HINTS & SOLUTIONS (PRACTICE PAPER-2)

ANSWER KEY

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	A	D	A	D	C	C	B	C	C	B	B	C	A	D	B
Ques.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	C	A	A	D	A	D	C	B	D	C	D	A	C	B	B
Ques.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	C	A	B	D	B	D	C	D	A	D	D	B	B	B	A
Ques.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	B	A	A	C	A	D	C	B	D	A	B	A	D	B	B
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans.	A	C	A	A	D	B	C	B	C	B	A	C	B	B	C
Ques.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans.	B	A	B	C	B	B	A	A	D	D	D	C	C	C	A
Ques.	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
Ans.	B	A	C	B	A	C	D	B	D	D	D	C	B	A	A
Ques.	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
Ans.	B	A	A	D	A	D	D	B	A	C	A	B	D	A	C

PART-I (1 Mark)

MATHEMATICS

1. The equation $z^2 = \bar{z}$, where z is a complex number, has

(A*) 4 solution (B) 2 solution
(C) no solution (D) infinitely many solutions

Sol. $z = a + ib$

$\bar{z} = a - ib$

It is given : $z^2 = \bar{z}$

$(a + ib)^2 = a - ib$

$a^2 - b^2 + i\,2ab = a - ib$

$\therefore\ a^2 - b^2 = a$ and $2ab = -b$

$2ab + b = 0$

$b(2a + 1) = 0$

$b = 0$ or $a = \dfrac{-1}{2}$

When $b = 0$, $a^2 - b^2 = a$

$a^2 - 0 = a$

$a(a - 1) = 0$

So, $a = 0$, or $a = 1$

When $a = \dfrac{-1}{2}$, $\left(\dfrac{-1}{2}\right)^2 - b^2 = \dfrac{-1}{2}$

$$\frac{1}{4} - b^2 = \frac{-1}{2}$$

$$b^2 = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$$

$$b = \pm \frac{\sqrt{3}}{2}$$

$\therefore$ $z = 0 + 0i$ or $1 + 0i$

$\therefore$ $z = \frac{-1}{2} + i \cdot \frac{\sqrt{3}}{2}$ or $\frac{-1}{2} - i \frac{\sqrt{3}}{2}$

$\therefore$ There will be four solutions possible.

2. $$\left[\frac{x+1}{x^{2/3} - x^{1/3} + 1} - \frac{x-1}{x - x^{1/2}}\right]^{10}$$

$$\left[\frac{(x^{1/3}+1)(x^{2/3} - x^{1/3} + 1)}{(x^{2/3} - x^{1/3} + 1)} - \frac{(x^{1/2}-1)(x^{1/2}+1)}{x^{1/2}(x^{1/2}-1)}\right]^{10}$$

$$\left[(x^{1/3}+1) - (1 + x^{-1/2})\right]^{10}$$

$$\left[x^{1/3} - x^{-1/2}\right]^{10}$$

General Term $T_{r+1} = (-1)^r\, {}^{10}C_r (x^{1/3})^{10-r} (x^{-1/2})^r$

$$= (-1)^r\, {}^{10}C_r\, x^{\frac{10-r}{3} - \frac{r}{2}}$$

For the independent term $\frac{10-r}{3} - \frac{r}{2} = 0$

$$\frac{10-r}{3} = \frac{r}{2}$$

$20 - 2r = 3r$

$5r = 20$

$r = 4.$

So, independent term $= (-1)^4\, {}^{10}C_4 = \frac{10!}{4!6!} = 210.$

3. $$\begin{vmatrix} a & a^2 & a^3 - 1 \\ b & b^2 & b^3 - 1 \\ c & c^2 & c^3 - 1 \end{vmatrix} = 0$$

$$\begin{vmatrix} a & a^2 & a^3 \\ b & b^2 & b^3 \\ c & c^2 & c^3 \end{vmatrix} + \begin{vmatrix} a & a^2 & -1 \\ b & b^2 & -1 \\ c & c^2 & -1 \end{vmatrix} = 0$$

$$abc \begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} - 1 \begin{vmatrix} a & a^2 & 1 \\ b & b^2 & 1 \\ c & c^2 & 1 \end{vmatrix} = 0$$

$$abc\begin{vmatrix}1 & a & a^2\\1 & b & b^2\\1 & c & c^2\end{vmatrix} + 1\begin{vmatrix}a & 1 & a^2\\b & 1 & b^2\\c & 1 & c^2\end{vmatrix} = 0$$

$$abc\begin{vmatrix}1 & a & a^2\\1 & b & b^2\\1 & c & c^2\end{vmatrix} - 1\begin{vmatrix}1 & a & a^2\\1 & b & b^2\\1 & c & c^2\end{vmatrix} = 0$$

$$\begin{vmatrix}1 & a & a^2\\1 & b & b^2\\1 & c & c^2\end{vmatrix}(abc - 1) = 0$$

$\therefore$ $abc = 1.$

4. $ax^2 - 6xy + y^2 = 0$

$m_1 + m_2 = \frac{-2h}{b}$

$m_1 + m_2 = \frac{6}{1}$

$m_1m_2 = \frac{a}{b}$

$m_1m_2 = \frac{a}{1} = a$

Given : $m_2 = m_1^2$

$m_1^2 + m_1 - 6 = 0$

$(m_1 + 3)(m_1 - 2) = 0$

$m_1 = -3$ and $m_1 = 2$

and $m_1m_2 = a$

$m_1 \times m_1^2 = a$

$m_1^3 = a$

a is positive, so $a = (2)^3 = 8$.

