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2082-2-17 Hints & Solution

Section – I

1.(d) $Bx = Dt$

or, $\frac{D}{B} = LT^{-1}$

2.(b) $R = \frac{u^2\sin2\theta}{g}$, R will be max if

$\sin2\theta = 1 = \sin90°$

$\theta = 45°$

3.(c) $\frac{1}{2}m(2v_e)^2 - \frac{1}{2}mv_e^2 = \frac{1}{2}mv'^2$

or, $\sqrt{3}\,v_e = v'$

4.(c) $r = \sqrt{r_1^2 + r_2^2} = \sqrt{3^2 + 4^2} = 5$ cm

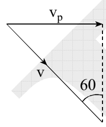
5.(c) i.e. 0 to 4°C → volume decreases, 4°C to 15°C → volume increases

6.(c) $a_2 = 6$ unit, $a_1 = 8$ unit

$\frac{I_{max}}{I_{min}} = \left(\frac{a_1+a_2}{a_1-a_2}\right)^2 = \left(\frac{8+6}{8-6}\right)^2 = \left(\frac{14}{2}\right)^2 = 49 : 1$

7.(c) $\sin60° = \frac{v_p}{v}$

$v_p = \frac{\sqrt{3}v}{2}$



8.(c)

$$\underbrace{Q \quad\quad}_{a/2}\underbrace{\quad\quad Q}_{a/2}$$

$\frac{Qq}{4\pi\varepsilon_0\frac{a^2}{4}} = \frac{Q.Q}{4\pi\varepsilon_0 a^2} \Rightarrow q = \frac{Q}{4}$

9.(b) $\frac{R'}{R} = \left(\frac{2l}{l}\right)^2 = 4$

$R' = 4R$

10.(c) $E = \frac{\Delta\phi}{\Delta t} = \frac{8\times10^{-4}}{0.5} = 1.6$mV

11.(a) $V_L = 60V$, $V_C = 30V$, $V_R = 40V$

$V = \sqrt{V_R^2 + (V_L-V_C)^2} = 50V$

12.(d) $v = \sqrt{\frac{2eV}{m}} = \sqrt{2\times1.8\times10^{11}\times100} = 6\times10^6$ m/s

13.(a) $\phi = hf_0 \Rightarrow f_0 = \frac{\phi_0}{h} = 8\times10^{14}$ Hz

14.(b) P-type semiconductor holes are the majority charge carriers.

15.(a) No. of protons = No. of mole × N_A × No. of protons in one molecule of $CaCO_3$

16.(b)

17.(b) $MHPO_4$ shows that valency of M = 2 (since HPO_4 has valency 2). Hence chloride will be MCl_2

18.(b)

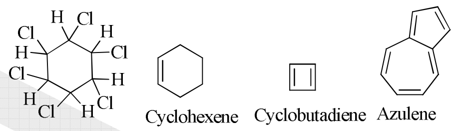
19.(d)

20.(a)

21.(d) F^- is the most electronegative element.

22.(c) The impurity in extraction of copper is FeO which is removed by adding SiO_2.

23.(d) It obeys Huckel's rule i.e. it contains (4n+2) delocalized π electrons e.g.10 π electrons.



BHC   Cyclohexene   Cyclobutadiene   Azulene

24.(a) It is known as enyne compound. Its IUPAC format is: Alk-en-yne. Numbering is done by the lowest sum rule.

25.(d) Carbonium ion e.g. CH_3^+ (6 electrons)

Free radical e.g. $.CH_3$ (7 electrons)

Nitrene e.g. CH_3N (6 electrons)

Carbanion e.g. CH_3^- (8 electrons)

26.(d) $(CH_3)_3CNO_2$, CCl_3CHO and $(CH_3)_3CHO$ do not have α hydrogen atoms so they do not show tautomerism.

27.(a) +R or +M groups viz. –OH, OR, $–NH_2$, –X etc give ortho and para substituted product due to mesomeric effect or resonating effect.

