Section - I

1.(a) We have, time of flight (T) = $\frac{2u\sin\theta}{g}$

$T \propto \sin\theta$

Since, $T_A < T_B$, A will fall earlier.

2.(c) Here, F acts as normal reaction
Hence, $\mu F = w$ Therefore,

$F = \frac{w}{\mu}$, since $\mu < 1$, hence $F > w$

3.(c) The volume of water formed by melting ice is same as volume of water displaced by ice so level remain same.

4.(c) During boiling, temperature of water remains constant.
i.e. $\Delta\theta = 0$

So $S = \frac{dQ}{m\Delta\theta} = \infty$

5.(d) Fraction $= \frac{\Delta U}{\Delta Q} = \frac{nC_v dT}{nC_p dT} = \frac{C_v}{C_p} = \frac{\frac{5}{2}R}{\frac{7}{2}R} = \frac{5}{7}$

6.(b) On heating liquid, volume increases and density decreases. i.e. R.I. decreases.

7.(a) Due to the presence of test charge q_0 in front of positively charged ball, there would be redistribution of charge on ball and due to this electric field is decreased.

Thus, actual electric field will be greater than $\frac{F}{q_0}$.

8.(c) In non-uniform magnetic field a magnetic needle experience both force and torque due to unequal forces acting on it.

9.(a) As 'n' increases, energy difference between adjacent energy levels decreases.

10.(c) Frequency of A = 512 ± 5 = 517 or 507
When A is filed, its frequency increases.
i.e. $f_A = 517$

11.(c) $\frac{KE_1}{KE_2} = \frac{\frac{p^2}{2m_1}}{\frac{p^2}{2m_2}} = \frac{m_2}{m_1} = \frac{1}{4}$

12.(c) The force is perpendicular to path so the speed remain constant i.e. KE remain constant.

13.(d) A layer of air encloses whose conductivity is very less.

14.(b) After 1 slab = 0.9I
After two slab = 0.9 × 0.9I = 0.81I

% reduce = $\left(\frac{I - 0.81\,I}{I}\right) \times 100\% = 19\%$

15.(d) Specific resistance depends on nature of matter.

16.(a) $\frac{v}{u} = \frac{1}{n}$

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

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

or, $-\frac{1}{f} = \frac{1}{u} - \frac{n}{u}$

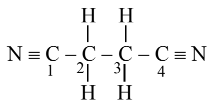
or, $\frac{1}{f} = \frac{n-1}{u}$ or, $u = (n-1)f$

17.(d) $\frac{\lambda_p}{\lambda_\alpha} = \frac{p_\alpha}{p_p} = \sqrt{\frac{2m_\alpha E_\alpha}{2m_p E_p}} = \sqrt{\frac{2 \times 4m \times 2eV}{2m \times eV}}$

$= 2\sqrt{2} : 1$

18.(b) For alkane no. of isomers = $2^{n-4} + 1$
Where, n = no. of carbon = $2^{6-4} + 1$
$= 2^2 + 1 = 5$

19.(a)



Butane –1, 4 –dinitrile

20.(d)

21.(c) 6g Mg = Rs. 5

12g Mg = $\frac{5}{6} \times 12 = 10$

12 Mg = 9g Al

9g Al = Rs. 10

27g Al = $\frac{10}{9} \times 27 = 30$

∴ Rs. 30

22.(d) $N_2O_5 + H_2O \longrightarrow 2HNO_3$

23.(b)

24.(d)

25.(b) $Na_2CO_3.10H_2O$ effloresces to form $Na_2CO_3.H_2O$ loosing $9H_2O$

26.(a) Black mass of carbon is formed.

27.(d)

28.(b) $CH_3I \xrightarrow[\text{red}^n]{\text{HI/P}} CH_4$

$2CH_3I + Na \longrightarrow CH_3CH_3$

29.(c) $\frac{1}{abc}\begin{vmatrix} 1 & abc & a \\ 1 & abc & b \\ 1 & abc & c \end{vmatrix}$

$= \frac{1}{abc} . abc \begin{vmatrix} 1 & 1 & a \\ 1 & 1 & b \\ 1 & 1 & c \end{vmatrix} = 0$

30.(d) $|(3 + 4i)(x + iy)| = |1 + i|$

$\sqrt{3^2 + 4^2}\sqrt{x^2 + y^2} = \sqrt{1^2 + 1^2}$

Squaring: $x^2 + y^2 = \frac{2}{25}$

31.(c) $\lim_{x \to 0} \frac{\sin^{-1}x}{2x} = \frac{1}{2}\lim_{x \to 0} \frac{\sin^{-1}x}{x} = \frac{1}{2}$