5. $x^2 + 4y^2 = 1$ ....(i)

$4x^2 + y^2 = 4$

$y^2 = 4 - 4x^2$

put in (i)

$x^2 + 4(4 - 4x^2) = 1$

$x^2 + 16 - 16x^2 = 1$

$16 - 1 = 15x^2$

$15 = 15x^2$

$x^2 = 1$

$x = \pm 1$

$y^2 = 4 - 4x^2$

$= 4 - 4(1)$

$y^2 = 0$

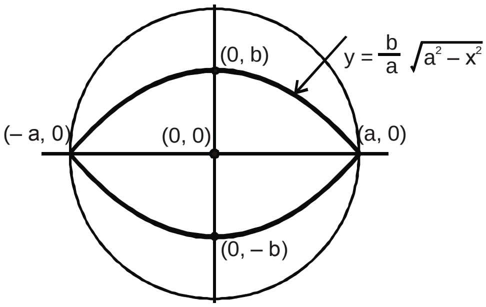
$y = 0$

$\therefore$ (1, 0) and (– 1, 0) are two common point.

6. Diameter = major axis = 2a

radius = a

Area of circle = πa^2



Let the equation of the ellipse be $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.

$\therefore\ y = \frac{b}{a}\sqrt{a^2-x^2}$

Area of ellipse = $\frac{1}{3}\pi a^2 = 4 \times \int_0^a \frac{b}{a}\sqrt{a^2-x^2}\,dx$

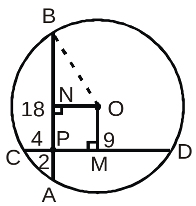
$$= 4 \times \frac{b}{a}\left[\frac{x}{2}\sqrt{a^2-x^2}+\frac{1}{2}a^2\sin^{-1}\frac{x}{a}\right]_0^a$$

$$\frac{1}{3}\pi a^2 = 4 \times \frac{b}{a}\left[\frac{\pi a^2}{4}\right]$$

$$\frac{b}{a}=\frac{1}{3}$$

$e = \sqrt{1-\left(\frac{b}{a}\right)^2} = \sqrt{1-\left(\frac{1}{3}\right)^2} = \sqrt{\frac{8}{9}} = \frac{2\sqrt{2}}{3}$.

7. PD = $\frac{PA \times PB}{PC} = \frac{18 \times 2}{4} = 9$



BN = $\frac{1}{2}$AB = 10

MC = $\frac{1}{2}$CD = $\frac{13}{2}$

PM = MC – PC

$= \frac{13}{2} - 4 = \frac{5}{2}$

ON = PM = $\frac{5}{2}$

In ΔONB

OB = $\sqrt{10^2+\left(\frac{5}{2}\right)^2} = \sqrt{100+\frac{25}{4}} = \sqrt{\frac{425}{4}} = \frac{5\sqrt{17}}{2}$

Diameter = 2 × OB = $\frac{5\sqrt{17}}{2} \times 2 = 5\sqrt{17}$ cm.

8. cos 175 = cos (180 – 5) = – cos 5

cos 185 = cos (180 + 5) = – cos 5

cos 355 = cos(360 – 5) = cos 5

$\therefore$ cos 5 + cos 10 + cos 15 + ...+ cos 355

= cos5 + cos 10 + ...+ cos 85 + cos 90º + cos(180º – 85) + cos (180º – 80º)

+ ....+ cos (180º – 5) + cos 180º + cos (180º + 5) + cos(180º+ 10)

+ ....+ cos (180º + 85) + cos 270 + cos(360 – 85) + ...+ cos(360 – 5)

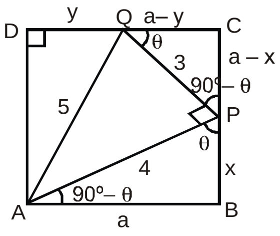
= cos 5 + cos 10 + ...+ cos 85 + 0 – cos 85 – cos 80 – ....– cos 5 – 1

– cos 5 – cos 10 – cos 85 + 0 + cos 85 + cos 80 + ...+ cos 5

= – 1

9. By AA similarity

$\Delta QCP \sim \Delta PBA$



$$\frac{a-y}{x} = \frac{a-x}{a} = \frac{3}{4}$$

$$\frac{a-x}{a} = \frac{3}{4}$$

$$x = \frac{a}{4}$$

$$\frac{a-y}{x} = \frac{3}{4}$$

$$\frac{a-y}{a/4} = \frac{3}{4}$$

$$y = \frac{13a}{16}$$

In ΔPAB

$4^2 = x^2 + a^2$

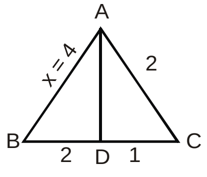
$$16 = \left(\frac{a}{4}\right)^2 + a^2$$

$$16 = \frac{17a^2}{16}$$

$$a^2 = \frac{16 \times 16}{17} = \frac{256}{17}$$

Area of square ABCD = $a^2 = \dfrac{256}{17}$.

