightarrow x = 2$

There is no value of x which satisfies both the above equations. Thus, $A = \phi$

30. (a)

31. (c) Let $\theta = \cos^{-1}(x)$

Then $\cos\theta = x \Rightarrow -\cos\theta = -x$

or, $-x = \cos(\pi - \theta)$

$\therefore \cos^{-1}(-x) = \pi - \theta$

$= \pi - \cos^{-1}x$

32. (a) $4\cos^2 x = 3$

$\cos^2 x = \left(\frac{\sqrt{3}}{2}\right)^2 = \cos^2\frac{\pi}{6}$

$\therefore \quad x = n\pi \pm \frac{\pi}{6}$

33. (a) $a = 4, b = -17, c = k$

For reciprocal roots, we have $c = a$

$\therefore \quad k = 4$

34. (b) The determinant is zero.

35. (a) $\log_e e + \frac{\log_e 3}{1!} + \frac{(\log_e 3)^2}{2!} + \frac{(\log_e 3)^3}{3!} + ...$

$= 1 + \frac{\log_e 3}{1!} + \frac{(\log_e 3)^2}{2!} + \frac{(\log_e 3)^3}{3!} + ...$

$= e^{\log_e 3}\left(\because e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + ...\right) = 3$

36. (b) Total no. of terms

$= \frac{(n+1)(n+2)}{2} = \frac{(10+1)(10+2)}{2} = 66$

37. (d)

38. (d) Denominator = 0

$\Rightarrow \quad x^2 - x = 0$

$\Rightarrow \quad x(x-1) = 0$

$\therefore \quad x = 0, x = 1$

39. (c) Total no. of relations $= 2^{4\times4} = 2^{16}$

40. (a) $e^{2x+3} = e^{2x}e^3 = e^3\left(1 + \frac{2x}{1!} + \frac{(2x)^2}{2!} + ... + \frac{(2x)^{10}}{10!} + ...\right)$

Taking term with x^{10}

$\frac{e^3 2^{10}}{10!}x^{10}$

Coefficient of $x^{10} = \frac{e^3 2^{10}}{10!}$

41. (a)

42. (c) $(2 - K)x + (-3 + K)y + 4 + 5K = 0$

For horizontal line, slope = 0

$\frac{-(2-K)}{-3+K} = 0 \quad \Rightarrow K = 2$

43. (a) $g = -4, f = \frac{1}{2}, c = -20$

y-intercept $= 2\sqrt{g^2 - c} = 9$

44. (a)

45. (a) Ratio $= -\frac{x_1}{x_2} = \frac{-4}{-1} = 4 : 1$

46. (c) $\cos^{-1}(-x) - \sin^{-1}x$

$= \pi - \cos^{-1}x - \sin^{-1}x = \pi - (\cos^{-1}x + \sin^{-1}x)$

$= \pi - \frac{\pi}{2} = \frac{\pi}{2}$

47. (d)

48. (b)

49. (d) 50. (b) 51. (a) 52. (b) 53. (c) 54. (a)

55. (c) 56. (a) 57. (d) 58. (b) 59. (a) 60. (c)

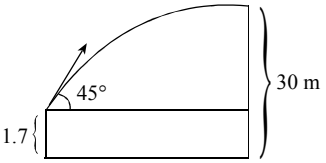
Section - II

61. (b) $a = \frac{v}{M}\frac{dm}{dt} - g$

$= \frac{400}{100} \times 5 - 10$

$= 10 \text{ m/s}^2$

62. (b)



Horizontal motion $v_x = u\cos45° = 100 \times \cos45°$

$= 50\sqrt{2}$ m/s

Vertical motion

$h = 30 - 1.7$

$= 28.3$ m

$v_y = \sqrt{(u\sin45)^2 - 2gh}$

$= \sqrt{\left(100 \times \frac{1}{\sqrt{2}}\right)^2 - 2 \times 10 \times 28.3}$