28.(c)

29.(a) $B \subset A$, then $A \cup B = A$

30.(a) $z = \frac{1}{2+i} \times \frac{2-i}{2-i} = \frac{2-i}{2^2-i^2} = \frac{2-i}{5}$

$\bar{z} = \frac{2+i}{5}$

31.(c) $AM \times H.M = GM^2$

or, $H.M = \frac{G^2}{A}$

32.(c) θ lies on 3rd quadrant.

∴ $\theta = \pi + \frac{\pi}{6} = \frac{7\pi}{6}$

Most general value $= 2n\pi + \frac{7\pi}{6}$

33.(b) Focus $= \left(\frac{-5+3}{2}, \frac{6+6}{2}\right) = (-1, 6)$

34.(b) Let $\vec{a} = a_1\vec{i} + a_2\vec{j} + a_3\vec{k}$

Then, $\vec{a}.\vec{i} = a_1$, $\vec{a}.\vec{j} = a_2$, $\vec{a}.\vec{k} = a_3$

So, $(\vec{a}.\vec{i})\vec{i} + (\vec{a}.\vec{j})\vec{j} + (\vec{a}.\vec{k})\vec{k}$

$= a_1\vec{i} + a_2\vec{j} + a_3\vec{k} = \vec{a}$

35.(a)

36.(b) Let $y = \sec^2 x$, $z = \tan x$

$$\frac{dy}{dx} = 2\sec x.\sec x \tan x$$

& $$\frac{dz}{dx} = \sec^2 x$$

$$\therefore \quad \frac{dy}{dz} = 2\tan x$$

37.(b) $\sin^{-1}(\cos x) = \frac{\pi}{2} - \cos^{-1}(\cos x)$

$$= \frac{\pi}{2} - x$$

Now, $\int \sin^{-1}(\cos x)\,dx = \frac{\pi}{2}x - \frac{x^2}{2} + c$

38.(c) $xy = 1$ which is rectangular hyperbola. So, $e = \sqrt{2}$.

39.(a)

40.(b) (0, 1, 0)

41.(d) Greatest coefficient is the coeff. of mid term.

42.(d) $f(x) = \frac{1}{3\sin x - 4\cos x + 7}$ will be minimum when $3\sin x - 4\cos x + 7$ is maximum.

Maximum of denominator

$= \sqrt{3^2 + 4^2} + 7 = 5 + 7 = 12$

43.(c) The given equation are intersecting lines.

44.(c) $ax + by = 2ab$

or, $\frac{x}{2b} + \frac{y}{2a} = 1$

$A = \frac{1}{2} \times b \times h = \frac{1}{2}.2b.2a = 2ab$

45.(a) $\int_{-1}^{2} |x|\,dx = \int_{-1}^{0} (-x)\,dx + \int_{0}^{2} x\,dx$

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

$= -\left(0 - \frac{1}{2}\right) + \left(\frac{4}{2} - \frac{0}{2}\right)$

$= \frac{1}{2} + 2 = \frac{5}{2}$

46.(b)

47.(a) Here, $a = \cos^2\theta - 1 = -\sin^2\theta$

$b = \sin^2\theta$

and $a + b = 0$

So, the lines are perpendiculars

48.(a) Obvious

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

Section – II

61.(c) $\frac{h}{2} = \frac{g}{2}(2n - 1)$

or, $\frac{1}{2} \times \frac{1}{2} gn^2 = \frac{g}{2}(2n - 1)$

or, $n^2 - 4n + 2 = 0$

or, $n = 3.42$ sec

$\therefore \quad h = \frac{1}{2} g (3.42)^2$

$= \frac{1}{2} \times 10 (3.42)^2$

$= 58$ m

62.(c) $\frac{Gm_1}{x^2} = \frac{Gm_2}{(1-x)^2} \Rightarrow x = \frac{1}{11}$ m

63.(b) Energy stored = K.E. of mass

$\frac{1}{2}\frac{YAe^2}{ml} = \frac{1}{2}mv^2$

$v = \sqrt{\frac{YAe^2}{ml}} = \sqrt{\frac{5 \times 10^8 \times 10^{-6} \times 0.02^2}{5 \times 10^{-3} \times 0.1}} = 20$ m/s