10. By Angle bisector theorem



$$\frac{x}{2} = \frac{2}{1} \Rightarrow x = 4$$

$$\cos B = \frac{3^2 + 4^2 - 2^2}{2 \times 3 \times 4} = \frac{9 + 16 - 4}{24} = \frac{21}{24} = \frac{7}{8}.$$

11. $s = \dfrac{18x+6}{2} = 9x + 3$

$s = \sqrt{(9x+3)(2)(3x+1)(6x)}$

$= 6\sqrt{(3x+1)(3x+1)(x)}$

$= 6(3x + 1)\sqrt{x}$

x is a perfect square, so in 1 to 20, 4 perfect square i.e. possible values are {1, 4, 9, 16}.

12. $f(1) = 0$ as $\lim_{h\to 0}\frac{f(1+h)}{h}$ exists.

$\Rightarrow \lim_{h\to 0}\frac{f(1+h)-f(1)}{h} \Rightarrow f'(1)$ exists.

So, f is differentiable at 1.

13. Statement I is true that the derivative of an odd differentiable function is always even and statement II is also true that If $f(x)$ is differentiable at a point x_0 and $g(x)$ is not differentiable at x_0, then $f(x)\,g(x)$ is not differentiable at x_0.

14. $[x] = \begin{cases} 0, & 0 \le x < 1 \\ -1, & -1 \le x < 0 \end{cases}$

$f(x) = \begin{cases} \frac{\sin(-1)}{-1} = \sin 1, & -1 \le x < 0 \\ 0, & 0 \le x < 1 \end{cases}$

$\lim_{x\to 0^-} f(x) = \sin 1$

and $\lim_{x\to 0^+} f(x) = 0$

$\therefore \lim_{x\to 0} f(x)$ does not exists.

15. $x - \sqrt{x} > 0$ for all $x > 1$.

and $-\sqrt{x} + \sqrt[4]{x} > 0$ for all $x < 0$

So, range of f is $[0, \infty)$.

16. $f(x) = \int_0^x e^t(t-1)(t-2)\,dt$

$f'(x) = e^x(x-1)(x-2)$

For decreasing

$f'(x) < 0$

$e^x(x-1)(x-2) < 0$

$(x-1)(x-2) < 0$ $\quad [\therefore e^x > 0]$

$x \in (1, 2)$.

17. $\int_{-1}^{1} x\,|x|^{3/2}\,dx$

$= \int_{-1}^{0} x(-x)^{3/2}\,dx + \int_0^1 x(x)^{3/2}\,dx$

$= \int_{-1}^{0} x^{5/2}(-1)^{3/2}\,dx + \int_0^1 x^{5/2}\,dx$

$= (-1)^{3/2}\left[\frac{x^{7/2}}{7/2}\right]_{-1}^{0} + \left[\frac{x^{7/2}}{7/2}\right]_0^1$

$= (-1)^{3/2}\,\frac{2}{7}\,[0 - (-1)^{7/2}] + \frac{2}{7}[1-0]$

$= -(-1)^5\frac{2}{7} + \frac{2}{7} = \frac{2}{7} + \frac{2}{7} = \frac{4}{7}$.

18. $\int (x f_1(x) f_2(x) \ldots\ldots f_{10}(x))^{-1} dx$

Let $f_{11}(x) = t$

$$\frac{dx}{x f_1(x) f_2(x) \ldots\ldots f_{10}(x)} = dt$$

$$\int 1.dt \quad = t + C$$

$$= f_{11}(x) + C.$$

19. Applying AM and GM condition :

$$\frac{x_1 + 2x_2 + 3x_3}{3} \geq (6x_1x_2x_3)^{1/3}$$

$$\frac{4}{3} \geq (6x_1x_2x_3)^{1/3}$$

Cubing both sides

$$\frac{64}{27} \geq 6x_1x_2x_3$$

$$x_1x_2x_3 \leq \frac{32}{81}$$

Now also $\frac{x_1^2 + x_2^2 + x_3^2}{3} \geq (x_1^2x_2^2x_3^2)^{1/3}$

$$\frac{x_1^2 + x_2^2 + x_3^2}{3} \geq \left(\frac{32}{81}\right)^{2/3}$$

$$x_1^2 + x_2^2 + x_3^2 \geq 3\left(\frac{2^{10}}{3^8}\right)^{1/3}$$

$$x_1^2 + x_2^2 + x_3^2 \geq \frac{3 \times 8}{9}\left(\frac{2}{9}\right)^{1/3}$$

$$x_1^2 + x_2^2 + x_3^2 \geq \frac{24}{9} \times 0.6$$

$$x_1^2 + x_2^2 + x_3^2 \geq 1.6$$

So, according options least value is 2.

20. $\bar{1}\bar{2}\bar{3}\bar{4}\bar{5}\bar{6}\bar{7}$

at each position two posibility i.e. either H or T

So total posible outcomes = 2^7

As we want three tails is sequence and it happened at 7^{th} turn. So at position 5, 6, 7 we have tails and position 4 must have head otherwise our requirement is fullfilled at position 6.

