Section - I

1. (b) $\vec{v} = (u + at)\hat{i} + (u + at)\hat{j}$
$= (2 + 0.3 \times 10)\hat{i} + (3 + 0.2 \times 10)\hat{j}$
$= 5\hat{i} + 5\hat{j}$
$\therefore$ Velocity $|\vec{v}| = \sqrt{5^2 + 5^2} = 5\sqrt{2}$ m/s

2. (a) $h = h_2 - h_1 = \frac{1}{2}g(3)^2 - \frac{1}{2}g(2)^2$
$= 5(9 - 4) = 25$

3. (c) $ab = (a + c)\,v$
or, $v = \frac{ab}{a + c}$

4. (a) Work done per unit volume
$\left(\frac{E}{V}\right) = \frac{1}{2}$ stress × strain
$= \frac{1}{2} \times Y_x$ strain × strain
$= \frac{YS^2}{2}$

5. (b)

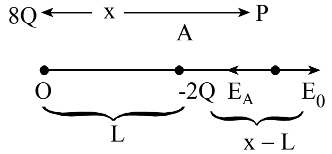
6. (b) During expansion work done will be maximum in isobaric process.

7. (b) $T = 2\pi\sqrt{\frac{m}{K}}$
if sprig is cut in n pieces then spring constant become.
K' = nK so
Time period (T') $= 2\pi\sqrt{\frac{m}{K'}}$
$= 2\pi\sqrt{\frac{m}{nK}} = \frac{T}{\sqrt{n}}$

8. (b) $3f_0^c = 4f_0^0$
or, $3 \times \frac{v}{4l_c} = 4 \times \frac{v}{2l_0}$
or, $\frac{l_c}{l_0} = \frac{3}{8}$

9. (a) $\sigma_1 = \sigma_2$
or, $\frac{Q - Q'}{4\pi R^2} = \frac{Q'}{4\pi(2R)^2}$
or, $Q - Q' = \frac{Q'}{4}$
or, $Q' = \frac{4Q}{5}$

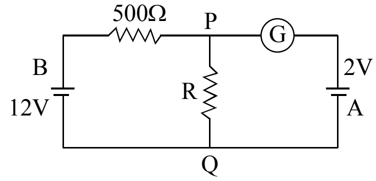
10. (b)



or, $E_0 = E_A$
or, $\frac{8Q}{4\pi\varepsilon_0 x^2} = \frac{2Q}{4\pi\varepsilon_0(x - L)^2}$
or, $4(x - L)^2 = x^2$
or, $2(x - L) = x$
or, $x = 2L$

11. (c) $\frac{R'}{R} = \left(\frac{1 + \frac{l}{10}}{l}\right)^2 = 1.21$
$\therefore$ R' = 12.1 Ω

12. (a)



$V_{PQ} = 2V$
Pd across 500 Ω resistor is
V = 12 – 2 = 10V
$\therefore$ $I = \frac{V}{R} = \frac{10}{500} = \frac{1}{50}$ A
$\therefore$ $V_{PQ} = IR_{PQ}$
or, $R_{PQ} = \frac{2}{\frac{1}{50}} = 100\ \Omega$

13. (a) $\tan\theta = \frac{V}{H}$ …. (i)
Again $\tan\theta' \frac{V}{H\cos x} = \frac{\tan\theta}{\cos x}$
$\therefore$ $\frac{\tan\theta'}{\tan\theta} = \frac{1}{\cos x}$

14. (d)

15. (b) Vertical displacement
$= d - \frac{d}{\mu} = \frac{(\mu - 1)d}{\mu}$

16. (d) $\frac{\lambda_p}{\lambda_\alpha} = \frac{p_\alpha}{p_p} = \frac{\sqrt{2m_\alpha Q_\alpha V}}{\sqrt{2m_p Q_p V}}$
$= \sqrt{\frac{4m \times 2eV}{meV}} = 2\sqrt{2} : 1$

17. (a) Voltage gain $= \frac{V_{out}}{V_{in}} = \frac{I_c R_{out}}{I_b R_{in}} = \beta\frac{R_{out}}{R_{in}}$
$\therefore$ $\beta = \frac{\Delta I_c}{\Delta b} = \frac{2 \times 10^{-3}}{40 \times 10^{-6}} = \frac{2000}{40} = 50$
$\therefore$ Voltage gain $= 50 \times \frac{4000}{100} = 2000$

18. (d) It obeys Huckel's rule i.e.: It contains (4n + 2) delocalized π electrons eg. 10 electrons.

