Section – I

1.(d) $P \propto T^x$ ...(i)

For adiabatic process

$T^\gamma \propto P^{\gamma-1}$

or, $P \propto T^{\frac{\gamma}{\gamma-1}}$ ...(ii)

Comparing (i) & (ii)

$x = \frac{\gamma}{\gamma-1} = \frac{7/5}{7/5-1} = \frac{7}{5} \times \frac{5}{2} = \frac{7}{2}$

for diatomic gas $\gamma = \frac{7}{5}$

2.(c) $\lambda = \frac{h}{mv}$ $\therefore \lambda \propto \frac{1}{m}$

$m_\beta < m_p < m_n < m_\alpha$ so λ_β maximum.

3.(c) For maximum current

R = r

4.(b) $E = \frac{Q}{4\pi\varepsilon_o R^2} = \frac{\sigma}{\varepsilon_o}$ $\left[\because \frac{Q}{A} = \sigma\right]$

5.(b) The box just start to slide down the plane then angle of inclination is called angle of repose. If box is pushed down then angle must be less than angle of repose.

6.(c) Dimension of $P = ML^2T^{-3}$

P is constant and mass is also constant so

$L^2 \propto T^3$

or, $L \propto T^{3/2}$

7.(d) PV = mrT

or, $\frac{m}{v} = \frac{P}{rT}$

or, $\rho = \frac{P}{\frac{R}{M}T}$

$= \frac{PM}{RT} = \frac{PN_A.m}{RT} = \frac{Pm}{KT}$

8.(c) $x = at^2 - bt^3$

or, $v = 2at - 3bt^2$

or, a = 2a – 6bt

if a = 0 then 2a – 6bt = 6

or, $t = \frac{2a}{6b} = \frac{a}{3b}$

9.(b) $W = \frac{M}{L} \times l \times g\frac{l}{2}$

$= \frac{4}{2} \times \frac{0.6^2 \times 10}{2}$

= 3.6J

10.(c) $\phi = \frac{2\pi x}{\lambda}$

or, $\lambda = \frac{2\pi \times 0.4}{1.6\pi} = 0.5m$

$\therefore$ $f = \frac{v}{\lambda} = \frac{330}{0.5} = 660$ Hz

11.(d) $l_1\alpha_1 = l_2\alpha_2$

$\frac{l_2}{l_1} = \frac{\alpha_1}{\alpha_2}$

or, $\frac{l_2 + l_1}{l_1} = \frac{\alpha_1 + \alpha_2}{\alpha_2}$

or, $\frac{l_1}{l_1 + l_2} = \frac{\alpha_2}{\alpha_1 + \alpha_2}$

12.(a) $W_{AB} = q(V_B - V_A)$

or, $V_B - V_A = \frac{10 \times 10^{-3}}{5 \times 10^{-6}} = 2000V$

= 2KV

13.(c) P = IV cosϕ

if P = 0 then

cosϕ = 0 = cos90°

ϕ = 90°

14.(d) For 2nd line Balmer series

$\frac{1}{\lambda_2} = R\left[\frac{1}{4} - \frac{1}{16}\right] = \frac{3R}{16}$

$\therefore \lambda_2 = \frac{16}{3R}$ ...(i)

For 1st line of Balmer series

$\frac{1}{\lambda_1} = R\left[\frac{1}{4} - \frac{1}{9}\right] = \frac{5R}{36}$

$\therefore \lambda_1 = \frac{36}{5R}$ ...(ii)

Dividing (ii) by (i)

$\frac{\lambda_1}{\lambda_2} = \frac{36}{5R} \times \frac{3R}{16}$

or, $\lambda_1 = \frac{36}{5} \times \frac{3}{16} \times 4861 = 6562$Å

15.(d) The scattering of α- ray is due presence of nucleus in the atom.

16.(c) Electron affinity for noble gases (rave gases) and alkaline earth metals is zero due to their fully filled orbitals.
Compressibility greater than one → positive deviation.
Less than one → negative deviation.
Equal to one → Zero deviation.

17.(b)

18.(b)

19.(c)

20.(c) Both
$Au + 3[Cl] \rightarrow AuCl_3$
$2Au + 3HNO_3 + 11HCl \rightarrow 2HAuCl_4 + 3NOCl + 6H_2O$

21.(d) In halogen halide the order of reducing nature is
$HF < HCl < HBr < HI$.

22.(c) Franklinite is $ZnO.Fe_2O_3$ which is an ore of zinc.

23.(c) In open-hearth process the impurities are oxidized by hematite.

24.(a) H_2O is a nucleophile as it has lone pair of electron on oxygen.