So, the position 1, 2, 3 can have anything i.e. H/T = 2^3

To get tail at 1, 2,3 position we have only one probability.

So, total favourable cases = $2^3 - 1 = 7$

required probability = $\frac{7}{2^7} = \frac{7}{128}$.

PHYSICS

22. PV = nRT
PdV + VdP = 0

$$-\frac{1}{V}\times\frac{dv}{dP}=\frac{1}{P}$$

$\beta = P^{-1}$ **(Answer is C)**

23. $E \propto \frac{1}{r^2}$ for point charge

Force solid sphere

Inside the sphere $E \propto r$ and out side the sphere $E \propto \frac{1}{r^2}$

24. $\eta = \frac{\tau L}{\theta \pi r^4}$

So, $\theta = \frac{\tau L}{\eta \pi r^4}$

25. Angular momentum, $\ell = mvr$

Magnetic moment, $\mu = IA = nq\pi r^2 = \frac{\omega}{2\pi} q\pi r^2$

$\mu = \frac{v}{2\pi r} q\pi r^2 = \frac{vqr}{2}$

or $\frac{\mu}{\ell} = \frac{vqr}{2mvr} = \frac{q}{2m}$ **(Answer is C)**

26. $\frac{\sqrt{kT}}{c\sqrt{m}} = \frac{[ML^2T^{-2}]^{1/2}}{[2T^{-1}][M]^{1/2}} = [M^0L^0T^0]$

Which dimensionally ratisfies

$\frac{\Delta f}{f} = \frac{1}{c}\sqrt{\frac{kT}{m}}$ **(Answer is D)**

27. Average power, $\langle P \rangle = \frac{1}{2}\rho v A^2 w^2$

$\rho \propto Av^2$ **(Answer is A)**

28. Wave length, $\lambda = \frac{\beta d}{D} = \frac{0.2\times 6\times 10^{-3}}{24} = 0.5 \times 10^{-4}$ m

$\lambda = 5 \times 10^{-5}$ cm

$\lambda = 500$ nm **(Answer is B)**

29. **(B)**

30. By angular momentum conservation

$m_1v_1r_1 = m_2v_2r_2$ $(\because m_1 = m_2)$

So, $v_2 = \frac{5.6\times 10^4 \times 9 \times 10^{10}}{5.6\times 10^{12}} = 900$ m/s **(Answer is B)**

31. $y = y_1 + y_2$
$= 2A \cos(2Kx) \cos(2cost)$
$x = 0,\ y = 0$
$\lambda = 20m$ **(Ans. C)**

32. $A \rightarrow m$ (some as x)

$\alpha \rightarrow \frac{1}{t}\ sec^{-1}$

$\omega \rightarrow \frac{1}{t} sec^{-1}$

β = angle(dimensionless) **(Answer is A)**

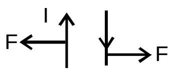
33. $\Delta KE = 0.01864 \times 931 = 17.4$ Mev
$KE_f - KE_i = 17.4$ Mev
As proton is at rest (B) option is correct

34. $\frac{mv^2}{r} = \frac{kq_1q_2}{r^2}$

$v = \sqrt{\frac{kq_1q_2}{mr}}$

$v = 1.6 \times 10^{-19} \sqrt{\frac{9 \times 10^{-9}}{9.11 \times 10^{-31} \times 0.53 \times 10^{-10}}}$

$v = 2.24 \times 10^6$ m/s **(Answer is D)**

35. 

$F = \frac{\mu_0 I_1 I_2}{2\pi d} \ell$

$F = \frac{4\pi \times 10^{-7} \times 4000 \times 4000 \times 60 \times 10^{-2}}{2\pi \times 1.5 \times 10^{-2}}$

F = 128N repulsion **(Answer is B)**

37. (C)

38. Phase different between V_R and V_C is 90º

so, $\sqrt{V_R^2 + V_C^2} = 220$ **(Answer is D)**

39. Distance between to consecutive destructive interference is 1.7cm, so total number of points of destructive interference on the line PQ is 4. **(Answer is A)**

40. **(D)**

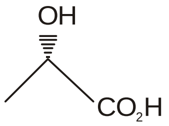
CHEMISTRY

41. The ionization energy or enthalpy of Na is greater than that of Li but the hydration enthalpy of Li is higher than that of Na. Difference between ionization enthalpy of both is less than difference between their hydration enthalpy so overall oxidation potential of Li is greater than Na. Therefore Li metal is a better reducing agent than Na metal.

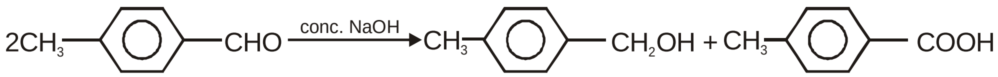
42. Compressibility K = $\frac{1}{P}$

$\therefore K_x - K_y = \frac{1}{1} - \frac{1}{2}$

$= 0.5\ atm^{-1}$

43. 

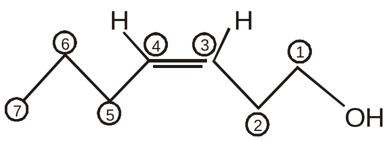
44.