32.(a) $S_n = 1 + 2 + 3t \ldots\ldots + n\frac{n(n+1)}{2}$

$S_m = \left[\frac{n(n+1)}{2}\right]^2 = S_n^2$

33.(c)

$\int_{-11}^{11} \sin^{11}x \, dx = 0$

[∵ odd function]

34.(a) $t = \frac{y}{4a}$

Then $x = a\left(\frac{y}{4a}\right)^2$

$\boxed{y^2 = 16ax}$ Parabola

35.(d) Obvious

36.(c) Obvious

37.(a) $xx_1 + yy_1 = a^2$

$x + 2y = 5$

38.(d) Length of latus rectum $= \frac{2b^2}{a}$

$= \frac{2.(3)^2}{5} = \frac{18}{5}$ units

39.(b) $4a = 12$

$a = 3$

Focus = (0, a) = (0, 3)

40.(d) Obvious

41.(c) $R = 2r = 2 \times 4 = 8$

42.(c) Obvious

43.(b) $\frac{\cot\theta.\cot\frac{\pi}{4} - 1}{\cot\frac{\pi}{4} + \cot\theta} \cdot \frac{\cot\frac{\pi}{4}.\cot\theta + 1}{\cot\theta - \cot\frac{\pi}{4}}$

$\frac{\cot\theta - 1}{\cot\theta + 1} \cdot \frac{\cot\theta + 1}{\cot\theta - 1} = 1$

44.(a) $\sin^{-1}x = \frac{\pi}{10}$

$\frac{\pi}{2} - (0)^{-1}x = \frac{\pi}{10}$ $\boxed{\cos^{-1}x = \frac{2\pi}{5}}$

45.(d) $A = \int_0^\pi y dx = \int_0^\pi \sin x \, dx = -[\cos x]_0^\pi$

$= 2$ sq. units

46.(d) Actual d.c.'s are

$\left(\frac{7}{\sqrt{7^2 + (+6^2)}}, \frac{6}{\sqrt{7^2 + (-6)^2 + 6^2}}, \frac{6}{\sqrt{7^2 + (-6)^2 + 6^2}}\right)$

$= \frac{7}{11}, -\frac{6}{11}, \frac{6}{11}$

47.(d) The plane x = 0 is yz-plane and y = 0 is zx-plane. Two planes meet in z-axis and they are also at rt. angle.

48.(a) $b^2 - 4ac = 36 - 4.19 = 0$

Real and equal

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

Section – II

61.(c) $v = \left(\frac{\alpha\beta}{\alpha + \beta}\right) t = \frac{2 \times 4 \times 3}{2 + 4} = 4$ m/s

$s = \frac{v^2(\alpha + \beta)}{2\alpha\beta} = \frac{4^2 \times (2 + 4)}{2 \times 2 \times 4} = 6$ m

62.(a) Here, $v = \sqrt{5gR}$

$\sqrt{2gh} = \sqrt{5g\frac{d}{2}}$

$h = \frac{5}{4}d = \frac{5}{4} \times 8$ m $= 10$ m

63.(d) P.A. = 2πr.T

$\rho gh.\pi r^2 = 2\pi r.T$

$h = \frac{2T}{\rho gr} = \frac{4T}{\rho gd} = \frac{4T}{\rho gd}$

$= \frac{4 \times 75 \times 10^{-3}}{1000 \times 10 \times 0.1 \times 10^{-3}} = 0.3$ m

64.(b) $\Delta P.E. = \left\{-\frac{GMm}{R + R} - \left(-\frac{GMm}{R}\right)\right\}$

$= \frac{GMm}{R}\left(1 - \frac{1}{2}\right) = \frac{gR^2.m}{R} \cdot \frac{1}{2} = \frac{mgR}{2}$

65.(a) $PV_1 = \frac{mR}{M}T$

$V_1 = \frac{mRT}{PM} = \frac{10 \times 8.31 \times 383}{3 \times 10^5 \times 32}$

$= 3.32 \times 10^{-3} m^3$

W = PdV

$= 3 \times 10^5 (0.1 - 3.32 \times 10^{-3})$

$= 2.9 \times 10^4$ J

66.(c) For convex lens

$v = \frac{fu}{u - f} = \frac{20 \times 25}{25 - 20} = 100$ cm

Object and image coincide so image of convex lens must be at c of convex mirror so r = (100 – 40) = 60 cm

