

HINTS & SOLUTIONS (PRACTICE PAPER-1)

ANSWER KEY

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

PART - I (1 Mark) MATHEMATICS

1. $\left(x^{\frac{1}{2}} - x^{\frac{2}{3}}\right)^7$

$$\text{General term} = (-1)^r {}^7C_r \left(x^{\frac{1}{2}}\right)^{7-r} \times \left(x^{\frac{2}{3}}\right)^r$$

$$\begin{aligned} T_{r+1} &= (-1)^r {}^7C_r x^{\frac{7-r}{2}} x^{\frac{2r}{3}} \\ &= (-1)^r {}^7C_r x^{\frac{7-r}{2} + \frac{2r}{3}} \\ &= (-1)^r {}^7C_r x^{\frac{21-3r+4r}{6}} \\ &= (-1)^r {}^7C_r x^{\frac{21+r}{6}} \end{aligned}$$

$$\text{For the coefficient of } x^4, \frac{21+r}{6} = 4$$

$$21 + r = 24$$

$$r = 24 - 21$$

$$r = 3$$

$$\begin{aligned} \therefore T_{3+1} &= (-1)^3 {}^7C_3 \\ &= -1 \times \frac{7 \times 6 \times 5}{3 \times 2} \\ &= -35. \end{aligned}$$

$$2. \quad \left| \frac{z}{z} + \frac{\bar{z}}{z} \right| = 1 \text{ and } |z| = 1$$

$$\text{Let } z = x + iy$$

$$\text{Then, } \bar{z} = x - iy$$

$$|z| = \sqrt{x^2 + y^2} = 1$$

$$\text{or } x^2 + y^2 = 1$$

$$\left| \frac{x+iy}{x-iy} + \frac{x-iy}{x+iy} \right| = 1$$

$$\left| \frac{x^2 - y^2 + 2ixy + x^2 - y^2 - 2ixy}{x^2 + y^2} \right| = 1$$

$$\left| \frac{2(x^2 - y^2)}{x^2 + y^2} \right| = 1$$

$$2x^2 - 2y^2 = x^2 + y^2$$

$$x^2 = 3y^2$$

$$x = \pm \sqrt{3}y$$

$$\text{Now, } x^2 + y^2 = 1$$

$$3y^2 + y^2 = 1$$

$$4y^2 = 1$$

$$y^2 = \frac{1}{4}$$

$$y = \pm \frac{1}{2}$$

$$\text{Then, } x = \pm \frac{\sqrt{3}}{2}$$

$$\therefore \text{ Different complex number are : } z = \frac{\sqrt{3}}{2} + i\frac{1}{2}, z = \frac{\sqrt{3}}{2} - i\frac{1}{2}, z = -\frac{\sqrt{3}}{2} + i\frac{1}{2} \text{ and } z = -\frac{\sqrt{3}}{2} - i\frac{1}{2}.$$

$$3. \quad \text{Let } A^{-1} = B$$

$$\text{Therefore } AB = I$$

$$A \begin{bmatrix} 35 & 37 \\ 41 & 43 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$R_1 \rightarrow \frac{R_1}{35}$$

$$A \begin{bmatrix} 1 & \frac{37}{35} \\ 41 & 43 \end{bmatrix} = \begin{bmatrix} \frac{1}{35} & 0 \\ 0 & 1 \end{bmatrix}$$

$$R_2 \rightarrow R_2 - 41R_1$$

$$A \begin{bmatrix} 1 & \frac{37}{35} \\ 0 & -\frac{12}{35} \end{bmatrix} = \begin{bmatrix} \frac{1}{35} & 0 \\ -\frac{41}{35} & 1 \end{bmatrix}$$

$$R_2 \rightarrow -\frac{35}{12}R_2$$

$$A \begin{bmatrix} 1 & \frac{37}{35} \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{35} & 0 \\ \frac{41}{12} & -\frac{35}{12} \end{bmatrix}$$

