Section – I

1.(c) $\frac{t_1}{t_2} = \sqrt{\frac{2h_1/g}{2h_2/g}} = \sqrt{\frac{h_1}{h_2}}$

2.(c) $10 = \frac{1}{2} ks^2$ .... (i)

Again, $10 + w = \frac{1}{2} k (2s)^2$

or, $10 + w = 4 \times 10$

or, $w = 30$ J

3.(d) $F = G\frac{mm}{(2r)^2} = G\frac{\frac{4\pi}{3}r^3 \times \frac{4\pi}{3}r^3}{4r^2}$

$\therefore$ $F \propto r^4$

4.(c) % increase in volume $\left(\frac{\Delta V}{V}\right) = \gamma\Delta\theta \times 100\%$

$= 3\alpha\Delta\theta \times 100\%$
$= 3 \times 10^{-5} \times 100 \times 100\%$
$= 0.3\%$

5.(d) When fan run it increases the rate of evaporation & feel cold.

6.(d) cos wave lead sine wave by 90°

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

7.(b) When charge is placed on soap bubble then it's radius increases.

8.(b) $F = k\frac{8 \times 5}{r^2}$ .... (i)

$F' = k\frac{5 \times 8}{r^2} = F$

9.(a) $V = E - Ir$

or, $1.8 = 2.2 - \frac{E}{5 + r} . r$

or, $\frac{2.2\, r}{5 + r} = 2.2 - 1.8$

or, $2.2r = 2 + 0.4r$

or, $1.8r = 2$

$r = \frac{20}{1.8} = \frac{10}{9}\,\Omega$

10.(d) $P = \frac{P_1P_2}{P_1 + P_2}$

or, $P_1P_2 = 25 \times (P_1 + P_2)$ ... (i)

In parallel $P_1 + P_2 = 100$ ... (ii)

$P_1P_2 = 2500$

Check from option.

11.(c) Intensity of normal light doesnot change while passing through polaroid.

12.(b) $P = P_1 + P_2$

or, $P_2 = 2 - 5 = -3D$

$\frac{f_1}{f_2} = -\frac{\omega_1}{\omega_2}$

or, $\frac{\omega_1}{\omega_2} = \frac{f_1}{f_2} = \frac{P_2}{P_1} = \frac{3}{5}$

13.(c) Depletion layer is layer of ion.

14.(c) No of photo electrons $\propto$ intensity of radiation.

15.(b) Molecular mass = 2 × vapor density = 60. Empirical formula mass = 30. n = 60/30 = 2

16.(b) 2 moles Al need 3 moles Cl_2, but only 4 moles available. For complete reaction, need 3 moles Cl_2, so Cl_2 is limiting.

17.(c) Average kinetic energy depends only on temperature, not pressure.

18.(b) Total electrons = 18 + 10 + 2 + 3 = 33. Element is As (Arsenic), Group 15, Period 4.

19.(d) All are isoelectronic with 10 electrons. Higher nuclear charge = smaller radius. Mg^{2+} has highest nuclear charge (12).

20.(b) HNO_3 is reduced (N: +5 → +2 in NO), so it's the oxidizing agent.

21.(b) $pH = pK_a + \log([salt]/[acid]) = -\log(1.8\times10^{-5}) + \log(0.2/0.1) = 4.74 + 0.30 = 5.04$

22.(b) $\alpha = \sqrt{K_a/C} = \sqrt{1.0\times10^{-4}/0.1} = \sqrt{1.0\times10^{-3}} = 0.032$

23.(b) E°cell = E°cathode – E°anode

E°cell = E°Cu^{2+}/Cu – E°Zn^{2+}/Zn

E°cell = (+0.34 V) – (–0.76 V) = +1.10 V

24.(b) $t_{1/2} = 0.693/k = 0.693/0.693 = 1.0$ min

25.(b) Fe is surrounded by 6 CN^- ligands, so coordination number is 6.

26.(b) Longest chain has 5 carbons. Numbering from right: 2, 2,4-trimethylpentane

27.(c) SN_1 rate depends on carbocation stability. Tertiary carbocation is most stable.

28.(b) Two chiral centers, but one isomer is meso compound. Total stereoisomers = 3 (2 enantiomers + 1 meso)

29.(a) Here n(A) = 6, n(B) = 9

$n(A\cup B)$ will be maximum when A and B are dB joint. So maximum value of $n(A\cup B) = 6 + 9 = 15$

Also, $n(A\cap B)$ is maximum when $A \subseteq B$. So maximum value of $n(A\cap B) = 6$.