19. (a) It is known a enyne compound . Its IUPAC format is Alk-en-yne. Numbering s done by he lowest sum rule.
$\underset{5}{CH_3} - \underset{4}{CH} = \underset{3}{CH} - \underset{2}{C} \equiv \underset{1}{CH}$

20. (c) $Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$
By Clark's process

21. (b) $2HgO \xrightarrow{\Delta} 2Hg + O_2$

22. (d)

23. (b)

24. (b)

$Pb + 4Na + 4C_2H_5Cl \longrightarrow$ **$(C_2H_5)_4Pb$** $+ 4NaCl$
↳ used as antiknock agen in petrol

25. (c)

26. (a)

27. (b) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
100g56g 22.4 L
10g $\frac{22.4}{100} \times 10 = 2.24L$

28. (d)

29. (a) $\text{cosec}\left(\sin^{-1}\frac{2x}{1+x^2}\right) = \text{cosec}\left(\text{cosec}^{-1}\frac{1+x^2}{2x}\right)$
$= \frac{1+x^2}{2x}$

30. (c) Expansion is valid for:
$|4x| < 1$
$|x| < \frac{1}{4}$

31. (d) Number of permutation with repetition $= 5^5$

32. (a) $s_{even} - s_{odd} = n(n+1) - n^2 = n, \therefore n = 5$

33. (a) Equating the corresponding coefficients:
$2x = 4$
$x = 2$

34. (d) It is obvious.

35. (b) Putting x = 2
$2^3 + 4k - 2 - 30 = 0$
$k = 6$

36. (b) It is obvious.

37. (b) It is obvious

38. (b) It is obvious

39. (d) $\tan\theta = \frac{1}{\tan 2\theta} = \cot 2\theta$
$\tan\theta = \tan\left(\frac{\pi}{2} - 2\theta\right)$
$\theta = n\pi + \left(\frac{\pi}{2} - 2\theta\right)$
$3\theta = \left(n + \frac{1}{2}\right)\pi$
$\theta = (2n+1)\frac{\pi}{6}$

40. (c) $y = \tan|x|$
$\frac{dy}{dx} = \sec^2|x|.\frac{x}{|x|}$

41. (a) Dividing by $\cos^2x$, we get
$= \int\frac{\sqrt{\tan x}}{\tan x}\sec^2x\,dx$
$= \int\frac{\sec^2x}{\sqrt{\tan x}}dx = 2\sqrt{\tan x} + c$

42. (a) Coincident lines:
$b^2 - 4ac = 0$
$4^2 - 4.5 \quad K = 0 \qquad k = \frac{4}{5}$

43. (d) Obvious

44. (b) $\Delta = 80 \qquad 2s = 8 \Rightarrow s = 4$
$r = \frac{\Delta}{s} = 20$

45. (d) Centre (h, k) = (4, 3)

46. (a) Obvious

47. (b) $f'(x) = -3 < 0$ (decreasing)

48. (d) Obvious

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

Section – II

61. (d) $t = \frac{l}{\text{Ve. of parrot relativetotrain}}$
$= \frac{150}{10+5} = 10s$

62. (a) $\sqrt{h_1h_2} = \sqrt{\frac{u^2\sin^2\theta}{2g} \times \frac{u^2\sin^2(90° - \theta)}{2g}}$
$= \frac{u^2\sin\theta.\cos\theta}{2g}$
$= \frac{u^2\sin2\theta}{4g} = \frac{R}{4}$
$\therefore \quad R = 4\sqrt{h_1h_2}$

63. (d) $W = 2lT$
or, $T = \frac{1.5 \times 10^{-2}}{2 \times 0.3} = 0.025$ N/m

64. (b) $t = \frac{\rho L_f}{2K\theta}(x_2^2 - x_1^2)$
$= \frac{0.92 \times 80(10^2 - 5^2)}{2 \times 0.004 \times 10}$
= 69000 s = 19.2 hrs

65. (b) Heat lost = Heat gained
or, $(200 + 20)(\theta - 20) = 440(92 - \theta)$
or, $220(\theta - 20) = 440(92 - \theta$
or, $\theta - 20 = 184 - 2\theta$
or, $\theta = \frac{204}{3} = 68°C$