$$R_1 \rightarrow R_1 - \frac{37}{35}R_2$$

$$A \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} -\frac{43}{12} & \frac{37}{12} \\ \frac{41}{12} & -\frac{35}{12} \end{bmatrix}$$

$$A = \begin{bmatrix} -\frac{43}{12} & \frac{37}{12} \\ \frac{41}{12} & -\frac{35}{12} \end{bmatrix}$$

$$12A = \begin{bmatrix} -43 & 37 \\ 41 & -35 \end{bmatrix}$$

$$\begin{aligned} \det(12A) &= |43 \times 35 - 41 \times 37| \\ &= 1505 - 1517 \\ &= -12. \end{aligned}$$

4. Given : $\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$

$$\sum_{n=1}^{\infty} \frac{1+3+5+\dots+(2n-1)}{1^3+2^3+3^3+\dots+n^3}$$

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

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

$$4 \sum_{n=1}^{\infty} \left[\left(1 + \frac{1}{2^2} + \frac{1}{3^2} + \dots \right) - 1 \right]$$

$$4 \sum_{n=1}^{\infty} \left[\frac{1}{n^2} - 1 \right]$$

$$4 \left(\frac{\pi^2}{6} - 1 \right).$$

5. $4ax^2 + xy + 4y^2 = 0$

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

$$m_1 + m_2 = \frac{-1}{4}$$

$$m_1 m_2 = \frac{a}{b}$$

$$m_1 m_2 = \frac{4a}{4} = a$$

Given: $m_2 = m_1^2$

$$m_1 + m_1^2 = \frac{-1}{4}$$

$$4m_1^2 + 4m_1 = -1$$

$$4m_1^2 + 4m_1 + 1 = 0$$

$$(2m_1 + 1)^2 = 0$$

$$m_1 = \frac{-1}{2}$$

$$m_1 m_2 = a$$

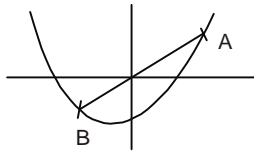
$$m_1 \times m_1^2 = a$$

$$m_1^3 = a$$

$$\left(\frac{-1}{2}\right)^3 = a$$

$$\therefore a = \frac{-1}{8}$$

6. $y = 2x^2 + x - 2$



Let point A is $(t_1, 2t_1^2 + t_1 - 2)$ and point B is $(t_2, 2t_2^2 + t_2 - 2)$

Given: Mid point of AB is $(0, 0)$

$$\text{So, } \frac{t_1 + t_2}{2} = 0 \Rightarrow t_1 + t_2 = 0$$

$$\frac{2t_1^2 + t_1 - 2 + 2t_2^2 + t_2 - 2}{2} = 0$$

$$2(t_1^2 + t_2^2) + (t_1 + t_2) - 4 = 0$$

$$2[(t_1 + t_2)^2 - 2t_1 t_2] + 0 - 4 = 0$$

$$2[0 - 2t_1 t_2] = 4$$

$$-4t_1 t_2 = 4$$

$$t_1 t_2 = -1$$

$$(t_1 - t_2)^2 = (t_1 + t_2)^2 - 4t_1 t_2$$

$$= 0 - 4(-1)$$

$$= 4$$

$$t_1 - t_2 = 2$$

Distance AB:

$$AB = \sqrt{(t_1 - t_2)^2 + (2t_1^2 + t_1 - 2 - 2t_2^2 - t_2 + 2)^2}$$

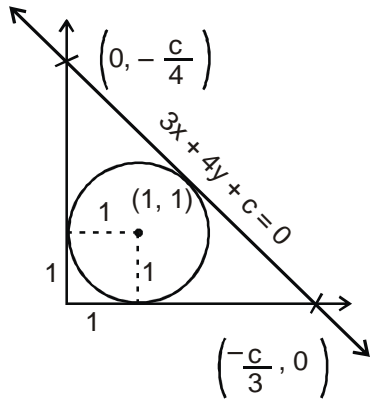
$$AB = \sqrt{(t_1 - t_2)^2 + [2(t_1^2 - t_2^2) + (t_1 - t_2)]^2}$$

$$AB = \sqrt{(2)^2 + [2(t_1 + t_2)(t_1 - t_2) + (t_1 - t_2)]^2}$$

$$AB = \sqrt{4 + [2(0) + (2)]^2}$$

$$AB = \sqrt{4+4} = \sqrt{8} = 2\sqrt{2}.$$

7.