30.(c) The matrix is skewsymmetric if $a_{ij} = -a_{ji}$.

So, $K + 1 = -(-5)$ or $K = 5 - 1$ i.e., $K = 4$

31.(d) Here $AB = AC \Rightarrow A^{-1}AB = A^{-1}AC \Rightarrow B = C$

So, this is possible only when A^{-1} exists for which A must be non singular.

32.(c) Here the points are collinear if slope of join of (a, 0) and (0, b) = slope of join of (a, 0) and (x, y)

or, $\frac{b - 0}{a - a} = \frac{y - 0}{x - a}$ or, $b(x - a) = -ay$

or, $\frac{b}{-a} = \frac{y}{x - a}$ or, $bx - ab = -ay$

$\therefore$ $bx + ay = ab$

33.(d) Given circle is $x^2 + y^2 - 6x - 8y = 0$

So, centre = (3, 4). Thus there infinitely normals can be drawn from (3, 4) to the circle $x^2 + y^2 - 6x - 8y = 0$.

34.(b) Here, PS + PS' = constant, S and S' are fixed. Hence the locus is ellipse, by definition.

35.(c) Here conic sections are $xy = c^2$, $x^2 - y^2 = a^2$ which are rectangular hyperbolas. So $e = \sqrt{2}$, $e' = \sqrt{2}$. Then $e^2 + e'^2 = 2 + 2 = 4$

36.(b) We have $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

Now, $\cos2\alpha + \cos2\beta + \cos2\gamma$

$= 2\cos^2\alpha + 1 + 2\cos^2\beta - 1 + 2\cos^2\gamma - 1$

$= 2(\cos^2\alpha + \cos^2\beta + \cos^2\gamma) - 3$

$= 2 - 3 = -1$

37.(b) The equation of plane parallel to $2x + 3y + 4z = 16$ is
$$2x + 3y + 4z = K$$
If it passes through the point (2, 3, 4) then
$$2 \times 2 + 3 \times 3 + 4 \times 4 = K \quad \text{i.e. } K = 29$$
$\therefore$ Required plane is $2x + 3y + 4z = 29$

38.(a) Given, $\vec{a} = \vec{i} + 2\vec{j} + 2\vec{k}$, $\vec{b} = 6\vec{i} - 2\vec{j} + 3\vec{k}$

Now, $\vec{a}.\vec{b} = 1 \times 6 + 2 \times -2 + 2 \times 3 = 6 - 4 + 6 = 8$

and $|\vec{a}| = |\vec{i} + 2\vec{j} + 2\vec{k}| = 3$, $|\vec{b}| = |6\vec{i} - 2\vec{j} + 3\vec{k}| = 7$

$\therefore$ Projection of $\vec{b}$ on $\vec{a} = \dfrac{\vec{a}.\vec{b}}{|\vec{a}|} = \dfrac{8}{3}$

39.(c) $\dfrac{c - a\cos B}{b - a\cos C} = \dfrac{a\cos B + b\cos A - a\cos B}{c\cos A + a\cos C - a\cos C} = \dfrac{b\cos A}{c\cos A}$
$$= \frac{2R\sin B}{2R\sin C} = \frac{\sin B}{\sin C}$$

40.(b) Given Cov(X, Y) = 18. Var(X) = 16, Var(Y) = 81
$$\therefore\ r = \frac{\text{Cov}(X, Y)}{\sqrt{\text{Var}(X)}\sqrt{\text{Var}(Y)}} = \frac{18}{\sqrt{16}\sqrt{81}} = \frac{18}{4 \times 9} = 0.5$$

41.(d) Given $P(A) = 0.25$, $P(B) = 0.32$, $P(\overline{A \cup B}) = 0.55$

Now, $P(A \cup B) = 1 - P(\overline{A \cup B}) = 1 - 0.55 = 0.45$

and $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

or, $0.45 = 0.25 + 0.32 - P(A \cap B)$

i.e., $P(A \cap B) = 0.57 - 0.45 = 0.12$

Then $P(A/B) = \dfrac{P(A \cap B)}{P(B)} = \dfrac{0.12}{0.32} = \dfrac{12}{32} = \dfrac{3}{8} = 0.375$