66. (c)
$f_t \to f_s = f_t + 5 \quad l = 1$ m
$f_t \to f_{s'} = f_t - 5 \quad l' = 1.05$ m
Now $\frac{f_s}{f_s'} = \frac{l'}{l}$

or, $\frac{f_t + 5}{f_t - 5} = \frac{1.05}{1}$

or, $f_t + 5 = 1.05\ f_t - 5.25$

or, $0.05\ f_t = 10.25$

or, $f_t = \frac{10.25}{0.05} = 205$ Hz

67. (a) $C = C'$

or, $\frac{\varepsilon_0 A}{d} = \frac{\varepsilon_0 A}{d - t\left(1 - \frac{1}{\varepsilon r}\right) + 3.5 \times 10^{-5}}$

or, $d = d - 4 \times 10^{-5}\left(1 - \frac{1}{\varepsilon r}\right) + 3.5 \times 10^{-5}$

or, $4 \times 10^{-5}\left(1 - \frac{1}{\varepsilon r}\right) = 3.5 \times 10^{-5}$

or, $0.5 = \frac{4}{\varepsilon_r}$

or, $\varepsilon_r = 8$

68. (d) Total resistance remain same then

$(\Delta R)_1 + (\Delta R)_2 = 0$

or, $R_1\alpha\Delta\theta - R_2\beta\Delta\theta = 0$

or, $R_1\alpha = R_2\beta$

or, $\frac{R_1}{R_2} = \frac{\beta}{\alpha}$

69. (c) $\frac{B_c}{B_a} = \frac{\frac{-\mu_0 I}{2R}}{\frac{\mu_0 I R^2}{2(x^2 + R^2)^{3/2}}}$

$= \frac{(x^2 + R^2)^{3/2}}{R^3} = \frac{(4^2 + 3^2)^{3/2}}{3^3} = \frac{5^3}{3^3}$

$\therefore\ B_c = \frac{125}{27} \times 54 = 250\ \mu T$

70. (a) $I = I_0 (1 - e^{-Rt/L})$

or, $\frac{I_0}{2} = I_0(1 - e^{-Rt/L})$

or, $\frac{1}{2} = 1 - e^{-Rt/L}$

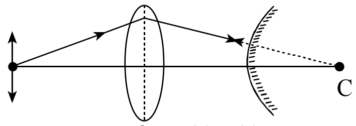
or, $e^{-Rt/L} = \frac{1}{2}$

or, $e^{\frac{Rt}{L}} = 2$

or, $\frac{Rt}{L} = ln2$

or, $t = ln2 \times \frac{L}{R} = ln2 \times \frac{300 \times 10^{-3}}{2} = 0.1$ s

71. (c)



For lens, $v = \frac{fu}{u - f} = \frac{20 \times 30}{30 - 20} = 60$ cm

r = 10 cm

d = v – r = 60 – 10 = 50 cm

72. (d) $\frac{dx}{D} = (2n + 1)\frac{\lambda_1}{2} = (2m + 1)\frac{\lambda_2}{2}$

or, $(2n + 1)\ 400 = (2m + 1)\ 560$

or, $10n + 5 = 14m + 7$

or, $10n - 14m = 7 - 5$

If n = 3, m = 2 then result agree

Again n = 10 & m = 7 then again result agree so

$\Delta y = y'' - y'$

$= \left(\frac{2 \times 10 + 1}{2}\right)\beta - \left(\frac{2 \times 3 + 1}{2}\right)\beta$

$= (10.5 - 3.5)\beta = 7\beta$

$= 7 \times \frac{D\lambda_1}{d} = \frac{7 \times 1 \times 400 \times 10^{-9}}{0.1 \times 10^{-3}}$

$= 0.028$ m = 28 mm

73. (b) Force (F) = Rate of change in momentum

$= \frac{1.6 \times \text{momentum}}{t}$

$= 1.6 \times \frac{nh}{t\lambda}$

$= 1.6\frac{\text{Power}}{C}\left[\because P = \frac{nhc}{t\lambda}\right]$

$= \frac{1.6 \times 60}{3 \times 10^8} = 3.2 \times 10^{-7}$ N

74. (b) When $\left(\frac{2}{3}\right)^{rd}$ of sample decayed then

$\frac{1}{3} = \left(\frac{1}{2}\right)^{\frac{t_1}{T_{1/2}}}$

or, $ln\left(\frac{1}{3}\right) = \frac{t_1}{T_{1/2}} ln\left(\frac{1}{2}\right)$

or, $t_1 = T_{1/2}\left\{\frac{ln\left(\frac{1}{3}\right)}{ln\left(\frac{1}{2}\right)}\right\}$

$= 50 \times \frac{ln\frac{1}{3}}{ln\frac{1}{2}} = 79.2$ days.