25.(d) Haloform on heating with silver powder gives acetylene
$HCX_3 + 6Ag + X_3CH \longrightarrow HC \equiv CH + 6AgX$

26.(c)

27.(a) Fehling solution only react with aldehydes.

28.(a) Formic acid

29.(b) Obvious

30.(b) Replace x by –x in $f(x) = \log\left(\frac{1+x}{1-x}\right)$
we find, $f(-x) = -f(x)$
So, f(x) is odd

31.(a) Since, sinA = SinB
cosA = cosB
$\therefore$ tanA = tanB $\quad \therefore$ A = nπ + B

32.(d) $A - A'$ is not symmetric
$\because (A - A')' = A' - A$

33.(c) We write $|x|^2$ for x^2.
Hence, $|x|^2 - 3|x| + 2 = 0$
$(|x|-1)(|x|-2) = 0$
$\Rightarrow \quad |x| = 1,2$ i.e $x = \pm1, \pm2$

34.(a) Among three lines $x - 3y = 0$ and $3x + y = 0$ are perpendicular.
$\therefore$ Orthocenter = point of intersection of these two lines = (0,0)

35.(b) Here $r = \sqrt{12^2 + 4^2 + 3^2} = 13$
$\therefore$ Direction cosines of line are:
$\frac{12}{13}, \frac{4}{13}, \frac{3}{13}$

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

37.(c) $y = \sin^{-1}\left(\frac{1-x}{1+x}\right) + \cos^{-1}\left(\frac{1-x}{1+x}\right)$
$y = \frac{\pi}{2} \quad \therefore \frac{dy}{dx} = 0$

38.(b) Let $\sqrt{x} = t$, then $dt = \frac{dx}{2\sqrt{x}}$
Integrand = $\int \sec^2 t\, dt = \tan t + c$
$= \tan\sqrt{x} + c$

39.(a) Total number of triangles = ${}^6C_3 = 20$
Favourable cases (m) = 2
$P(E) = \frac{2}{20} = \frac{1}{10}$

40.(c) $\left|\frac{x}{2}\right| < 1 \Rightarrow |x| < 2$

41.(c) $1 + \frac{(\log_e x)^2}{2!} + \frac{(\log_e x)^4}{4!} + ...$
$= \frac{1}{2}(e^{\log_e x} + e^{-\log_e x})$
$= \frac{1}{2}\left(x + \frac{1}{x}\right)$

42.(a) a = b = 0 and h ≠ 0, then 2hxy = 0
$\therefore \quad x = 0, y = 0$

43.(b) For normal, the line passes through centre (–y, f) of circle.
So, $l(-g) + m(-f) + n = 0$
$\therefore \quad lg + mf = n$

44.(b) Using L-Hospital's rule
$\lim_{x \to y} -\frac{\sin x - 0}{1 - 0} = -\sin y$

45.(b) $\frac{dy}{dx} = 2x + 2$ At (1, 6)

$\frac{dy}{dx} = 4$

$\therefore$ Tangent is $y - 6 = 4(x - 1)$

$y - 4x - 2 = 0$

46.(b) We have, $\int \frac{f'(x)}{\sqrt{f(x)}} dx = 2\sqrt{f(x)} + c$

$\therefore \int \frac{2x + 4}{\sqrt{x + 4x + 5}} dx = 2\sqrt{x^2 + 4x + 5} + c$

47.(b) $\log_{10}x = \log_{10}y^2 - 3\log_{10}{}^{10} = \log_{10}\left(\frac{y^2}{1000}\right)$

$\therefore x = \frac{y^2}{1000}$

48.(b) $\frac{(1 + 2i)(1 + i)}{1 - i^2} = \frac{1}{2}(-1 + 3i)$ lies in 2nd quadrant.

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

Section – II

61.(b) $W = \Delta PE = \left\{\frac{-GMm}{R+h} - \left(\frac{-GMm}{R}\right)\right\}$

$= GMm\left[\frac{1}{R} - \frac{1}{R + R/2}\right]$

$= gR^2m\left[\frac{1}{R} - \frac{2}{3R}\right]$

$= gR^2m\left[\frac{3-2}{3R}\right] = \frac{mgR}{3}$

62.(a) wt = upthrust

or, $(120 + m)g = \frac{120}{600}\sigma_w g$

or, $120 + m = \frac{120}{600} \times 1000$

or, $120 + m = 200$

or, $m = 80$kg

63.(a) Vertical height in practice (H′) = 240m

vertical height theoretically

$H = \frac{u^2\sin^2\theta}{2g} = \frac{100^2 \times \sin^2 45}{2 \times 10} = 250$m