42.(d) We have, $p \Leftrightarrow q \equiv (p \Rightarrow q) \wedge (q \Rightarrow p)$

So, $\sim(p \Leftrightarrow q) \equiv \sim[(p \Rightarrow q) \wedge (q \Rightarrow p)]$
$$\equiv \sim(p \Rightarrow q) \vee \sim(q \Rightarrow p)$$
$$\equiv [p \wedge (\sim q)] \vee [q \wedge (\sim p)]$$
So the negation is

ΔABC is right angled triangle right angle at B and $AB^2 + BC^2 \neq AC^2$

or, $AB^2 + BC^2 = AC^2$ and ΔABC is not right angled triangle right angle at B.

43.(d) Ax = B cannot be solved by inverse matrix method when A^{-1} doesnot exist. So we must have $|A| = 0$.

44.(c) $\lim\limits_{x \to 0} \dfrac{\sin 5x}{\sin kx} = \dfrac{1}{3}$

or, $\lim\limits_{x \to 0} \dfrac{5\cos 5x}{k\cos kx} = \dfrac{1}{3}$ or, $\dfrac{5\cos 0}{k\cos 0} = \dfrac{1}{3}$ $\therefore$ k = 15

45.(c) Since the function is continuous at x = 1, so
$$\lim_{x \to 1^-} f(x) = \lim_{x \to 1^+} f(x)$$
or, $\lim\limits_{x \to 1^-} (3x + 1) = \lim\limits_{x \to 1^+} (kx - 2)$

or, $3 \times 1 + 1 = k \times 1 - 2$

or, $3 + 1 = k - 2$ $\therefore$ $k = 4 + 2 = 6$

46.(d) $\log_{\sqrt{x}} x = \dfrac{1}{\log_x \sqrt{x}} = \dfrac{1}{\frac{1}{2}\log_x x} = 2$ and $\dfrac{dx}{dx} = 0$

47.(b) Actual change $= (x + \Delta x)^2 - x^2 = (2.01)^2 - 2^2$
$$= 4.0401 - 4 = 0.0401$$

48.(b) Given differential equation is $\dfrac{dy}{dx} + y\tan x = \sec x$

Here, integrating factor $= e^{\int \tan x\, dx} = e^{\log_e \sec x} = \sec x$

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

Section – II

61.(d) Vel. of ball relative to balloon = (u + v)
$$0 = (u + v) - gt$$
or, $t = \dfrac{u + v}{g}$

Time to meet balloon $(2t) = \dfrac{2(u + v)}{g}$

62.(b) For hammer & nail

$Mu = (M + m)v'$

$v' = \dfrac{Mu}{M + m}$

After impact
$$O = v'^2 + 2as$$
or, $a = \left(\dfrac{Mu}{M + m}\right)^2 \times \dfrac{1}{2s}$

Force (F) = (M + m) a
$$= \frac{M^2u^2}{(M + m)} \times \frac{1}{2s}$$

63.(c) Wt = upthrust

$V\rho g = \dfrac{V}{2}\sigma_1 g + \dfrac{V}{2}\sigma_2 g$

or, $\rho = \dfrac{\sigma_1 + \sigma_2}{2}$
$$= \frac{0.8 + 13.6}{2} = 7.2 \text{ g/cc}$$

64.(a) $\alpha = \dfrac{\Delta l}{l\Delta\theta} = \dfrac{0.08 \times 10^{-3}}{0.1 \times 100} = 8 \times 10^{-6}/°C$

$\Delta V = V_0\gamma\Delta\theta = 1000 \times 3 \times 8 \times 10^{-6} \times 100$
$$= 2.4 \text{ cc}$$
$\therefore$ Volume $= V + \Delta V = 1002.4$ cc