64.(b) $E = \sigma AT^4 \times t = 4.45$ kJ

65.(a) $(\mu - 1)t = n\lambda$, $\lambda = \frac{(\mu - 1)t}{n} = \frac{(1.5 - 1) \times 6 \times 10^{-6}}{5}$

$= 6 \times 10^{-7}$ m $= 6000$ Å

66.(b) $f_0 = \frac{1}{2L}\sqrt{\frac{stress}{\rho}} = \frac{1}{2l}\sqrt{\frac{Y \times strain}{\rho}} = 170$ Hz

67.(c) $F = 9\times10^9.\frac{Q_1Q_2}{r^2} \Rightarrow r^2 = 9 \times 10^9\frac{Q_1Q_2}{F} = 9$cm

68.(b) Amount of heat energy required for the water to boil
$Q = 1\,(100 - 20) \times 4200 + 420\times80 = 369600$J

Q = 90% of Pt, t = 467 sec

69.(d) $E = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2 \times 2 \times 10^6 \times 1.6 \times 10^{-19}}{1.67 \times 10^{-27}}}$

$= 1.96 \times 10^7$ m/s

$F = Bev = 2.5 \times 1.6 \times 10^{-19} \times 1.96 \times 10^7$

$= 7.84 \times 10^{-12}$ N

70.(c) $L = \frac{N\phi}{I} = 2.5\times10^{-3}$ H

The magnetic energy stored, $U = \frac{1}{2}LI^2 = 5 \times 10^{-3}$ J

71.(d) $\phi_0 = \frac{hc}{\lambda} - K.E. = 3 \times 10^{-19}$

$f_0 = \frac{3\times10^{-19}}{h} = 4.5\times10^{14}$ Hz

72.(d) For 1st member of Balmer series $\frac{1}{\lambda_{B'}} = R\left(\frac{1}{4}-\frac{1}{9}\right)$

$\Rightarrow \quad \lambda_B = \frac{36}{5R}$

For second member of same series,

$\frac{1}{\lambda_{B'}} = R\left(\frac{1}{4}-\frac{1}{16}\right) \Rightarrow \lambda_B' = \frac{16}{3R}$ ……(i)

i.e. $\frac{\lambda_{B'}}{\lambda_B} = \frac{16 \times 5R}{3R \times 36}$

$\therefore \quad \lambda_B' = \frac{20}{27} \times 6563 = 4861Å$

73.(b) $\frac{N'}{N_0}$

So, $\frac{N}{N_0} = 1 - \frac{N'}{N_0} = 1 - \frac{1}{4} = \frac{3}{4}$

$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

or, $\frac{3}{4} = \left(\frac{1}{2}\right)^{\frac{t}{T_{1/2}}}$

or, $\frac{ln\left(\frac{3}{4}\right)}{ln\left(\frac{1}{2}\right)} = \frac{t}{T_{1/2}}$

or, t = 224 yrs

74.(a) $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O] \times 3$

$Fe^{2+} \rightarrow Fe^{3+} + 1e^-] \times 5$

As 5 moles of $Fe(C_2O_4)$ = 3 moles of $KmnO_4$

So, 1 mol of $Fe(C_2O_4)$ = 3/5 moles of $KmnO_4$ = 0.6 mol

75.(a) $N_{mix} = (N_1V_1 + N_2V_2 + N_3V_3)/V_{total}$

76.(b) 71 parts of chlorine combine with 32 parts sulphur 35.5 parts of chlorine combine with 16 parts of sulphur

Hence, eq.wt of S in SCl_2 = 16

77.(d) 1mol of Au = 197g = 0.197kg = 6.02×10^{23} atoms so, 19.7 kg Au = 6.02×10^{25} atoms