Cannizzarro reaction

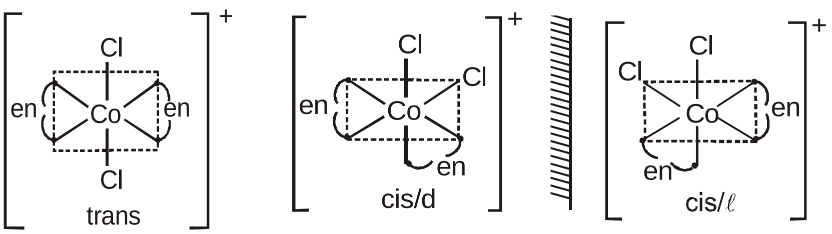
45. On heating solution becomes unsaturated
$\therefore$ solubility and conductance both are increase.

46. According to graph, segment BC represents isobaric process. It means pressure is constant so according to Charle's law $V \propto T$ [on constant pressure]
From B to C volume decreases so temperature will also decreases.

47. 

when same groups present in same side of the double bond then geometrical isomer is known as Z – isomer.

48. Due to back donation electron defficiency of [B] almost neutral.

49. 

50. $xH_2S + 2NaNO_3 + 2HCl \longrightarrow yS + zNO + k\ NaCl + 4H_2O$

Put the following value of variables in above equation

x = 3, y = 3, z = 2, k = 2

$3H_2S + 2NaNO_3 + 2HCl \longrightarrow 3S + 2NO + 2NaCl + 4H_2O$

51. $\because R = k[X]^{1/3}[Y]^{2/3}$

order of reaction = $\frac{1}{3} + \frac{2}{3} = 1$

52. Because Zn has higher oxidation potential than Cu. so Zn loses its electrons at an anode and convert in Zn^{2+} ions and come into the solution. These electrons flow externally from zinc to Cu by wire.

53. Because ideal mixture of benzene and toluene follows Raoult's law

according to Raoult's law

$P_{mix} = P_A + P_B$

$P_{mix} = X_A P_A^o + X_B P_B^o$

$P_{mix} = X_A P_A^o + (1 - X_A) P_B^o$

$P_{mix} = X_A(P_A^o - P_B^o) + P_B^o$

This is a linear equation, by comparing with y = mx + c

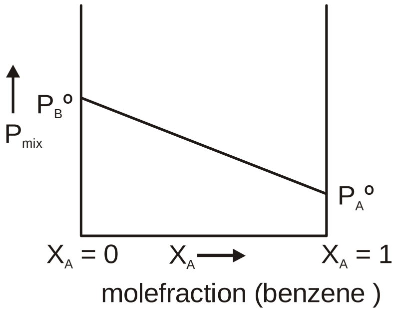
$y = P_{mix}$

$x = X_A$

$m = P_A^o - P_B^o$

$c = P_B^o$

according to above data graph will be like following -



54. sp^3d^2 hybridization explains the bonding of complex which has C.N. (co-ordination number) 6 so answer may be either $[Fe(CN)_6]^{3-}$ or $[Fe(H_2O)_6]^{2+}$. But H_2O is a weak ligand and CN^- is a strong ligand. Because weak ligand form an outer orbital complex with metal ion and this is possible when sp^3d^2 hybridization takes place.

55. $2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl$

$MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

56. Bond order = $\frac{1}{2}[N_b - N_a]$

$\therefore$ B.O. of $O_2^+ = \frac{1}{2}$ [10 – 5] = 2.5 N_b = no. of electron present in BMO

B.O. of $O_2^- = \frac{1}{2}$ [10 – 7] = 1.5 N_a = no. of electron present in ABMO

B.O. of $O_2^{2-} = \frac{1}{2}$ [10 – 8] = 1

$\because$ Inter atomic distance $\propto \frac{1}{B.O}$

$\therefore$ order of inter atomic distance ; $O_2^{2-} > O_2^- > O_2^+$

57. amylose [it is a part of starch]

58 $t_{1/2} = \frac{0.693}{K}$

$t/_{12} = \frac{0.693}{6.93 \times 10^{-3}}$

$t_{1/2}$ = 100 s

59. Because unit cell has six faces and every facial atom is a part of two unit cell. It means only half part of one facial atom belongs to one unit cell.

so, total no. of facial atoms in fcc unit cell = 6 × $\frac{1}{2}$ = 3

60. $\eta = \frac{T_1 - T_2}{T_1} = \frac{W}{Q_1}$

$= \frac{800 - 200}{800} = \frac{W}{100}$

W = 75 J

PART-II (2 Mark)

MATHEMATICS

81. a = A – d
b = A
c = A + d

$a + b + c = 3A = \frac{3}{2}$

$A = \frac{1}{2} = b$

$\therefore \quad a + b + c = \frac{3}{2}$

$a + c = \frac{3}{2} - b = \frac{3}{2} - \frac{1}{2} = 1$ ....(i)

$b^2 = \sqrt{a^2c^2}$

$\left(\frac{1}{2}\right)^2 = \pm ac$

When $ac = \frac{1}{4}$

$c = \frac{1}{4a}$ ...(ii)