$= 66.6$ m/s

$\therefore \quad v = \sqrt{v_x^2 + v_y^2}$

$= \sqrt{(50\sqrt{2}^2 + (66.6)^2)}$

$= 97.1$ m/s

63. (d) Reading = wt – upthrust

$= 12 - \frac{v}{2}\sigma g$

$= 12 - \frac{1000}{2} \times 10^{-6} \times 1000 \times 10$

$= 12 - \frac{10}{2}$

$= 7$ N

64. (c) $\frac{f'}{f} = \frac{d}{d'} = \frac{0.9}{0.93} = 0.967$

% change $= \left(\frac{f'}{f} - 1\right) \times 100\%$

$= (0.967 - 1) \times 100\%$

$= -3.3\%$

65. (a) Heat lost by steam = Heat gained by metal

or, $0.762 \times 540 = 48.3 \times s\,(100 - 10.7)$

or, $S = \frac{0.762 \times 540}{48.3 \times 89.3} = 0.095$ cal/g°C

66. (c) $\alpha = \frac{\gamma}{3} = \frac{3.6 \times 10^{-5}}{3} = 1.2 \times 10^{-5}/°C$

$\alpha = \frac{\Delta d}{d\Delta\theta}$

or, $\Delta\theta = \frac{\Delta d}{d\alpha} = \frac{b \times 10^{-3}}{1 \times 1.2 \times 10^{-5}} = 500°C$

67. (a) $w = P_1V_1 \, ln \frac{V_2}{V_1}$

$= 1.01 \times 10^5 \times 10 \times 10^{-3} \, ln \left(\frac{5}{10}\right)$

$= -700$ J

Workdone on gas is 700 J

68. (d) At surface

$V = 9 \times 10^9 \frac{Q}{R} = \frac{9 \times 10^9 \times 10 \times 10_{-6}}{0.1} = 9 \times 10^5$ V

Potential at every point in side sphere is same as potential on surface.

69. (b) $f = \frac{1}{p} = \frac{1}{2} = 0.5$ m

u = 25 cm, v = ? f = 50 cm

Now $v = \frac{fu}{u - f}$

$= \frac{50 \times 25}{25 - 50}$

$= -50$ cm $= 50$ cm virtual

$\therefore$ Near point = 50 cm

70. (c) $\frac{110}{R} = \frac{130}{n\left(\frac{R}{n} + 26 + 0.4\right)}$

or, $\frac{11}{200} = \frac{13}{(200 + 3n)}$

or, $2200 + 33n = 2600$

or, $n = \frac{400}{33} = 12$

71. (a) $L = \frac{\mu_0 N^2 A}{l}$

$\therefore \quad \frac{L'}{L} = \left(\frac{N'}{N}\right)^2$

or, $L' = \left(\frac{500}{600}\right)^2 \times 108$

$= 75$ mH

72. (b) $V - \frac{LdI}{dt} = IR$

or, $200 - 0.5 \frac{dI}{dt} = 5 \times 20$

or, $\frac{dI}{dt} = \frac{100}{0.5} = 200$ A/s

73. (a) $A_0 = 1$ Ci $= 3.7 \times 10^{10}$ dis/s

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

After 9 yrs.

$A_1 = A_0\left(\frac{1}{2}\right)^{\frac{9}{10}} = 3.7 \times 10^{10} (0.5)^{0.9}$

$= 1.98 \times 10^{10}$ dis/s

After 10 yrs

$A_2 = A_0\left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}} = 3.7 \times 10^{10} \left(\frac{1}{2}\right)^{\frac{10}{10}}$

$= 1.85 \times 10^{10}$ dis/s

Now $A_{10}{}^{th} = A_1 - A_2$

$= 1.98 \times 10^{10} - 1.85 \times 10^{10}$

$= 1.3 \times 10^9$ dis/s

74. (a) **1st case**

$\frac{hc}{\lambda_1} = \phi + KE_1$

or, $\frac{hc}{\lambda_1} - \frac{hc}{\lambda_0} = \frac{1}{2} mv^2$ .... (i)

2nd case

$\frac{hc}{\lambda_2} - \frac{hc}{\lambda_0} = \frac{1}{2} m (2v)^2 = 4 \times \frac{1}{2} mv^2$ .... (ii)

From (i) & (ii)

$hc\left(\frac{1}{\lambda_2} - \frac{1}{\lambda_0}\right) = 4 \times hc\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_0}\right)$