65.(b) **1[st] case:**
$$40\% = \left(1 - \frac{T_2}{500}\right) \times 100\%$$
or, $\dfrac{2}{5} = 1 - \dfrac{T_2}{500}$

or, $T_2 = \dfrac{3}{5} \times 500 = 300K$

2[nd] case:
$$\eta_2 = \left(1 - \frac{T_2}{T_1'}\right) \times 100\%$$
or, $\dfrac{50}{100} = 1 - \dfrac{300}{T_1'}$

or, $\dfrac{300}{T_1'} = \dfrac{1}{2}$

$\therefore$ $T_1' = 600K$

66.(c) $f' = \dfrac{v}{v - v_s} \times f$

or, $\dfrac{10000}{9500} = \dfrac{300}{300 - v_s}$

or, $300 - v_s = \dfrac{300 \times 9500}{10000}$

or, $300 - v_s = 285$

or, $v_s = 15$ m/s

67.(d) $Q_1 = 4\pi R^2\sigma$, $Q_2 = 16\pi R^2\sigma$

After connection

$$Q_1 + Q_2 = 4\pi\varepsilon_0(R + 2R)V$$

or, $V = \frac{20\pi R^2\sigma}{4\pi\varepsilon_0 \times 3R} = \frac{5\sigma R}{3\varepsilon_0}$

For bigger:

$$\sigma' = \frac{4\pi\varepsilon_0\, 2R \times 5\sigma R}{4\pi(2R)^2\, 3\varepsilon_0} = \frac{5\sigma}{6}$$

68.(b) $ms\Delta\theta = P_1 \times T_1$ ... (1)

$ms\Delta\theta = P_2 \times T_2$ ... (2)

In series $(P_1 + P_2) \times T = ms\Delta\theta$

or, $ms\Delta\theta\left(\frac{1}{T_1} + \frac{1}{T_2}\right)T = ms\Delta\theta$

or, $T = \frac{T_1T_2}{T_1 + T_2}$

69.(b) $E = \frac{d\phi}{dt} = AN\frac{d\phi}{dt}$

$= 0.1^2 \times 500 \times 1 = 5V$

70.(a) For convex lens

$$V = \frac{fu}{u - f} = \frac{10 \times 15}{15 - 10} = 30 \text{ cm}$$

For mirror

$r = 2f = 2 \times 12 = 24$ cm

$d = V - r = 30 - 24 = 6$ cm

71.(c) $1.5\,\beta = 1 \times 10^{-3}$

or, $1.5\frac{D\lambda}{d} = 10^{-3}$

or, $\lambda = \frac{10^{-3} \times 0.9 \times 10^{-3}}{1.5 \times 1}$

$= 6 \times 10^{-7}$ m

$= 6000$ Å

72.(b) $P = \frac{n}{t}\frac{hc}{\lambda} = \frac{nhc}{t \times h} \times P$

or, $\frac{np}{t} = \frac{P}{C}$

Rate of change in momentum $= \frac{P}{C}$

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

73.(b) **2nd case:**

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

or, $\frac{3000}{6000} = \left(\frac{1}{2}\right)^{140/T_{1/2}}$

or, $T_{1/2} = 140$ days

1st case:

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

or, $\frac{6000}{A_0} = \left(\frac{1}{2}\right)^{280/140}$

or, $A_0 = 24000$ dps

74.(b) $PH_2 = (nH_2 \times R \times T)/V = (2 \times 0.082 \times 300)/10 = 4.92$ atm

75.(a) Initial $[PCl_5] = 1$ M. Let x mol/L dissociate. $Kc = [PCl_3][Cl_2]/[PCl_5] = x^2/(1\text{-}x) = 0.04$ Solving: $x^2 + 0.04x - 0.04 = 0$, $x = 0.2$ M

76.(a) In K_2MnO_4: $2(+1) + x + 4(-2) = 0$, $x = +6$ In MnO_2: $x + 2(-2) = 0$, $x = +4$ Difference $= 6 - 4 = 2$

77.(a) Mass of H_2SO_4 in 1000 mL $= 1400 \times 0.49 = 686$ g Moles $= 686/98 = 7.0$ mol Molarity $= 7.0$ M

78.(b) $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ Each $K_2Cr_2O_7$ accepts 6 electrons

79.(c) Xe has 8 valence electrons + 4 from F atoms = 12 electrons 6 electron pairs arranged octahedrally, 4 bonding + 2 lone pairs Hybridization = sp^3d^2

80.(d) For octahedral $[Ma_2b_2c_2]$ complex with three different types of ligands Total geometrical isomers = 15 (considering all possible arrangements)

81.(a) In presence of peroxides, HBr follows anti-Markovnikov addition Br goes to less substituted carbon, forming 1-bromo-2-methylpropane

82.(d) 6N = {6, 12, 18, 24, 30, 36, 42, 48, ...]