78.(a) No. of mol × N_A

79.(c) Bond length order: Single bond > bond created by resonance > double bond > triple bond

80.(c)

81.(c) B shows + I effect and hyperconjugation

C shows - I effect D shows -R and -I effect

82.(a) $\frac{dy}{dx} = -\frac{fx}{fy} = -\frac{2ax + 2hy}{2hx + 2by}$

$= -\frac{ax + hy}{hx + by}$

83.(a) $f(x) = y = x^2 - 6x + 9 - 3$

$y + 3 = (x - 3)^2 \geq 0$

$y + 3 \geq 0$

$y \geq -3$

84.(b) z is a locus of a point whose distance from a point (3, 4) is always 5 unit. So, locus of z is a circle.

OR, put z = x + iy and solve.

We get; $(x - 3)^2 + (y - 4)^2 = 25$

85.(a) Since, one of the lines bisects the angle b/w the axes so the line is either y = x or

$y = -x$

Then the eq^n is

$ax^2 \pm 2hx^2 + bx^2 = 0$

or, $a + b = \pm 2h$

$\therefore \quad (a + b)^2 = 4h^2$

86.(d) The line passes through the centre of the circle. So, it is a diameter.

$\therefore$ Angle between diameter and tangent of circle is 90°

87.(a) If a = 0, by + cz + d = 0 is a plane parallel to x-axis.

88.(b) $\vec{a} \times \vec{b} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 1 & 1 \\ -2 & 3 & 1 \end{vmatrix}$

$= -2\vec{i} - 3\vec{j} + 5\vec{k}$

Area $= \frac{1}{2}|\vec{a} \times \vec{b}| = \frac{\sqrt{38}}{2}$

89.(b) $a^{1/x} = b^{1/y} = c^{1/z} = k$

Then, $a = k^x, b = k^y, c = k^z$

Since, a, b, c are in G.P.

$b^2 = ac$

$k^{2y} = k^x.k^y = k^{x+y}$

or, $2y = x + y$

$\therefore$ x, y, z are in A.P.

90.(a) $\sum\frac{n^2}{n!} = \sum\frac{n}{(n-1)!}$

$= \sum\frac{n-1+1}{(n-1)!}$

$= \sum\frac{1}{(n-2)!} + \sum\frac{1}{(n-1)!}$

$= 2e$

91.(c) $f'(x) = 4x^3 + 12x^2$

$f''(x) = 12x^2 + 24x$

$= 12x(x + 2)$

Point of inflection, $x = 0$, $x = -2$

i.e. $x \in (-\infty, -2)\cup(0, \infty)$

92.(b) No of diagonals, $nC_2 - n = 144$

It is true when n = 11

93.(d) $V = \frac{4}{3}\pi r^3$

$\frac{dv}{dt} = \frac{4}{3}\pi\, 3r^2\frac{dr}{dt}$

$18 = 4\pi r^2\frac{dv}{dt}$

$\frac{dr}{dt} = \frac{9}{128\pi}$ cm/sec

94.(a) Let $y = \sin x$

Then $dy = \cos x\, dx$

When $x = 0$; $y = 0$ and when $x = \frac{\pi}{2}$, $y = 1$

Then $\int_0^{\pi/2}\frac{\cos x}{1+\sin^2 x}dx = \int_0^1\frac{dy}{1+y^2} = [\tan^{-1}y]_0^1 = \frac{\pi}{4}$

95.(c) Area $= 2\int_0^a y\,dx$

$= 2\sqrt{4a}\int_x^a \frac{1}{2}dx$

$= 4\sqrt{a}.\frac{a^{3/2}}{3/2} = \frac{8}{3}a^2$

96.(c) Apply, $R_2 \to R_2 - R_1$

and $R_3 \to R_3 - R_1$

$\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 0 & x & 0 \\ 0 & 0 & y \end{vmatrix} = xy$

i.e. Δ is divisible by both x & y

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

...The End...