When $\left(\frac{1}{3}\right)^{rd}$ of sample decayed then

$\frac{2}{3} = \left(\frac{1}{2}\right)^{t_2/T_{1/2}}$

or, $ln\left(\frac{2}{3}\right) = \frac{t_2}{T_{1/2}} ln\left(\frac{1}{2}\right)$

or, $t_2 = T_{1/2}\frac{ln\left(\frac{2}{3}\right)}{ln\left(\frac{1}{2}\right)} = 29.2$ days

$\therefore\ \Delta T = t_1 - t_2 = 79.2 - 29.2 = 50$ days

75. (d) Conc^n $2HNO_3 \xrightarrow{\Delta} H_2O + 2NO_2 + [O]$

$P_4 + 10[O] \longrightarrow 2P_2O_5$

$P_2O_5 + 3H_2O \longrightarrow 2H_3PO_4$

76. (b)

77. (b) X = nitrobenzene and Y = 3-nitrochlorobenzene

78. (d) 6.023×10^{23} molecules of $C_6H_{12}O_6$ = 180g

6.023×10^{22} molecules of $C_6H_{12}O_6$

$= \frac{180}{6.023 \times 10^{23}} \times 6.023 \times 10^{22}$

$= 18g$

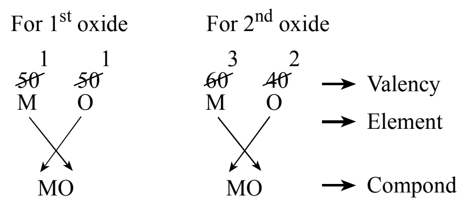
$\frac{W}{m} = \frac{M \times V_m}{1000}$

$\frac{8}{180} = \frac{M \times 500}{1000}$

M = 0.2 M

79. (a)

80. (b)



81. (d)

82. (d) Integrating by parts:

$[xe^x - \int 1.e^x dx]_0^1 = (xe^x - e^x)_0^1$

$= (1.e - e) - (0 - e^0) = 1$

83. (a) $\frac{2\sin nx \cos nx}{\cos^2 nx} = 2 \tan nx$

$\frac{d}{dx}(2\tan nx) = 2n \sec^2 nx$

84. (b) $f(x) + g(x) = x + x$ for $x > 0$

$= 2x$

$f(x) + g(x) = x - x$ for $x < 0$

$= 0$

85. (b) Let α be the common root then

$\alpha^2 + p\alpha + q = 0$

$\alpha^2 + q\alpha + p = 0$

By cross-multiplication:

$\frac{\alpha^2}{p^2 - q^2} = \frac{\alpha}{q - p}$

On solving, we get the result

86. (d) $\sum_{n=0}^{\infty} \frac{x^{2n+1}}{(2n+1)!} = \left(\frac{x}{1!} + \frac{x^3}{3!} + \frac{x^5}{5!} + \ldots.. \infty\right)$

$= \frac{e^x - e^{-x}}{2} = \sinh x$

87. (c) Total number of ways = 6!

If the oldest player is to throw first, then the no. of ways = 5!

No. of ways so that oldest player not to throw 1st = 6! – 5!

= 600

88. (b) $\sin\frac{\pi}{6} = \sin\theta = \frac{|\vec{a} \times \vec{b}|}{|\vec{a}|\,|\vec{b}|}$

$\frac{1}{2} = \frac{|\vec{a} \times \vec{b}|}{2.4}$

i.e. $|\vec{a} \times \vec{b}| = 4$ $(\vec{a} \times \vec{b})^2 = 16$

89. (d) Equation of the plane parallel to the given plane is:

$x + 3y + 4z + K = 0$

It passes through the point (1, 2, 5)

i.e. $1 + 3.2 + 4.5 + K = 0$

$K = -27$

The required equation of the plane is:

$x + 3y + 4z - 27 = 0$

90. (b) $x^2 - 8x + 16 + y^2 + 4y + 4 = 16$

$(x - 4)^2 + (y + 2)^2 = 4^2$

$\therefore$ h = r

Hence, it touches only y-axis

91. (d) We have: $c = \frac{a}{m}$

$1 = \frac{1}{m}$

m = 1

92. (b) $A = 2\int_0^1 (y_1 - y_2)\,dx$

$= 2\int_0^1 (x - x^2)dx = \frac{1}{3}$

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

$= \sin(\sin^{-1}\sqrt{1 - x^2})$

$= \sqrt{1 - x^2}$

We get same result from the option (c)

94. (a) $\frac{dy}{dx} = 6x - 12$

Tangent line is parallel to x-axis

i.e. $\frac{dy}{dx} = 0$

x = 2

and y = –6

The point is (2, – 6)

95. (a) $8R^2 = 4R^2(\sin^2A + \sin^2B + \sin^2C)$

$2 = 2 + 2\cos A \cos B \cos C$

$\cos A \cos B \cos C = 0$

Either, $\cos A = 0$

$A = 90°$

96. (b) $\frac{a}{r} \times a \times ar = 216$ i.e. a = 6

and $\frac{6}{r} + 6 + 6r = 19$

On solving: $r = \frac{3}{2}$

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

…The End…