Section - I

1. (a) $h_1 = \frac{1}{2} g \times 5^2$ … (1)

$h_2 = \frac{1}{2} g(10^2 - 5^2) = \frac{1}{2} g \times 75$ …. (2)

$h_3 = \frac{1}{2} g(15^2 - 10_2) = \frac{1}{2} g \times 125$ …. (3)

$\therefore$ $h_1 : h_2 : h_3 = 25 : 75 : 125$

or, $h_1 : h_2 : h_3 = 1 : 3 : 5$

$\therefore$ $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$

So $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$

2. (c) $T_{max} = \frac{mv^2}{r} + mg = \frac{m \times 5gr}{r} + mg = 6\ mg$

$T_{min} = \frac{mv^2}{r} - mg = \frac{mgr}{r} - mg = 0$

$\therefore$ $\Delta T = T_{max} - T_{min} = 6\ mg$

3. (d) $mg - T = ma$

or, $T = mg - \frac{mg}{8} = \frac{7\ mg}{8}$

$W = T.h \cos 180° = -\frac{7mgd}{8}$

4. (b) $v_0 = \sqrt{gR}$

$KE = \frac{1}{2} mv_0^2 = \frac{mgR}{2} = E$

$v_e = \sqrt{2gR}$

$KE' = \frac{1}{2} = mv_0^2 = \frac{1}{2} m \times 2gR$

$= mgR = 2E$

5. (c) $\frac{E'}{E} = \frac{\sigma A'T'^4}{\sigma AT^4} = \frac{(2R)^2 (2T)^4}{R^2T^4}$

$= 64:1$

6. (d) $C_{rms}{}^H = C_{rms}{}^o$

or, $\sqrt{\frac{3RT_H}{M_H}} = \sqrt{\frac{3RT_0}{M_0}}$

or, $\sqrt{\frac{T_H}{2}} = \sqrt{\frac{320}{32}}$

or, $T_H = 20K$

7. (d) $g' = \sqrt{g^2 + a^2}$

8. (c) $3f_0{}^0 = 5f_0{}^e$

or, $3 \times \frac{v}{2l_0} = 5 \times \frac{v}{4l_c}$

or, $\frac{l_0}{l_c} = \frac{3}{2} \times \frac{4}{5} = \frac{6}{5}$

9. (c) $\frac{1}{2} mv^2 = \frac{Qq}{4\pi\varepsilon r}$ …. (i)

Again $\frac{1}{2} m(2v)^2 = \frac{Q.q}{4\pi\varepsilon_0 r'}$

or, $4 \times \frac{Q.q}{4\pi\varepsilon_0 r} = \frac{Qq}{4\pi\varepsilon_0 r'}$

or, $r' = \frac{r}{4}$

10. (b) $\frac{E}{V} = \frac{\frac{1}{2} CV}{Ad} = \frac{1}{2} \frac{\varepsilon_0 A}{d.Ad} . V^2$

$= \frac{1}{2} \varepsilon_0 \frac{V^2}{d^2}$

11. (b) $\frac{E_1}{E_2} = \frac{\frac{V^2}{R} \times t}{\frac{V^2}{2R}.t} = 2:1$

12. (a) $M = 2\ ml$

If magnet is divided in 4 equal parts with length and breadth half then new length (l') = l

Pole strength (m') = $\frac{m}{2}$

Magnetic moment (M') = $\frac{m}{2} \times l$

$= \frac{M}{4}$

13. (c) $E = -\frac{d\phi}{dt}$

14. (b) $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

or, $0 = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

or, $\frac{d}{f_1 f_2} = \frac{f_1 + f_2}{f_1 f_2}$

or, $d = f_1 + f_2$

15. (d) $\frac{x}{D} = \frac{\lambda}{d}$

or, $x = \frac{D\lambda}{d}$

$x \propto \lambda$, when red light is replaced by blue, $\lambda_r > \lambda_b$ so $x_r > x_b$ i.e. become closer.

16. (c) $\lambda_p = \lambda_e$

or, $\frac{h}{\sqrt{2m_pE_p}} = \frac{h}{\sqrt{2m_eE_e}}$

or, $m_pE_p = m_eE_e$

or, $m_p > m_e$ so $E_p < E_e$

i.e. energy of proton is less than electron.