Perpendicular from $(1, 1)$ on line $3x + 4y + c = 0$

$$\frac{|3 + 4 + c|}{\sqrt{9 + 16}} = 1$$

$$|7 + c| = 5$$

$$7 + c = \pm 5$$

$$c = -5 - 7$$

$$c = -12$$

$$|c| = 12.$$

8. $p \cos^2 \left(\frac{R}{2} \right) + r \cos^2 \left(\frac{P}{2} \right)$

$$p \frac{s(s-r)}{pq} + r \frac{s(s-p)}{qr}$$

$$= \frac{s}{q} [s - r + s - p]$$

$$= \frac{s}{q} [2s - r - p]$$

$$= \frac{s}{q} [p + q + r - r - p]$$

$$= s$$

$$= \frac{p+q+r}{2}.$$

9. $3\cos^2 x \sin^2 x - \sin^4 x - \cos^2 x = 0$

$$\Rightarrow 3(1 - \sin^2 x) \sin^2 x - \sin^4 x - (1 - \sin^2 x) = 0$$

$$\Rightarrow 3 \sin^2 x - 3 \sin^4 x - \sin^4 x - 1 + \sin^2 x = 0$$

$$\Rightarrow -4 \sin^4 x + 4 \sin^2 x - 1 = 0$$

$$\Rightarrow 4 \sin^4 x - 4 \sin^2 x + 1 = 0$$

$$\Rightarrow (2 \sin^2 x - 1)^2 = 0$$

$$\Rightarrow 2 \sin^2 x = 1$$

$$\Rightarrow \sin^2 x = \frac{1}{2}$$

$$\Rightarrow \sin x = \pm \frac{1}{\sqrt{2}}$$

\therefore $\sin x$ has 4 solutions in the interval $[0, 2\pi]$.

10. $\theta = \frac{1}{2} \sin^{-1} \left(\frac{1}{4} \right)$

$$\sin 2\theta = \frac{1}{4} \Rightarrow 2\sin\theta \cos\theta = \frac{1}{4}$$

$$\Rightarrow \sin\theta \cos\theta = \frac{1}{8}$$

Value of : $64\sin\theta + 64\cos\theta - 8\sec\theta - 8\operatorname{cosec}\theta + \tan\theta + \cot\theta$

$$= 64(\sin\theta + \cos\theta) - 8(\sec\theta + \operatorname{cosec}\theta) + \left(\frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta} \right)$$

$$= 64(\sin\theta + \cos\theta) - 8 \left(\frac{1}{\cos\theta} + \frac{1}{\sin\theta} \right) + \left(\frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta} \right)$$

$$= 64(\sin\theta + \cos\theta) - 8 \left(\frac{\sin\theta + \cos\theta}{\sin\theta\cos\theta} \right) + \frac{1}{\sin\theta\cos\theta}$$

$$= 64(\sin\theta + \cos\theta) - 8 \frac{(\sin\theta + \cos\theta)}{1/8} + 8$$

$$= 64(\sin\theta + \cos\theta) - 64(\sin\theta + \cos\theta) + 8$$

$$= 8.$$

11. $L = \lim_{n \rightarrow \infty} \left\{ \lim_{x \rightarrow 0} \left(x \sin\left(\frac{1}{x}\right) + x^2 \sin\left(\frac{1}{x^2}\right) + \dots + x^n \sin\left(\frac{1}{x^n}\right) \right) \right\}$