$f = \frac{r}{2} = \frac{60}{2} = 30$ cm

67.(a) $f = 5 \times \frac{1}{2l}\sqrt{\frac{9g}{m}} = 3\frac{1}{2l}\sqrt{\frac{Mg}{m}}$

or, $5\sqrt{9} = 3\sqrt{M}$

or, M = 25 kg

68.(d) $y = 5\sin\left(\frac{t}{0.04} - \frac{x}{4}\right)$

Then maximum velocity of particle will be

$v_p = a\omega = 5 \times 10^{-2} \times \frac{1}{0.04} = 1.25$ m/s

69.(c) $I = fcv = f'c'v$

or, $100 \times 10^3 \times c = (100 \times 10^3 - 50)\, \varepsilon_r c$

or, $\varepsilon_r = \frac{100 \times 10^3}{100 \times 10^3 - 50} = 1.0005 = 1.001$

70.(a) Magnetic energy stored in inductor is

E = Energy density (U) × volume (V)

or, $\frac{1}{2}LI^2 = U \times V$

or, $I = \sqrt{\frac{2UV}{L}} = \sqrt{\frac{2 \times 70 \times 0.02}{110 \times 10^{-3}}}$

$= 5.05$ A

71.(b) $M = \frac{\phi_c}{I_s} = \frac{N_cB_sA_c}{I_s} = \frac{N_c(\mu_0 nI_s)A_c}{I_s}$

$M = 100 \times 4\pi \times 10^{-7} \times 10 \times 100 \times \pi\, (0.01)^2$

$= 40\ \mu H$

72.(b) For maximum power

$R = r_t = 2\Omega$ $\quad P = I^2R = \left(\frac{2E}{2+2}\right)^2 \times 2$

$= \left(\frac{2 \times 2}{2+2}\right)^2 \times 2 = 2W$

73.(c) $r \propto A^{1/3}$

$\frac{r_2}{r_1} = \left(\frac{A_2}{A_1}\right)^{1/3} = \left(\frac{206}{4}\right)^{1/3} = 3.72$

$r_2 = 3.72 \times 1.9 = 7$ Fermi

74.(b) Half life $(T_{1/2}) = 4$ min

$\frac{m}{m_0} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$ $\quad$ or, $\frac{10}{80} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

$t = T_{1/2} \times 3 = 4 \times 3 = 12$ min

75.(c) Wt. of pure $CaC_2 = \frac{80}{100} \times 8 = 6.4$ g

$CaC_2 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)_2$

1 mole	1 mole
64g	22.4 L
6.4g	$\frac{22.4}{64} \times 6.4 = 2.24$ L

76.(b) EW of metal $= \frac{\text{wt. of metal}}{\text{wt. of oxygen}} \times 8$

$= \frac{65.22}{34.78} \times 8 = 15$

Valency of metal

$= \frac{2 \times \text{V.D.}}{\text{EW of metal + EW of Cl}}$

$= \frac{2 \times 75.75}{15 + 35.5} = 3$

At. wt. of metal = 15 × 3 = 45

77.(a) $X_{H_2O_2} = \frac{nH_2O_2}{nH_2O_2 + nH_2O}$

$= \frac{\frac{20}{34}}{\frac{20}{34} + \frac{80}{18}} = \frac{9}{77} = 0.117$

78.(d) $CaF_2 \longrightarrow Ca^{++} + 2F^-$

K_{ip} of $CaF_2 = [Ca^{++}]\,[F^-]^2$

$= 10^{-3} \times (10^{-3})^2$

$= 10^{-9}$

$K_{ip} > K_{sp}$ so ppt of CaF_2 occurs.

79.(c) The gas formed is H_2S. It gives ppt with Zn^{++} ion (present in group (II B) in alkaline medium only.

80.(c) $Na = \frac{V_b \times N_b}{V_a} = \frac{32 \times 0.5}{25} = 0.64$ N

$E_{acid} = \frac{W \times 1000}{V \times N} = \frac{7.2 \times 1000}{250 \times 0.64} = 45$

Mol. wt. $= 2 \times E_{acid} = 2 \times 45 = 90$

81.(d) Ethene adds H_2O in presence of H_3PO_4 as crystal to give ethanol.