8N = {8, 16, 24, 32, 40, 48, ...}

$6N \cap 8N$ = {24, 48, ...} = 24N

Also, LCM of 6 and 8 = 24

So $6N \cap 8N$ = 24N

83.(c) x^{th} term of the series $= \frac{1^3 + 2^3 + 3^3 + \ldots \text{ to n terms}}{1 + 3 + 5 + \ldots \text{ to 'n' terms}}$

$$= \frac{\frac{n^2(n+1)^2}{4}}{n^2} = \frac{(n+1)^2}{4} = \frac{n^2 + 2n + 1}{4}$$

84.(d) Given $|ZW| = 1$ i.e., $|Z|\,|W| = 1$

Also, $\arg(Z) - \arg(W) = \frac{\pi}{2}$ or, $\arg\left(\frac{Z}{W}\right) = \frac{\pi}{2}$ So, $\frac{Z}{W} = i$

and $\overline{\left(\frac{Z}{W}\right)} = -i$ i.e., $\frac{\bar{Z}}{\bar{W}} = -i$

Now, $\frac{Z}{W} + \frac{\bar{Z}}{\bar{W}} = i - i = 0$

or, $\frac{Z}{W} = -\frac{\bar{Z}}{\bar{W}}$

i.e. $\bar{Z}W = -Z\bar{W}$

So, $\bar{Z}W = -Z\frac{\bar{W}}{W}W$

$= -\frac{Z}{W}|W|^2 = -\frac{Z}{W} = -i$

85.(b) Let α be the root of $x^2 - x + k = 0$. So $\alpha^2 - \alpha + k = 0$

Also 2α will be the root of $x^2 - x + 3k = 0$.

So $4\alpha^2 - 2\alpha + 3k = 0$

On solving

$$\frac{\alpha^2}{-3k + 2k} = \frac{\alpha}{4k - 3k} = \frac{1}{-2 + 4}$$

i.e. $\frac{\alpha^2}{-k} = \frac{\alpha}{k} = \frac{1}{2}$ i.e., $\alpha^2 = -\frac{k}{2}$, $\alpha = \frac{k}{2}$

Then $\left(\frac{k}{2}\right)^2 = -\frac{k}{2} \Rightarrow \frac{k^2}{4} = -\frac{k}{2} \Rightarrow k = -2$ ($\because k \neq 0$)

86.(c) $C(2n + 1, 1) + C(2n + 1, 2) + \ldots + C(2n + 1, n) = 255$ ... (i)

Also, $C(2n + 1, 0) + C(2n + 1, 1) + C(2n + 1, 2) + \ldots + C(2n + 1, n) = 256$ ... (ii)

Using C(n, r) = C(n, n – r), we have,
C(2n + 1, 2n + 1) + C(2n + 1, 2n) + C(2n + 1, 2n – 1) + ... + C(2n + 1, n + 1) = 256 ... (iii)
Adding (ii) and (iii), we have
C(2n + 1, 0) + C(2n + 1, 1) + C(2n + 1, 2) + ... + C(2n + 1, n) + C(2n + 1, n + 1) + C(2n + 1, n + 2) + ... + C(2n + 1, 2n + 1) = 512

or, $2^{2n+1} = 512$

or, $2^{2n+1} = 2^9$

or, 2n + 1 = 9 or, 2n = 8 ∴ n = 4

87.(c) Given $(1+3)\log_e 3 + \frac{1+3^2}{2!}(\log_e 3)^2 + \frac{1+3^3}{3!}(\log_e 3)^3 + ...$

$$= \left[\log_e 3 + \frac{(\log_e 3)^2}{2!} + \frac{(\log_e 3)^3}{3!} + ...\right] + \left[3\log_e 3 + \frac{(3\log_e 3)^2}{2!} + \frac{(3\log_e 3)^3}{3!} + ...\right]$$

$$= \left[1 + \frac{\log_e 3}{1!} + \frac{(\log_e 3)^2}{2!} + \frac{(\log_e 3)^3}{3!} + ... - 1\right] + \left[1 + \frac{3\log_e 3}{1!} + \frac{(3\log_e 3)^2}{2!} + \frac{(3\log_e e)^3}{3!} + ... - 1\right]$$

$= (e^{\log_e 3} - 1) + [e^{3\log_e 3} - 1]$

$= 3 - 1 + 3^3 - 1 = 3 - 1 + 27 - 1 = 28$

88.(b) Given pairs are $x^2 - 2mxy - y^2 = 0$ ... (i) $x^2 - 2nxy - y^2 = 0$ ... (i)
Equation of bisectors of angle between the lines (i) is