$$L = \lim_{n \rightarrow \infty} \left\{ \lim_{x \rightarrow 0} x \sin \frac{1}{x} + \lim_{x \rightarrow 0} x^2 \sin\left(\frac{1}{x^2}\right) + \dots + \lim_{x \rightarrow 0} x^n \sin\left(\frac{1}{x^n}\right) \right\}$$

$$L = \lim_{n \rightarrow \infty} \{0 + 0 + 0 + \dots + 0\}$$

$$L = 0$$

12. $f(x) = \begin{cases} x^3 & \text{for } x \geq 1 \\ ax^2 + bx + c & \text{for } x < 1 \end{cases}$

$$f'(x) = 3x^2 = 2ax + b$$

$$[f'(x)]_{x=1} = 6x = 2a$$

$$\Rightarrow 6 = 2a$$

$$a = 3.$$

13. $f(x) = x^3 - 3ax^2 + b$

$$f'(x) = 3x^2 - 6ax$$

For the $f(x)$ to be increasing $f'(x) > 0$.

$$3x^2 - 6ax > 0$$

$$3x(x - 2a) > 0$$

$$(x - 2a) > 0 \quad [\because x > 0]$$

$$x > 2a$$

$$\text{So, } a \geq 0.$$

14.
$$\int_1^3 [x] \cos\left(\frac{\pi}{2}(x - [x])\right) dx$$

$$= \int_1^2 \cos\left(\frac{\pi}{2}(x - 1)\right) dx + \int_2^3 2 \cos\left(\frac{\pi}{2}(x - 2)\right) dx$$

$$= \left[\frac{\sin\left(\frac{\pi}{2}(x-1)\right)}{\frac{\pi}{2}} \right]_1^2 + 2 \left[\frac{\sin\left(\frac{\pi}{2}(x-2)\right)}{\frac{\pi}{2}} \right]_2^3$$

$$= \frac{2}{\pi}[1-0] + \frac{4}{\pi}[1-0]$$

$$= \frac{6}{\pi}.$$

15. Let $A = \frac{1}{n} \{(2n+1)(2n+2)\dots(2n+n)\}^{1/n}$

$$\log A = \frac{1}{n} \lim_{n \rightarrow \infty} \log \left[\frac{(2n+1)}{n} \frac{(2n+2)}{n} \frac{(2n+3)}{n} \dots \frac{(2n+n)}{n} \right]$$

$$\log A = \frac{1}{n} \lim_{n \rightarrow \infty} \log \left[\left(2 + \frac{1}{n}\right) \left(2 + \frac{2}{n}\right) \left(2 + \frac{2}{n}\right) \dots \left(2 + \frac{n}{n}\right) \right]$$

$$\log A = \int_0^1 \log(2+x) dx$$

$$\log A = [x \log(2+x) - x + 2 \log(2+x)]_0^1$$

$$\log A = [\log 3 - 1 + 2 \log 3 - 2 \log 2]$$

$$\log A = [\log 3 - \log e + \log 9 - \log 4]$$

$$\log A = [\log (27/4e)]$$

$$A = (27/4e).$$

16. $\vec{V}_1 + \vec{V}_2 + \vec{V}_3 = 0$

$$|\vec{V}_1 - \vec{V}_2| = ?$$

$$\vec{V}_1 + \vec{V}_2 = -\vec{V}_3$$

$$\vec{V}_1 + \vec{V}_2 \cdot \vec{V}_1 + \vec{V}_2 = (-\vec{V}_3) \cdot (-\vec{V}_3)$$

$$|\vec{V}_1|^2 + |\vec{V}_2|^2 + 2\vec{V}_2 \cdot \vec{V}_2 = |\vec{V}_3|^2$$

$$1 + 1 + 2\vec{V}_2 \cdot \vec{V}_2 = 1$$

$$2\vec{V}_2 \cdot \vec{V}_2 = -1$$

$$\vec{V}_2 \cdot \vec{V}_2 = \frac{-1}{2}$$

$$|\vec{V}_1 - \vec{V}_2|^2 = |\vec{V}_1|^2 + |\vec{V}_2|^2 - 2\vec{V}_1 \cdot \vec{V}_2$$