From (i) & (ii)

$$a + \frac{1}{4a} = 1$$
$$4a^2 - 4a + 1 = 0$$
$$(2a - 1)^2 = 0$$
$$2a - 1 = 0$$
$$a = \frac{1}{2}$$

By this we get

$$a = b = c$$

But a < b < c, so we take

When $-ac = \frac{1}{4}$

$$c = \frac{-1}{4a} \qquad ....(iii)$$

from (i) & (iii)

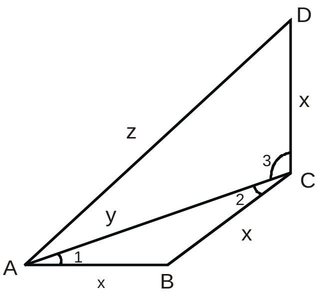
$$a - \frac{1}{4a} = 1$$
$$4a^2 - 4a - 1 = 0$$
$$a = \frac{4 \pm \sqrt{16+16}}{8}$$
$$= \frac{4 \pm 4\sqrt{2}}{8} = \frac{1 \pm \sqrt{2}}{2}$$

as b > a

$$\therefore \quad a = \frac{1-\sqrt{2}}{2}$$

82. g'(x) is changing its slope from positive to negative as it passes through g(2). So, g(2) is largest.

83. $\angle B = \left(\frac{9-2}{9}\right) \times 180° = 140°$



$$\angle 1 = \angle 2 = \frac{180°-140°}{2} = 20°$$

$\angle 3 = 140 - \angle 2 = 120°$

In ΔACD

$$\cos 120° = \frac{y^2 + x^2 - z^2}{2xy}$$
$$\frac{-1}{2} = \frac{y^2 + x^2 - z^2}{2xy}$$
$$-xy = y^2 + x^2 - z^2$$
$$z^2 = x^2 + y^2 + xy$$

84. $AA^T = \begin{pmatrix} 0 & * & * & \cdots & * \\ * & 0 & * & \cdots & * \\ * & * & 0 & \cdots & * \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ * & * & * & \cdots & 0 \end{pmatrix}$

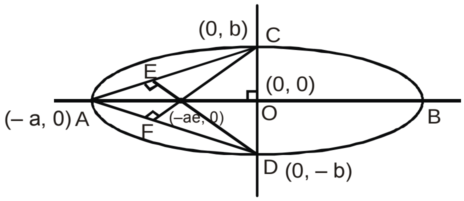
As the diagonal element of resulting matrix are zero.

$\therefore$ multiplication R_1 of A and C_1 of A^T (i.e. = R_1 of A) = 0

It is possible only when all element in R_1 of A is zero

In the same way we can say that element of all 10 rown of A is zero so for the above condition we can formm only 1 matrix i.e. A = null matrix.

85.



(i) As line DE and AC are $\perp$ so product of there slope = – 1.

$\frac{-b-0}{0+ae} \times \frac{b}{a} = -1$

$\frac{-b}{ae} \times \frac{b}{a} = -1$

$e = \left(\frac{b}{a}\right)^2$

(ii) and line CF and AD are also $\perp$.

$\therefore \quad \frac{b-0}{0+ae} \times \frac{-b-0}{0+a} = -1$

$\frac{b}{ae} \times \frac{-b}{a} = -1$

$e = \left(\frac{b}{a}\right)^2$

(iii) and line AO is $\perp$ to CD

$\therefore \quad \frac{0-0}{0+a} \times \frac{2b}{0} \neq -1$

From (i) & (ii) case $e = \left(\frac{b}{a}\right)^2$

But in (iii) case 'e' cannot be determined. So, we can not determined uniquely.

86. $\int_0^\infty [x]e^{-x}dx = \int_0^1 0\,e^{-x}dx + \int_1^2 (1)e^{-x}dx + \int_2^3 2e^{-x}dx + \ldots\ldots$

$= 0 + \left[-e^{-x}\right]_1^2 + \left[-2e^{-x}\right]_2^3 + \ldots\ldots\ldots$

$= -(e^{-2} - e^{-1}) - 2(e^{-3} - e^{-2}) - 3(e^{-4} - e^{-3}) \ldots\ldots\ldots$

$= e^{-1} + e^{-2} + e^{-3} \ldots\ldots\ldots\ldots$

$= \frac{1}{e^1} + \frac{1}{e^2} + \frac{1}{e^3} + \ldots\ldots\ldots\ldots \quad \Rightarrow \quad S_\infty = \frac{\frac{1}{e}}{1-\frac{1}{e}} = \frac{1}{e-1}.$