17. (b) $R = \frac{\Delta V}{\Delta I} = \frac{1}{0.5 \times 10^{-6}} = 2 \times 10^6\ \Omega$

18. (a)

19. (b)

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|
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20. (b) $2H_2 + O_2 \longrightarrow 2H_2O$

2 moles 1 mole 2 moles

0.2 moles 0.1 mole 0.2 moles

21. (c)

22. (c)

23. (d)
24. (d)
25. (a) $O_3 \xrightarrow{UV} O_2 + [O]$
Nascent oxygen acts as an good oxidizing agent.
26. (d) Isoelectronic means same number of electrons
$C = 6e = N^+$
27. (c) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
CaO acts as a basic flux
28. (d) Cation moves towards cathode and reduction reaction takes place.
29.(b) Putting x = y = 1
Sum of the coefficient = $(a + b)^n$
30.(b) $\lim_{x \to 0} \frac{e^{\sin x} - 1}{\sin x} \cdot \frac{\sin x}{x} = 1 \times 1 = 1$
31.(d) $\sqrt{3 + 4i} = \sqrt{2^2 + 2.2.i + i^2}$
$= \sqrt{(2 + i)^2} = \pm (2 + i)$
32.(b) $\tan\left(\tan^{-1}1 - \tan^{-1}\frac{2}{3}\right)$
$= \tan \tan^{-1}\left(\frac{1 - \frac{2}{3}}{1 + 1.\frac{2}{3}}\right) = \frac{1}{5}$
33.(a) $t_{10} = S_{10} - S_9$
$= (10^3 - 100) - (9^3 - 100)$
$= 10^3 - 9^3$
34.(a) $I = \int \tan^4 x.\sec^2 x \, dx$
$\int [f(x)^n f'(x) \, dx = \frac{[f(x)]^{n+1}}{(n + 1)} + c \; (n \neq -1)$
35.(d) $\alpha = 2 + 3i$
$\beta = 2 - 3i$
$\alpha + \beta = 2 + 3i + 2 - 3i$
$-\frac{p}{1} = 4$
$p = -4$
36.(c) It is obvious
37.(a) It is obvious
38.(c) It is obvious
39.(c) $2x + 2y\frac{dy}{dx} = 0$
$\frac{dy}{dx} = -\frac{2x}{2y} = -\frac{x}{y}$
At (x_1, y_1): $\frac{dy}{dx} = -\frac{x_1}{y_1}$
40.(d) Their dot product is zero.
41.(b) a + b = c
2 + 3 = 5 (No Δ is formed)
42.(b) f'(x) is negative
43.(c) $\frac{\sin A}{1 + \cos A} = \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{2\cos^2\frac{A}{2}} = \tan\frac{A}{2}$
44.(c) $A = \int_2^4 4x^2 dx = 4\left[\frac{x^2}{3}\right]_2^4$
= 240 sq. units
45.(a) $x_2 - x_1 = 12, y_2 - y_1 = 4, z_2 - z_1 = 3$
$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$
= 13
dc's of the line are: $\frac{12}{13}, \frac{4}{13}, \frac{3}{13}$
46.(d) It is obvious.
47.(b) $\left(x^2 - 2 + \frac{1}{x^2}\right)^n = \left(x - \frac{1}{x}\right)^{2n}$
Total no. of terms after B. Expansion = 2n + 1
No. of terms independent of x = 1
No. of terms dependent of x = (21 + 1 – 1) = 2n
48.(a) Required no. of ways = 5 × 5 × 5 = 5^3 = 125 ways.

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

Section – II

61. (b) $S_c - S_b = 96$
or, $20t - \frac{1}{2}at^2 = 96$
or, $t^2 - 20t + 96 = 0$
or, $t^2 - 8t - 12t + 96 = 0$
or, $t(t - 8) - 12(t - 8) = 0$
or, $t(t - 8)(t - 12) = 0$
Either t = 8s
or, 12s
∴ t = 8s
62. (c) $mg\sin\theta = F_f$
or, $m = \frac{10}{g\sin 30°} = 2$ kg
63. (a) Potential difference per^m (V) $= \frac{2}{20} = \frac{1}{10}$ J/kg
W = m × V × h
$= 5 \times \frac{1}{10} \times 4 = 2J$
64. (a) $Q = \frac{KAd\theta}{l} \times t = mL_f$
or, $K = \frac{4.8 \times 80 \times 4200 \times 0.1}{0.36 \times 100 \times 3600}$
$= 1.24 \; Wm^{-1}K^{-1}$
65. (c) $\left(\frac{T_2}{T_1}\right)^{\gamma} = \left(\frac{P_2}{P_1}\right)^{\gamma-1}$