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

$$= 1 + 1 + 1 = 3$$

$$\therefore |\vec{V}_1 - \vec{V}_2|^2 = 3$$

$$|\vec{V}_1 - \vec{V}_2| = \sqrt{3}.$$

17. Total number of possible cases = $4 + 3 + 2 + 1 = 10$
 Favourable cases = $\{(HTTHT), (THTHT), (TTHHT), (TTTTHH)\}$
 Total number of favourable cases = 4

$$\therefore p(4^{\text{th}} \text{ toss is a head}) = \frac{4}{10}$$

$$= \frac{2}{5}.$$

18. $a + b + c = \text{even}$

Case 1 : All taken are even : ${}^5C_3 = 10$

Case 2 : One even + 2 odd : ${}^5C_1 \times {}^5C_2 = 50$

$$\text{Total} = 10 + 50 = 60.$$

19. $2\log(x - 2y) = \log x + \log y$

$$\log(x - 2y)^2 = \log(xy)$$

$$(x - 2y)^2 = xy$$

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

$$x^2 + 4y^2 - 5xy = 0$$

$$x^2 - 4xy - xy + 4y^2 = 0$$

$$x(x - 4y) - y(x - 4y) = 0$$

$$(x - y)(x - 4y) = 0$$

$$x = y \text{ (N.P.)}, x = 4y$$

$$\frac{x}{y} = 4.$$

20. Let x, y and z are $2n, n^2 - 1$ & $n^2 + 1$.

Let $x = 2n, y = n^2 - 1$ and $z = n^2 + 1$.

Option (A) : 2 does not divide x .

Clearly 2 divides x . So option (A) is not true.

Ex : 8, 15 and 17 are pythagorean triplet. 2 divides 8.

Option (B) : 2 does not divide $z(x + y)$

$(n^2 + 1)(2n + n^2 - 1)$ which is an odd number so, 2 does not divides $z(x + y)$.

\therefore So, option (B) is true.

Option (C) : 4 divides $x + y + z$

Ex : 5, 12, 13 are the pythagorean triplet.

Clearly $5 + 12 + 13 = 30$, and 4 does not divides 30.

\therefore So, option (C) is not true.

Option (D) : 8 divides $x + y + z$

Ex : 8, 15, 17 are the pythagorean triplet.

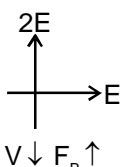
Clearly $8 + 15 + 17 = 40$, and 8 divides 40.

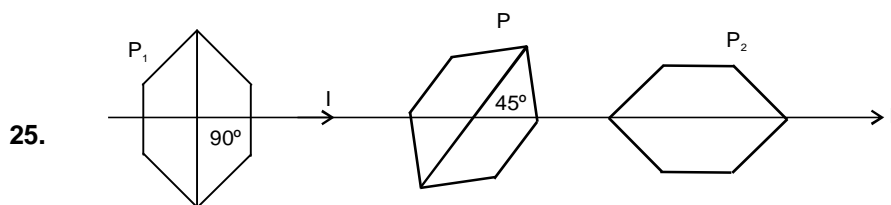
\therefore So, option (B) is true.