$-m(x^2 - y^2) = [1 - (-1)]\,xy$

$-mx^2 + my^2 = (1 + 1)\,xy$

i.e., $mx^2 + 2xy - my^2 = 0$ .... (ii)

According to question (ii) and (iii) are identical, so,

$$\frac{m}{1} = \frac{2}{-2n} = \frac{-m}{-1}$$

Taking first two $\frac{m}{1} = \frac{2}{-2n} \Rightarrow mn = -1$

89.(d) Given line is $lx + my + n = 0$ .... (i) and parabola is $x^2 = y$ ... (ii)
Solving (i) and (ii),

$mx^2 + lx + n = 0$ ... (iii)

Line (i) is a tangent to (ii) if discriminant of (iii) is zero.

$l^2 - 4mn = 0$

i.e. $l^2 = 4mn$

90.(c) Given $|\vec{a}| = |\vec{b}| = |\vec{c}| = 1$, $\vec{a}.\vec{b} = \vec{b}.\vec{c} = \vec{c}.\vec{a} = 0$

Now, $|\vec{a} + \vec{b} + \vec{c}|^2 = (\vec{a} + \vec{b} + \vec{c})^2$

$= |\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 + 2|\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a})$

= 1 + 1 + 1 + 0

= 3

∴ $|\vec{a} + \vec{b} + \vec{c}| = \sqrt{3}$

91.(a) $\tan^{-1}x + \tan^{-1}y = \frac{\pi}{4}$

or, $\tan^{-1}\frac{x+y}{1-xy} = \frac{\pi}{4}$

or, $\frac{x+y}{1-xy} = \tan\frac{\pi}{4}$

or, $\frac{x+y}{1-xy} = 1$

or, $x + y = 1 - xy$

∴ $x + y + xy = 1$

92.(b) Given f(x + y) = f(x) f(y)

Now, $f'(5) = \lim_{h \to 0} \frac{h(h+5)}{h} - f(5)$

$= \lim_{h \to 0} \frac{f(h+5) - f(5+0)}{h}$

$= \lim_{h \to 0} \frac{f(h)\,f(5) - f(5)\,.\,f(0)}{h}$

$= \lim_{h \to 0} f(5)\frac{[f(h) - f(0)]}{h} = f(5)\,f'(0)$

$= 2 \times 3 = 6$

93.(a) Given, $f(x) = \frac{e^{2x} - 1}{e^{2x} + 1} = \frac{e^x.e^x - e^x\,e^{-x}}{e^x\,e^x + e^x\,e^{-x}}$

$= \frac{e^x(e^x - e^{-x})}{e^x(e^x + e^{-x})} = \tanh x$

So, $f'(x) = \operatorname{sech}^2 x > 0$ for all real x. Thus the function is increasing.

94.(c) Put $\tan^{-1}x^4 = z$ ∴ $dz = \frac{1}{1 + (x^4)^2}\,.\,4x^3\,dx$

i.e. $\frac{1}{4}dz = \frac{4^3\,dx}{1 + x^8}$

Then $I = \int \sin z\,\frac{dz}{4} = -\frac{\cos z}{4} + c = -\frac{1}{4}\cos(\tan^{-1}x^4) + c$

95.(b) $I + J = \int_0^{\pi/4} \sin^2 x\,dx + \int_0^{\pi/4} \cos^2 x\,dx$

$= \int_0^{\pi/4} (\sin^2 x + \cos^2 x)\,dx = \int_0^{\pi/4} dx = [x]_0^{\pi/4} = \frac{\pi}{4}$

∴ $I = \frac{\pi}{4} - J$

96.(d) Required area

$= \int_1^3 y\,dx$

$= \int_1^3 |x - 2|\,dx$

$= \int_1^2 |x - 2|\,dx + \int_2^3 |x - 2|\,dx$

$= \int_1^2 -(x - 2)\,dx + \int_2^3 |x - 2|\,dx$

$= -\left[\frac{(x-2)^2}{2}\right]_1^2 + \left[\frac{(x-2)^2}{2}\right]_2^3$

$= -\left[0 - \frac{1}{2}\right] + \left[\frac{1}{2} - 0\right]$

$= \frac{1}{2} + \frac{1}{2}$

= 1 sq. unit

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

...Best of Luck...