or, $\frac{T_2}{300} = \left(\frac{P}{8P}\right)^{\frac{\frac{5}{3}-1}{\frac{5}{3}}}$

or, $T_2 = \left(\frac{1}{8}\right)^{\frac{2}{3}\times\frac{3}{5}}$

$= 130.6K = 142°C$

66. (a) $\sqrt{\frac{T'}{T}} = \frac{606}{600}$

or, $\frac{T'}{T} = 1.02$

Fractional increase $= \frac{T' - T}{T}$

$= \frac{T'}{T} - 1$

$= 1.02 - 1 = 0.02$

67. (d) $F_g = F_e$

or, $\frac{Gm^2}{r^2} = \frac{q^2}{4\pi\varepsilon_0 r^2}$

or, $\frac{q^2}{m^2} = 4\pi\varepsilon_0 G$

or, $\frac{q}{m} = \sqrt{4\pi\varepsilon_0 G}$

68. (b) **1st case**

$V_1 = E - \frac{E}{R + r}.r$

or, $V_1 = E\frac{R}{R + r}$

or, $5 = \frac{ER}{R + r}$ ..... (1)

2nd case

$V_2 = E - \frac{E}{6R + r} . r$

or, $10 = \frac{6RE}{6R + r}$ ..... (2)

Dividing (2) by (1)

$\frac{10}{5} = \frac{6ER}{6R + r} \times \frac{R + r}{ER}$

or, $12R + 2r = 6R + 6r$

or, $6R = 4r$

or, $r = 1.5R$

From (1)

$5 = \frac{E \times R}{R + 1.5R}$

or, $E = 5 \times 2.5 = 12.5V$

69. (b) $Bqv = \frac{mv}{r}$

or, $Bqr = mv = \sqrt{2mE}$

Now for proton

$Ber = \sqrt{2mE_p}$ .... (1)

For α particle

$B.2er = \sqrt{2 \times 4mE_\alpha}$ .... (2)

Dividing (2) by (1)

$2 = \sqrt{\frac{8E_\alpha}{2 \times 1}}$

or, $E_\alpha = 1$ MeV

70. (d) When capacitor is removed then current lag the voltage by 30° and when inductor is removed then voltage lag the current by 30°

$X_L = X_C$ so $Z = R$

$P = \frac{V_{rms}^2}{R}$

$= \frac{220^2}{200} = 242$ W

71. (b) $f = \frac{1}{p} = \frac{1}{4}$ m = 25 cm

For near object

u = ? v = –25 cm f = 25 cm

So $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

or, $\frac{1}{u} = \frac{1}{25} + \frac{1}{25} = \frac{2}{25}$

or, u = 12.5 cm

For distant object

u = ? v = ∞, f = 25 cm

or, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

or, u = 25 cm

∴ Range = 12.5 cm to 25 cm

72. (d) $\beta = \frac{D\lambda}{d}$

or, $\Delta\beta = \frac{\lambda.\Delta D}{d}$

or, $\lambda = \frac{\Delta\beta d}{\Delta D} = \frac{10^{-3} \times 0.03 \times 10^{-3}}{5 \times 10^{-2}}$

$= 6 \times 10^{-7}$ m = 6000Å

73. (c) $V_s = 1.36$ V

$E = \frac{hc}{\lambda} = \frac{6.62 \times 10^{-34} \times 3 \times 10^8}{5000 \times 10^{-10}} = 3.97 \times 10^{-19}$ J

$= 2.48$ eV

∴ $\phi = E - eV_s = 2.4 - 1.36$

$= 1.12$ eV

74. (c) No of atoms $(N_0) = \frac{6.023 \times 10^{23}}{226}$

$A = \lambda N_0 = \frac{0.693}{T_{1/2}} N_0$

$= \frac{0.693 \times 6.023 \times 10^{23}}{226 \times 1620 \times 365 \times 24 \times 3600}$

$= 3.6 \times 10^{10}$ dis/s

75. (a)

76. (d) ECE(Z) of Ag $= \frac{E}{F} = \frac{108}{96500} = 1.12 \times 10^{-3}$

77. (a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2$

78. (a)

79. (c) $K_4[Fe(CN)_6] + 6H_2SO_4 + 6H_2O \rightarrow 2K_2SO_4 + FeSO_4 + 2(NH_4)_2SO_4 + 6CO$