87. $\left(\int_0^{\pi/2}\cos^{1003} x dx\right)\left(\int_0^{\pi/2}\cos^{1004} x dx\right)$

$$= \frac{\pi}{2} \times \frac{(1002\times1000\times998.....2)}{1003\times1001\times.......1}\times\frac{(1003\times1001\times.....1)}{1004\times1002\times.......2}$$

$$= \frac{\pi}{2\times1004}$$

$$= \frac{\pi}{2008}$$

88. $\lim_{x\to\infty} g(x)\int_0^x e^{f(t)-f(x)}dt$

$$= \lim_{x\to\infty}\frac{g(x)\int_0^x e^{f(t)}dt}{e^{f(x)}}$$

$$= \lim_{x\to\infty}\frac{g'(x)\int_0^x e^{f(t)} + g(x)e^{f(x)}}{f'(x)e^{f(x)}}$$

$$= \lim_{x\to\infty} 0+\frac{g(x)}{f'(x)}$$

$$= \lim_{x\to\infty} 0+\frac{3x^3+.....}{16x^3+....}$$

$$= \frac{3}{16}.$$

89. $\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$

let $x + y = u$

Differentiating wrt x

$$1+\frac{dy}{dx} = \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{du}{dx} - 1$$

$$\therefore \frac{dy}{dx} = \sin(x + y) + \cos(x + y)$$

$$\frac{du}{dx} - 1 = \sin u + \cos u$$

$$\frac{du}{dx} = \sin u + \cos u + 1$$

$$\frac{du}{\sin u+\cos u+1} = dx$$

Integrating both sides

$$\int\frac{du}{\sin u+\cos u+1} = \int dx$$

$$\int \frac{du}{\frac{2\tan u/2}{1+\tan^2 u/2}+\frac{1-\tan^2 u/2}{1+\tan^2 u/2}+1} = \int dx$$

$$\int \frac{\sec^2(u/2)du}{2\tan u/2+1-\tan^2 u/2+1+\tan^2 u/2} = \int dx$$

$$\int \frac{\sec^2(u/2)du}{2\tan u/2+2} = \int dx$$

$$\int \frac{\sec^2(u/2)du}{2(\tan u/2+1)} = \int dx$$

Put 1+ tanu/2 = t

$(1/2)\sec^2 u/2du = dt$

$$\int \frac{dt}{t} = \int dx$$

log |t| = x + c

log |1+ tanu/2| = x + c

$$\log\left|1+\tan\frac{(x+y)}{2}\right| = x + c$$

It passes through origin.

$\therefore$ log1 = 0 + c

c = 0.

So, $\log\left|1+\tan\frac{(x+y)}{2}\right| = x.$

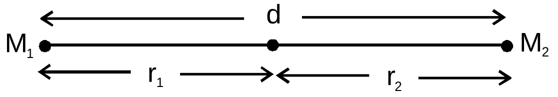
90. Total mappings of bijection is 6 !.

for self inverse

$$\underbrace{\frac{6!}{2!\ 2!\ 2!\ 3!}}_{2\text{ pairing}} + \underbrace{\frac{4!\ ^6C_4}{2!\ 2!\ 2!}}_{2\text{ going to their own value}} + \underbrace{^6C_2+1}_{4\text{ going to their own value}} = 76$$

$$P = \frac{76}{720} = \frac{19}{180}.$$

PHYSICS

91. 

$M_1r_1 = M_2r_2$ and $r_1 + r_2 = d$

so $r_1 = \dfrac{M_2 d}{M_1 + M_2}$ ....(i)

$\because T = \dfrac{2\pi r_1}{v_1}$ ....(ii)

Here

$$\frac{GM_1M_2}{d^2} = \frac{M_1 v_1^2}{r_1}$$

or $v_1 = \dfrac{\sqrt{GM_2 r_1}}{d}$

From (ii)

$$T = \frac{2\pi r_1 d}{\sqrt{GM_2 r_1}}$$

$$T = \frac{2\pi d\sqrt{r_1}}{\sqrt{GM_2}}$$

$$T = \frac{2\pi d}{\sqrt{GM_2}}\sqrt{\frac{M_2 d}{M_1 + M_2}}$$

$$T = \frac{2\pi d^{3/2}}{\sqrt{G(M_1 + M_2)}}$$ **(Answer is B)**

92. $a = \alpha r = 20 \times 0.5 = 10\ m/s^2$

93. For λ_{min}

$$\frac{hc}{\lambda_{min}} = K.E.$$

$$\lambda_{min} = \frac{hc}{K.E.}$$

$$\lambda_{min} = \frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{30 \times 10^{3} \times 1.6 \times 10^{-19}} = 4.14 \times 10^{-11}\ m$$

94. App. frequency, $N' = \left(\frac{V+V_0}{V-V_S}\right)N = \left(\frac{340+9}{340-9}\right)\times 90$

$N' = 94.9$ kHz

95. Mass of water, $m = \frac{\pi\times 18\times(3.96)^2\times 0.92}{10^3}$ kg

$m = \pi \times 18\times10^{-2} \times (3.96)^2 \times 10^{-4} \times 0.92 \times 10^3$

$mL_f = \frac{KA(\theta_1-\theta_2)\,t}{\ell}$ $\Rightarrow t = \frac{mL_f\ell}{KA(\theta_1-\theta_2)}$

$\Rightarrow t = \frac{\pi\times 18(3.96)^2\times 0.92\times 333\times 10^3\times 10^{-3}}{10^3\times 400\times\pi\times(3.96)^2\times 15}$ $\Rightarrow t = 9.2$ s **(Answer is A)**