PHYSICS

21. By work energy theorem, $W = \Delta K$
 $mgh - w_f = 0$
 $w_f = mgh$

22. $E = -13.6 \times \frac{z^2}{n^2} = -13.6 \times \frac{4}{1} = 54.4 \text{ eV}$ Ans (D)

23. 
 deflected in $-x$ direction (Ans.B)



By Malus's law, $I' = I_0 \cos^2 45^\circ$
 intensity after P_1

$$I = I \cos^2 45 = \frac{I}{2}$$

intensity after P_2

$$I_2 = \frac{I_1}{2} \cos^2 45 = \frac{I}{4} \text{ (Ans : B)}$$

26. Due to inertia ballon displace in the direction of motion of the bus.

27. (D) As for hydrogen like atom

$$\frac{1}{\lambda} = R \cdot z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \quad (\text{Here } z = 1, \text{ same for deuterium and hydrogen})$$

So, $\frac{1}{\lambda}$ will be same for deuterium as that for hydrogen.

28. Bulk modulus, $B = - \frac{\Delta P}{\left(\frac{\Delta V}{V} \right)}$

As in isothermal process, $PV = K$
 On differentiating, $PdV + VdP = 0$

$$\frac{\Delta V}{V} = - \frac{\Delta P}{P}$$

$$\text{Hence } B = \frac{-\Delta P}{\left(- \frac{\Delta P}{P} \right)} = P$$

29. From Brewster's law $\tan i = \frac{\mu_2}{\mu_1}$


30. Checking dimensionally all the formula

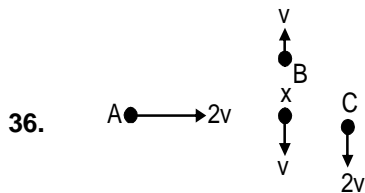
$$\frac{\lambda g}{2\pi} = [L] \left[\frac{L}{T^2} \right] = [L^2 T^{-2}] \quad \text{and} \quad \sqrt{\frac{\sigma g}{\rho}} = \left[\frac{[MLT^{-2}]}{[L]} \times \frac{[L^1 T^{-2}]}{[ML^{-3}]} \right]^{1/2} = [L^2 T^{-2}] \quad (\text{dimension of } v^2)$$

$$\frac{2\pi\sigma}{\lambda\rho} = \frac{[M^1 L^1 T^{-2}][L^{-1}]}{[L][ML^{-3}]} = [L^2 T^{-2}]$$

Only (A) option is correct dimensionally

33. As v & d depends on frame of reference but change in KE and hence heat does not depend.

34. $V \gg \sqrt{2gr}$ 



$$v_B = v_0 \left[1 - \frac{2v}{c} \right]$$

$$v_C = v_0 \left[1 - \frac{v}{c} \right]$$

$$v_A = v_0 \left[1 + \frac{2v \cos \theta}{c} \right]$$

$$v_A > v_C > v_B \quad (\text{Answer : C})$$

37. By Dalton's law of partial pressure. (Ans : D)

38. $E_{in} = 0 \quad E_{out} = \frac{KQ}{r^2}$

$$V_{in} = \frac{KQ}{R} = \text{const.} \quad V_{out} = \frac{KQ}{r}$$

X is for electric field versus distance graph

Y is for potential versus distance graph

Ans. is (B)

39. $E_{net} = 2 \frac{kq}{(x^2 + y^2)^{3/2}} [x]$

$$E_{net} = \frac{2kq}{x^2}$$

CHEMISTRY

41. For weak acid $[H^+] = C\alpha$
 $[H^+] = 0.1 \times 0.1$
 $[H^+] = 10^{-2}$
 $pH = -\log[H^+]$
 $pH = -\log[10^{-2}]$
 $pH = 2$

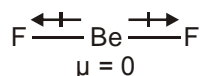
42. $\begin{array}{c} \text{O} \\ \parallel \\ \ddot{\text{N}} \\ \diagdown \\ \text{O}^- \end{array}$ \rightarrow it has two donor side [O & N]

43. H_3O^+
 sp^3 hybridisation, due to presence of 1 lp
 structure is trigonal pyramidal.

45. (D) $\text{Ba} > \text{Ca} > \text{Mg} > \text{Be}$
 Solubility increases down the group due to increase of size of cation.