$CH_2 = CH_2 + H_2O \xrightarrow{H_3PO_4} CH_3CH_2OH$

82.(a) $I = \int \frac{(x^4+1) - 1}{x(x^4+1)}\, dx$

$= \int \frac{1}{x}\, dx - \int \frac{1}{x(x^4+1)}\, dx$

$= \log_e x - f(x) - c + k$

$= \log_e x - f(x) + c_1$

83.(d) $y = \tan^{-1}\left(\frac{2\sin x/2 \cos x/2}{2\cos^2 x/2}\right)$

$= \tan^{-1}\tan\frac{x}{2} = \frac{x}{2}$ $\qquad \frac{dy}{dx} = \frac{1}{2}$

84.(b) Put $\tan^{-1}x = \theta$

$\tan\theta = \frac{x}{1} = \frac{p}{b}$

$h = \sqrt{1 + x^2}$

$\cos 2\theta = \frac{1}{2} \Rightarrow 1 - 2\sin^2\theta = \frac{1}{2}$

$1 - 2\frac{x^2}{1 + x^2} = \frac{1}{2}$

$x = \frac{1}{\sqrt{3}}$

85.(b) $\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c}$

$= \frac{b^2 + c^2 - a^2}{2abc} + \frac{c^2 + a^2 - b^2}{2abc} + \frac{a^2 + b^2 - c^2}{2abc}$

$= \frac{a^2 + b^2 + c^2}{2abc}$

86.(c) Putting z = 6 from option.

$\left|\frac{6-4}{6-8}\right| = 1$

$1 = 1$

87.(d) $|x|^2 - 7|x| + 12 = 0$
$(|x| - 3)(|x| - 4) = 0$
$|x| = 3, 4$ (Both are +ve)
No. of real roots = 4

88.(a) $x = \frac{1}{1-a} \Rightarrow a = \frac{x-1}{x}$ …… (i)
$y = \frac{1}{1-b} \Rightarrow b = \frac{y-1}{y}$ .... (ii)
We have: $1 + ab + a^2b^2 + ……. \infty = \frac{1}{1-ab}$
$= \frac{1}{1 - \frac{x-1}{x} \cdot \frac{y-1}{y}} = \frac{xy}{x+y-1}$

89.(c) $y = f(x) = \frac{1}{\sqrt{x-1}}$
$(x - 1) > 0$ i.e. $x > 1$
Domain = $(1, \infty)$

90.(c) $\vec{a} + \vec{b} + \vec{c} = 0$
$\vec{a} + \vec{b} = -\vec{c} \qquad \Rightarrow |\vec{a} + \vec{b}| = |-\vec{c}|$
Squaring $a^2 + b^2 + 2\vec{a}.\vec{b} = c^2$
$25 + 144 + 2|\vec{a}||\vec{b}| \cos\theta = 169$
$\cos\theta = 0$
$\theta = 90°$

91.(c) $b = \frac{a}{1} - \frac{a^2}{2} + \frac{a^3}{3} - \frac{a^4}{4} + ………\infty$
$b = \log_e(1 + a)$
$e^b = 1 + a$
$1 + a = 1 + \frac{b}{1!} + \frac{b^2}{2!} + \frac{b^3}{3!} + …….. \infty$

92.(b) $T = S_1$
$yy_1 - 2a(x + x_1) = (-3)(-3) - 2.2(2 + 2)$
$-3y - 4(\alpha + 2) = -7$
$\boxed{4x + 3y + 1 = 0}$
Altd: Only the option (b) is satisfied by the given point.

93.(d) Making homogeneous
$x^2 + y^2 - 2y(x + y) + \lambda(x + y)^2 = 0$
$x^2(1 + \lambda) + y^2(-1 + \lambda) - 2xy = 0$
Two lines are perpendicular if a + b = 0
$1 + \lambda - 1 + \lambda = 0$
$\lambda = 0$

94.(b) By direct method
$a = \frac{16ab}{3} = \frac{16 \times 1 \times 1}{3} = \frac{16}{4}$

95.(c) Equation of ellipse
$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 (a > b)$
$a = 5, ae = 3$
$\therefore \quad e = \frac{3}{5}$
$\therefore \quad 1 - \frac{b^2}{25} = \frac{9}{25}$
$\therefore \quad b^2 = 16$
$\therefore \quad \frac{x^2}{25} + \frac{y^2}{16} = 1$

96.(a) Put $\sin x = t$
$\cos dx = dt$
$\therefore \quad \int a^t\, dt = \frac{a^t}{\log a} + c = \frac{a^{\sin x}}{\log a} + c$

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

…The End…