96. Range, $R = 2\sqrt{(H-h)h}$

(i) $h = H/4$

$X_1 = 2\sqrt{\left(H-\frac{H}{4}\right)\frac{H}{4}}$

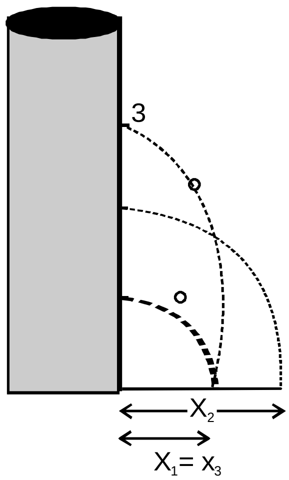
$X_1 = H\frac{\sqrt{3}}{2}$

(ii) $h = H/2$

$X_2 = H$

(iii) $h = 3H/4$

$X_3 = H\frac{\sqrt{3}}{2}$



$X_2 > X_1 = X_3$ **(Answer is C)**

CHEMISTRY

101. Xe contains 8 electrons in its outermost shell or valence shell. In XeF_2, Xe uses 2 electrons for σ bonds so it contains 3 lp. In XeF_4., Xe uses 4 electrons for σ bonds, so it contains 2 lp.

102. $N_2 + 3H_2 \rightleftharpoons 2NH_3$

	N_2	$3H_2$	$2NH_3$
initial moles	4	16	0
at equilibrium	$4-\alpha$	$16-3\alpha$	2α

[according to question ammonia gas is produced = 4 mol]

$\therefore\ 2\alpha = 4$

put the value of $\alpha = 2$

	4 – 2	16 – 3 × 2	2 × 2
moles at equilibrium	2	10	4
concentration at equilibrium	$\frac{2}{V}$	$\frac{10}{V}$	$\frac{4}{V}$

$$K_C = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$= \frac{\left(\frac{4}{V}\right)^2}{\left(\frac{2}{V}\right)\left(\frac{10}{V}\right)^3}$$

$$= \frac{4^2}{2\times10^3} \times V^2$$

$$= \frac{8}{10^3} \times (10)^2 \qquad (\because V = 10L]$$

$= 0.8\ mol^{-2}\ lit^2$

103. $\because$ Depression in freezing point $\Delta T_F = \frac{Kw_0}{m_0W}$

In given two cases m_0, W and K are constants

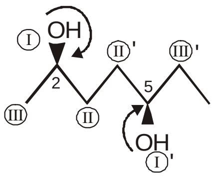
so $\Delta T_F \propto w_0$

$$\frac{(\Delta T_F)_1}{(\Delta T_F)_2} = \frac{(w_0)_1}{(w_0)_2}$$

$$\frac{5.5-4}{5.5-2.5} = \frac{2.9}{2.9+x}$$

$$\frac{1.5}{3} = \frac{2.9}{2.9+x}$$

x = 2.9 g

105. 2R and 5R 

106. $Zn + 2Ag^+ (0.0001M) \longrightarrow Zn^{2+} (0.1M) + 2Ag$

by nernst equation

$$E_{cell} = E^o - \frac{0.059}{n} \log_{10} \frac{[Zn^{2+}][Ag]^2}{[Ag^+]^2[Zn]}$$

$\because$ [Ag] = [Zn] = 1

$$\Rightarrow E_{cell} = E^o - \frac{0.059}{2} \log_{10} \frac{[Zn^{2+}]}{[Ag^+]^2}$$

$$\Rightarrow E_{cell} = 1.56 - \frac{0.059}{2} \log_{10} \frac{(0.1)}{(0.0001)^2}$$

$\Rightarrow E_{cell} = 1.56 - 0.2065$

$\Rightarrow E_{cell} \approx 1.35$ V

107. $\underset{(X)}{2CH_3Cl + Si} \xrightarrow{Cu(Y)} (CH_3)_2SiCl_2$

$\underset{(Z)}{SiCl_4} + 2CH_3MgBr \longrightarrow (CH_3)_2SiCl_2 + 2Mg(Br)Cl$

108. according to Arrhenius theory

$$K = A\,e^{-\frac{E}{RT}}$$

according to question K is same in both cases, so

$$\frac{E_1}{RT_1} = \frac{E_2}{RT_2}$$

E_1 and T_1 are activation energy and temp. in absence of catalyst

E_2 and T_2 are activation energy and temp. in presence of catalyst

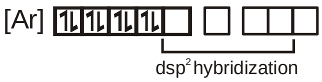
$$\frac{500}{625} = \frac{400}{T_2}$$

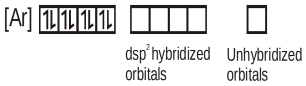
$T_2 = 600K$

109. ${}_{28}Ni \longrightarrow [Ar]3d^8 4s^2 4p^0$

$Ni^{2+} \longrightarrow [Ar]3d^8\, 4s^0\, 4p^0$

because CN^- is a strong ligand w.r.t. Ni^{2+} ion, so pairing of electrons takes place.





In dsp^2 hybridization geometry of complex is square planar.

110. ${}^{238}_{92}U \longrightarrow {}^{206}_{82}Pb + x\,{}^{4}_{2}He + y\,{}^{0}_{-1}e$

by balancing of mass no.

238 = 206 + 4x + 0y

x = 8

by balancing of nuclear charge

92 = 82 + 2x – 1y

92 = 82 + 2 × 8 – y

y = 6