$\frac{1}{\lambda_2} = \frac{4}{\lambda_1} - \frac{4}{\lambda_0} + \frac{1}{\lambda_0}$

or, $\frac{1}{\lambda_2} = \frac{4}{\lambda_1} - \frac{3}{\lambda_0}$

or, $\lambda_2 = \frac{\lambda_1\lambda_0}{4\lambda_0 - 3\lambda_1}$

$= \frac{480 \times 600}{4 \times 600 - 3 \times 480}$

$= \frac{480 \times 600}{960} = 300$ nm

75. (c)

76. (c) $N_aN_a = V_bN_b$

$V_b \times \frac{5 \times 10}{40} = 1000 \times \frac{1}{10}$

$V_b = \frac{1000 \times 40}{5 \times 10 \times 10}$

$V_b = 80$ ml

77. (b) $C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H_2SO_4} 12C + 11H_2O$

78. (c) $BaSO_4 \rightleftharpoons Ba^{++} + SO_4^{--}$

$BaCl_2 \longrightarrow Ba^{++} + 2Cl^-$

79. (b) $A + 2B \longrightarrow AB_2$

1 mole 2 moles 1 mole

$\therefore$ B is limiting reactant

2 moles B $\longrightarrow$ 1 moles AB_2

4 moles B $\longrightarrow$ 2 moles AB_2

80. (b) $\frac{E_{\text{metal carbonate}}}{E_{\text{metal oxide}}} = \frac{W_{\text{metal carbonate}}}{W_{\text{metal oxide}}}$

or, $\frac{x + 30}{x + 8} = \frac{4.2}{2}$

or, $2x + 60 = 4.2x + 33.6$

or, $60 - 33.6 = 4.2x - 2x$

or, $x = 12$

81. (d) $HCl + MnO_2 \longrightarrow MnCl_2 + H_2O + Cl_2$
$Cl_2 + NaOH \longrightarrow NaCl + NaClO_3 + H_2O$

82. (d) $y = \frac{3e^x + e^{-x}}{e^x + e^{-x}} = \frac{3e^{2x} + 1}{e^{2x} + 1}$

or, $e^{2x} = \frac{1 - y}{y - 3} = \frac{y - 1}{3 - y}$

$\Rightarrow \quad x = \log_e\left(\frac{x - 1}{3 - x}\right)^{\frac{1}{2}}$

83. (b) $1 - \tan\frac{A}{2}.\tan\frac{B}{2} = 1 - \frac{\Delta}{s(s-a)}.\frac{\Delta}{s(s-b)}$

$= 1 - \frac{s(s-a)(s-b)(s-c)}{s^2(s-a)(s-b)}$

$= 1 - \frac{2(s-c)}{2s} = \frac{2c}{2s} = \frac{c}{s}$

84. (a) $\begin{vmatrix} 1 & a & 1 \\ 1 & 1 & 0 \\ -1 & 0 & -1 \end{vmatrix} = 0$

Expanding along c_3

$1\begin{vmatrix} 1 & 1 \\ -1 & 0 \end{vmatrix} - 1\begin{vmatrix} 1 & a \\ 1 & 1 \end{vmatrix} = 0$

or, $1 - 1(1 - a) = 0$
or, $1 - 1 + a = 0$
$\therefore \quad a = 0$

85. (b) $H = \frac{2ab}{a + b}$

Now, $(H - 2a)(H - 2b) = \left(\frac{2ab}{a+b} - 2a\right)\left(\frac{2ab}{a+b} - 2b\right)$

$= 2a.2b\left(\frac{b}{a+b} - 1\right)\left(\frac{a}{a+b} - 1\right)$

$= 4ab\left(-\frac{a}{a+b}\right)\left(-\frac{b}{a+b}\right) = \frac{4a^2b^2}{(a+b)^2} = H^2$

86. (c) $z^n - \frac{1}{z^n} = z^n - z^{-n}$

$= (\cos\theta + i\sin\theta)^n - (\cos\theta + i\sin\theta)^{-n}$
$= (\cos n\theta + i\sin n\theta) - \{\cos(-n\theta) + i\sin(-n\theta)\}$
$= \cos n\theta + i\sin n\theta - \cos n\theta + i\sin n\theta$
$= 2i\sin n\theta$