46. $\text{C} > \text{Be} > \text{B} > \text{Li}$
 $Z^{\text{eff}} \uparrow \text{IE} \uparrow$

47. Dipole moment $\mu = e \times d$



48. $[\text{NiCl}_4]^{2-}$ is tetrahedral.

50. $mvr = \frac{nh}{2\pi}$ where $n = 1, 2, 3, \dots$

51. (A) both valencies occupy by the same group.

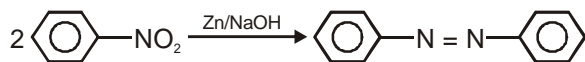
52.

p-nitrophenol	-o-nitrophenol	m-nitrophenol
-I & -M	-I & -M (intramolecular H-bond)	-I

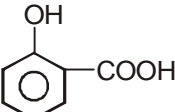
54. (A)
$$\begin{array}{c} \text{CH}_2 - \text{O} - \text{COR} \\ | \\ \text{CH} - \text{O} - \text{COR} \\ | \\ \text{CH} - \text{O} - \text{COR} \end{array} + 3\text{NaOH} \longrightarrow \begin{array}{c} 3\text{RCOONa} \\ \text{Salt of fatty acid} \end{array} + \begin{array}{c} \text{CH}_2 - \text{OH} \\ | \\ \text{CH} - \text{OH} \\ | \\ \text{CH}_2 - \text{OH} \\ \text{glycerol} \end{array}$$

55. (B) Branching \uparrow surface area \downarrow
 vanderwaals' forces \downarrow b.p. \downarrow

56. (C) Zn/NaOH



58. $\text{CH}_3 - \text{CH}_2 - \text{CH}(\text{OH}) - \text{COOH}$

59. (C)  [contains phenolic group]

60. (B) stability of carbanions $\propto \frac{-I \ \& \ -M}{+I \ \& \ +M}$

PART-II (2 Mark) **MATHEMATICS**

81. $ab = 2(a + b)$

$$\frac{a+b}{ab} = \frac{1}{2}$$

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{2} \quad \dots\dots \text{(i)}$$

$bc = 3(b + c)$

$$\frac{b+c}{bc} = \frac{1}{3}$$

$$\frac{1}{b} + \frac{1}{c} = \frac{1}{3} \quad \dots\dots \text{(ii)}$$

$ca = 4(c + a)$

$$\frac{c+a}{ca} = \frac{1}{4}$$

$$\frac{1}{c} + \frac{1}{a} = \frac{1}{4} \quad \dots\dots \text{(iii)}$$

Add (i), (ii) and (iii)

$$2\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right) = \frac{1}{2} + \frac{1}{3} + \frac{1}{4}$$

$$\frac{1}{a} + \frac{1}{b} + \frac{1}{c} = \frac{6+4+3}{24}$$

$$\frac{1}{a} + \frac{1}{b} + \frac{1}{c} = \frac{13}{24} \quad \dots\dots \text{(iv)}$$

From (i) and (iv)

$$c = 24$$

From (ii) and (iv)

$$a = \frac{24}{5}$$

From (iii) and (iv)

$$b = \frac{24}{7}$$

So, value of $5a + 7b + c$

$$= 24 + 24 + 24 = 72.$$

82.

$$x^2 + ax + b = 0$$

$$\alpha + \beta = -a, \alpha\beta = b$$

$$x^4 + ax^3 + cx^2 + dx + e = 0$$

Roots are $\alpha + \beta, \alpha - \beta, -\alpha + \beta$ and $-\alpha - \beta$