80. (b) $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

$E_v = \frac{22400}{2} = 11200$

$\frac{W_v}{E_v} = \frac{N \times V_{ml}}{1000}$

$\frac{10}{11200} = \frac{N \times 25}{1000}$

$N = \frac{10 \times 1000}{11200 \times 25} = \frac{100}{2800} = 0.0357\ N$

81. (b) pH = 13

$H^+ = 10^{-13}$ M

No. of moles $= \frac{M \times V_{ml}}{1000} = \frac{10^{-13} \times 1}{1000} = 10^{-16}$

No. of $H^+ = 10^{-16} \times 6.02 \times 10^{23}$

$= 6.02 \times 10^7$

82.(a) $\int_1^2 e^x \left(\frac{1}{x} - \frac{1}{x^2}\right) dx = \left[e^x . \frac{1}{x}\right]_1^2$

$= e^2 . \frac{1}{2} - e = e\left(\frac{e}{2} - 1\right)$

83.(c) $y = \log_{e^{1/2}} \cos x = \frac{1}{\frac{1}{2}} \log_e \cos x$

$\frac{dy}{dx} = 2 . \frac{1}{\cos x} (-\sin x) = -2\tan x$

84.(c) $\sec^2(\sec^{-1} 2) - 1 + \text{cosec}^2 (\text{cosec}^{-1} 3) - 1$

$= 2^2 - 1 + 3^2 - 1 = 11$

85.(a) r_1, r_2, r_3 are in H.P.

a, b, c are in A.P.

sinA, sinB, sinC are in A.P.

86.(c) $z = (1 + \sqrt{3}\, i)(1 + i)(\cos\theta + i\sin\theta)$

$= \frac{\pi}{3} + \frac{\pi}{4} + \theta$

$= \frac{7\pi}{12} + \theta$

87.(d) Let $x = \sqrt{6 + \sqrt{6 + \sqrt{6 + ... + \infty}}}$

Squaring: $x^2 = 6 + \sqrt{6 + \sqrt{6 + ... + \infty}}$

$x^2 = 6 + x$

$(x - 3)(x + 2) = 0$

$x = 3, -2$

88.(b) Taking option (c)

2, 4, 8 [sum = 14/G.P.]

(2 + 1), (4 + 1), (8 – 1)

3, 5, 7 A.P.

89.(a) $A\Delta B = (A - B) \cup (B - n)$

$= \{Q\} \cup \{S\}$

$= \{Q, S\}$

90.(c) $\overrightarrow{FC} + \overrightarrow{AD} + \overrightarrow{EB}$

$= 2\overrightarrow{AB} + 2\overrightarrow{AO} + 2\overrightarrow{OB}$

$= 2\overrightarrow{AB} + 2(\overrightarrow{AO} + \overrightarrow{OB})$

$= 2\overrightarrow{AB} + 2\overrightarrow{AB}$

$= 4\overrightarrow{AB}$

91.(b) $\frac{\frac{1}{(n+1)}}{1} + \frac{\left(\frac{1}{n+1}\right)^2}{2} + \frac{\left(\frac{1}{n+1}\right)^3}{3} + ... \infty$

$= -\left[\frac{\frac{1}{(n+1)}}{1} - \frac{\left(\frac{1}{n+1}\right)^2}{2} - \frac{\left(\frac{1}{n+1}\right)^3}{3} + ... \infty\right]$

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

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

$= \frac{1}{n} - \frac{1}{2n^2} + \frac{1}{3n^3} + ... \infty$

92.(a) $m + 3m = -\frac{2h}{b^2}$

$m = -\frac{h}{2b^2}$ .... (1)

and $m.3m = \frac{a^2}{b^2}$

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

$h = \frac{2}{\sqrt{3}}ab$

93.(a) $a = \frac{9}{4},\ m = \frac{2}{3}$

Equation of the tangent: $y = mx - am^2$

$2x - 3y = 3$

94.(c) Volume (v) $= \frac{4}{3}\pi . 3r^2 \frac{dr}{dt}$

Substituting the values:

$\frac{dr}{dt} = \frac{5}{2\pi}$

95.(d) Squaring: $x^2 + y^2 = 4$

$A = 2\int_0^2 y\,dx = 2\pi$

96.(c) $r^2 = 32\text{cosec}2\theta$

$(r\cos\theta)(r\sin\theta) = 32$

xy = 16 (rect. Hyperbola)

Eccentricity (e) $= \sqrt{2}$

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

…The End…