87. (d) As $(\sin\theta, \cos\theta)$ and (3, 2) lie on the same side of $x + y - 1 = 0$, they should be of same sign.
$\sin\theta + \cos\theta - 1 > 0$ as $3 + 2 - 1 > 0$

$\Rightarrow \quad \sqrt{2}\sin\left(\theta + \frac{\pi}{4}\right) > 1$

$\Rightarrow \quad \sin\left(\theta + \frac{\pi}{4}\right) > \frac{1}{\sqrt{2}} \qquad \Rightarrow \quad 0 < \theta < \frac{\pi}{4}$

88. (c) If d is the distance between the centres of two circles of radii r_1 and r_2, then they intersect in two distinct points if

$|r_1 - r_2| < d < (r_1 + r_2)$

Here, $r_1 = \sqrt{25 - 16} = 3$, $r_2 = r$
$\Rightarrow \quad |r - 3| < 5 < r + 3$
$\Rightarrow \quad r > 2$ and $-5 < r - 3 < 5$
$\Rightarrow \quad r > 2$ and $-2 < r < 8$
Then $2 < r < 8$

89. (d) Let point of contact be (x_1, y_1).

Eq^n of tangent is $yy_1 = \frac{a}{2}(x + x_1)$

Slope of tangent $= \frac{a}{2y_1} = \tan 45° = 1$

$\therefore \quad y_1 = \frac{a}{2}$ and $x_1 = \frac{y_1^2}{a} = \frac{a}{4}$

Point of contact $= \left(\frac{a}{4}, \frac{a}{2}\right)$

90. (c) Let d be the length of line.
The $dl = 3$, $dm = 4$, $dn = 5$
$\Rightarrow \quad d^2l^2 + d^2m^2 + d^2n^2 = 3^2 + 4^2 + 5^2$
$\Rightarrow \quad d^2(l^2 + m^2 + n^2) = 50$
$\Rightarrow \quad d = 5\sqrt{2}$

91. (c) Let θ be the angle between $\vec{a}$ & $\vec{b}$

$(\vec{a} \times \vec{b})^2 + (\vec{a}.\vec{b})^2 = 144$

or, $|\vec{a}|^2 |\vec{b}|^2 \sin^2\theta + |\vec{a}|^2 |\vec{b}|^2 \cos^2\theta = 144$

$\Rightarrow \quad |\vec{a}|^2 |\vec{b}|^2 = 144$

$\Rightarrow \quad 4^2 |\vec{b}|^2 = 144$

$\Rightarrow \quad |\vec{b}| = 3$

92. (c) x, y, z are in G.P.
$\Rightarrow$ $l$nx, $l$ny, $l$nz are in A.P.
$\Rightarrow$ $1 + l$nx, $1 + l$ny, $1 + l$nz are in A.P.
$\Rightarrow \quad \frac{1}{1 + l\text{nx}}, \frac{1}{1 + l\text{ny}}, \frac{1}{1 + l\text{nz}}$ are in H.P.

93. (d) Let $z = \cos\frac{\pi}{8} + i\sin\frac{\pi}{8}$. Then $\frac{1}{z} = \cos\frac{\pi}{8} - i\sin\frac{\pi}{8}$

Then, $\left(\frac{1 + z}{1 + \frac{1}{z}}\right)^8 = z^8 = \left(\cos\frac{\pi}{8} + i\sin\frac{\pi}{8}\right)^8$

$= \cos\pi + i\sin\pi = -1$

94. (b) Total no. of triangles $= {}^{12}C_3 - {}^7C_3 = 185$

95. (c) The function $f(x) = \sqrt{\log(x^2 - 6x + 6)}$ is defined when $\log(x^2 - 6x + 6) \geq 0$
$\Rightarrow \quad x^2 - 6x + 6 \geq 1$
$\Rightarrow \quad (x - 5)(x - 1) \geq 0$
$\Rightarrow \quad x \in (-\infty, 1] \cup [5, \infty)$
Domain $= (-\infty, 1] \cup [5, \infty)$

96. (b) $(b + c - a)\tan\frac{A}{2}$

$= (2s - 2a).\frac{\Delta}{s(s-a)} = \frac{2\Delta}{s}$

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

…The End…