Change in height due to air resistance

$h = H - H' = 250 - 240 = 10$m decreases

64.(a) $PV_1 = m\frac{R}{M}T$

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

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

$\therefore w = PdV = P(V_2 - V_1)$

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

$= 29004J = 2.9 \times 10^4 J$

65.(c) $f' = \frac{v + v_o}{v} f = \frac{v + v/10}{v} \times 90$

$= \frac{11}{10} \times 90 = 99$H z

66.(d) ${}_l\mu_g = \frac{{}_a\mu_g}{{}_a\mu_l} = \frac{1.66}{1.33}$

Again, ${}_l\mu_g = \frac{\sin\frac{A + \delta_{min}}{2}}{\sin\frac{A}{2}}$

or, $\frac{1.66}{1.33} = \frac{\sin\frac{A + \delta_{min}}{2}}{\sin\frac{A}{2}}$

or, $\sin\frac{60^0 + \delta_{min}}{2} = 0.624$

or, $\frac{60^0 + \delta_{min}}{2} = 38.6^0$

$\therefore \delta_{min} = 17.2^0$

67.(d) $n_1\lambda_1 = n_2\lambda_2$

or, $n_2 = \frac{62 \times 5893}{4358} = 84$

68.(c) When +ve of one is connected with –ve plate of another capacitor then

$Q_2 - Q_1 = (C_1 + C_2)V$

or, $V = \frac{C_2V_2 - C_1V_1}{C_1 + C_2}$

$= \frac{5 \times 10^{-6} \times 100 - 1 \times 10^{-6} \times 100}{1 \times 10^{-6} + 5 \times 10^{-6}}$

$= 66.6$V

69.(a) $E = Blv = 0.18 \times 10^{-4} \times 1 \times \frac{100 \times 1000}{3600}$

$= 5 \times 10^{-4}v = 0.5$mv

70.(c) $hf - \phi = \frac{1}{2}mv^2$

or, $h\times 2f_o - hf_o = \frac{1}{2}mv^2$

or, $hf_o = \frac{1}{2}mv^2$ ...(*i*)

Again, $hf' - \phi = \frac{1}{2}mv'^2$

or, $h5f_o - hf_o = \frac{1}{2}mv'^2$

or, $4hf_o = \frac{1}{2}mv'^2$ ...(ii)

Dividing (*ii*) by (*i*)

$\left(\frac{v'}{v}\right)^2 = 4$

$\therefore$ $v' = 2\times v = 2\times 4\times 10^6 = 8\times 10^6$ m/s

71.(b) $\frac{N}{N_o} = \left(\frac{1}{2}\right)^{t/T_{\frac{1}{2}}}$ or, $\frac{1}{20} = \left(\frac{1}{2}\right)^{t/3.8}$

or, $ln\left(\frac{1}{20}\right) = \frac{t}{3.8}\,ln\left(\frac{1}{2}\right)$

or, $t = \frac{\ln\left(\frac{1}{20}\right)}{\ln\left(\frac{1}{2}\right)}\times 3.8 = 16.4$ days.

72.(b) $z = \sqrt{R^2 + X_L{}^2} = \sqrt{0.5^2 + (2\pi fL)^2}$

$= \sqrt{0.5^2 + (2\pi\times 50\times 0.2)^2} = 62.8\Omega$

$V = I_{rms}Z = 2\times 62.8 = 125.6V$

73.(b) $R = \frac{v^2}{P} = \frac{100^2}{50} = 200\Omega$

$I = \frac{P}{V} = \frac{50}{100} = 0.5A$

To glow with full power, current through each bulb must be 0.5A so

$nI = \frac{V}{r + \frac{R}{n}}$

or, $0.5n = \frac{120}{10 + \frac{200}{n}}$

or, $0.5n = \frac{120n}{10n + 200}$

or, $5n + 100 = 120$

or, $5n = 20$ $\therefore$ $n = 4$

74.(d) The gas formed is ammonia which is dried using CaO.

75.(d) The compound formed is benzene which on reaction with chlorine in presence of sunlight gives benzene hexachloride.

76.(a) The number of moles of HC*l* = 0.1 × 0.5 = 0.05

$CaCO_3$ +	$2HCl \longrightarrow$	$CaCl_2 + CO_2 + H_2O$
1 mol	2 mol	1 mol
100g	2 mol	22.4*l*
5g	-	$\frac{22.4\times 5}{100} = 1.12l$
-	0.05mol	$\frac{22.4\times 0.05}{2} = 0.56l$

0.56 Liter being smaller value is correct answer.

77.(b) For $Mg(OH)_2$, $K_{sp} = 4S^3$

$S = \sqrt[3]{\frac{K_{SP}}{4}} = \sqrt[3]{\frac{1\times 10^{-11}}{4}} = 1.35\times 10^{-4}M$

$[OH^-] = 2S = 2.7\times 10^{-4}M$

$pOH = -\log[2.7\times 10^{-4}] = 3.56$

$pH = 14 - 3.56 = 10.44$

78.(b) 1 mole of SO_2 contains 1 mole of sulphur so it has 6.023×10^{23} no. of sulphur atoms.

79.(d) Water an addition to acetylene gives vinyl alcohol which rearrange forming acetaldehyde.

$CH = CH + H_2O \xrightarrow[\text{dil } H_2SO_4]{HgSO_2} CH_2 = \underset{|}{\overset{OH}{C}}H \rightarrow CH_3 - CHO$

80.(b) EW of element $= \frac{16.18}{83.82}\times 19 = 3.69$

Valency of element $= \frac{2\times 34}{3.67 + 19} = 3$

$\therefore$ Formula = EF_3

81.(b)

$CH_2 = CH_2 \xrightarrow{HOCl} \underset{OH}{CH_2} - \underset{Cl}{CH_2} \xrightarrow{NaHCO_3} \underset{OH}{CH_2} - \underset{OH}{CH_2}$

82.(b) If we put x = y = 1, then $3^n = 729 \Rightarrow n = 6$

83.(a) $S_1 - S_2 = 0$ gives $4x - 3y = 10$

84.(b) It only satisfies the condition
$al + bm + cn = 0$

85.(d) $y = \sqrt{l\text{n}x + y} \Rightarrow y^2 = l\text{n}x + y$

$\Rightarrow \quad 2y\frac{dy}{dx} - \frac{dy}{dx} = \frac{1}{x} \Rightarrow \frac{dy}{dx} = \frac{1}{x(2y-1)}$

86.(c) $\frac{x^3}{3^2} + \frac{y^2}{2^2} = 1 \; . \; \frac{2b^2}{a} = \frac{2 \times 2^2}{3} = \frac{8}{3}$

87.(a) $\frac{a+b+c}{abc} = \frac{2s}{\Delta 4R} = \frac{s}{\Delta 2R} = \frac{s}{\Delta . \frac{a}{\sin A}} = \frac{s \sin A}{a\Delta}$

[**Note:** The given expression has the dimension 2 in length. Check which expression has the same dimension.]

88.(b) $\int_0^{\pi/4} \tan^6 x \sec^2 x \, dx = \int_0^{\pi/4} [\tan x]^6 \, d(\tan x)$

$= \left[\frac{(\tan x)^7}{7}\right]_0^{\pi/4} = \frac{1}{7}$

89.(d) The minimum value will be at −2 or 3 any other point in between.

90.(b) Tanking option (b)

P = tanx

$\int P dx = e^{\int \tan x dx}$

$= e^{\log \sec x} = \sec x$

91.(b) n $7.\log_e(1 + 2x^3)$, for the term x^{12}, there should be the fourth power of $2x^3$. This term will be

$7.-\frac{(2x^3)^4}{4} = -28x^{12}$

92.(c) $|\vec{a}| = |\vec{b}| = 1$ and $|\vec{a} - \vec{b}| = 1$

$\Rightarrow \quad \vec{a}^2 - 2\vec{a}.\vec{b} + \vec{b}^2 = 1$

$\Rightarrow \quad 1 - 2\vec{a}.\vec{b} + 1 = 1 \Rightarrow \vec{a}.\vec{b} = \frac{1}{2}$.

So, $|\vec{a} + \vec{b}| = \vec{a}^2 + 2\vec{a}.\vec{b} + \vec{b}^2 = 1 + 1 + 1 = 3$

So, $|\vec{a} + \vec{b}| = \sqrt{3}$

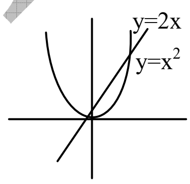
93.(c) When all the girls are together considering 6 girls as one, there are 7 people which can be arranged in 7! ways
Girls can rearrange themselves in 6! ways

$P(E) = \frac{m}{n}$

$P(E) = \frac{7! \times 6!}{12!}$

94.(c) $x^2 = 2x \Rightarrow x = 0, 2$

So, $\int_0^2 (2x - x^2)\, dx$



$= \left[x^2 - \frac{x^3}{3}\right]_0^2$

$= 4 - \frac{8}{3} = \frac{4}{3}$

95.(c) $\frac{a}{r^2} . \frac{a}{r} . a . ar . ar^2 = a^5 = 3^5 = 243$

96.(b) If (x_1, y_1) is the point of contact, then the eq^n of the tangent will be

$2yy_1 = \frac{9}{2}(x + x_1)$ or, $9x - 4y_1 y + 9x_1 = 0$.

Then

$\frac{9}{3} = -\frac{4y_1}{4} = -\frac{9x_1}{6} \Rightarrow x_1 = 2$ and $y_1 = -3$

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

…The End…