Sum of roots = $-a$

$$\alpha + \beta + \alpha - \beta - \alpha + \beta - \alpha - \beta = -a$$

$$a = 0 \Rightarrow \alpha + \beta = 0$$

Sum of roots taken two at a time = $+c$

$$(\alpha + \beta)(\alpha - \beta) + (\alpha - \beta)(-\alpha + \beta) + (-\alpha + \beta)(-\alpha - \beta) + (-\alpha - \beta)(\alpha + \beta) + (\alpha + \beta)(-\alpha + \beta) + (\alpha - \beta)(-\alpha + \beta) = c$$

$$0 - (\alpha + \beta)^2 + 0 + 0 + 0 - (\alpha + \beta)^2 = c$$

$$-2(\alpha - \beta)^2 = c$$

$$-2[\alpha^2 + \beta^2 - 2\alpha\beta] = c$$

$$-2[(\alpha + \beta)^2 - 2\alpha\beta - 2\alpha\beta] = c$$

$$-2[-4\alpha\beta] = c$$

$$c = 8\alpha\beta$$

$$c = 8b \neq 0$$

Product of roots taken three at a time = $-d$

$$(\alpha + \beta)(\alpha - \beta)(-\alpha + \beta) + (\alpha + \beta)(-\alpha + \beta)(-\alpha - \beta) + (-\alpha - \beta)(\alpha + \beta) + (\alpha + \beta)(-\alpha + \beta)(-\alpha + \beta)(-\alpha + \beta) = -d$$

$$0 + 0 + 0 + 0 = -d$$

$$d = 0$$

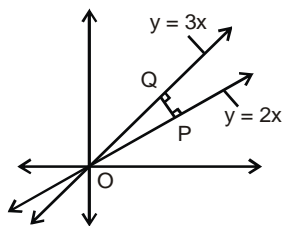
Product of roots = e

$$(\alpha + \beta)(\alpha - \beta)(-\alpha + \beta)(-\alpha - \beta) = e$$

$$e = 0$$

So, $c = 0$ is the false statement

83.



$$PQ = 5$$

Let point Q is $(x, 3x)$

Given $QP = 5$ and $QP \perp$ line $2x - y = 0$

$$\frac{|2x - 3x|}{\sqrt{4+1}} = 5$$

$$x = 5\sqrt{5}$$

Therefore point Q is $(5\sqrt{5}, 15\sqrt{5})$

$$\begin{aligned}\therefore OQ &= \sqrt{(5\sqrt{5})^2 + (15\sqrt{5})^2} \\ &= \sqrt{125 + 1125} \\ &= \sqrt{1250} \\ &= 25\sqrt{2}\end{aligned}$$

$$\begin{aligned}\therefore \text{In } \triangle OPQ \\ OQ^2 &= OP^2 + PQ^2 \\ (25\sqrt{2})^2 &= OP^2 + (5)^2 \\ 1250 - 25 &= OP^2 \\ OP^2 &= 1225 \\ OP &= 35 \text{ cm.}\end{aligned}$$

$$84. \quad \cot \frac{B}{2} = \sqrt{\frac{s(s-b)}{(s-c)(s-c)}}$$

$$\cot \frac{C}{2} = \sqrt{\frac{s(s-b)}{(s-a)(s-b)}}$$

$$\therefore \cot \frac{B}{2} \cot \frac{C}{2} = \sqrt{\frac{s(s-b)}{(s-a)(s-c)}} \sqrt{\frac{s(s-c)}{(s-a)(s-b)}}$$

$$\cot \frac{B}{2} \cot \frac{C}{2} = \sqrt{\frac{s^2(s-b)(s-c)}{(s-a)^2(s-b)(s-c)}}$$

$$\cot \frac{B}{2} \cot \frac{C}{2} = \sqrt{\frac{s^2}{(s-a)^2}}$$

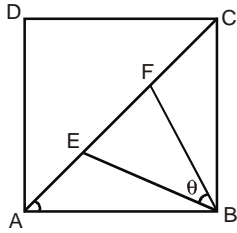
$$\cot \frac{B}{2} \cot \frac{C}{2} = \frac{s}{s-a}$$

Given : $b + c = 3a$

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

$$\therefore \cot \frac{B}{2} \cot \frac{C}{2} = \frac{2a}{2a-a} = \frac{2a}{a} = 2.$$

85.



$$\text{Given : } AE = EF = FC = \frac{AC}{3}$$

$$\text{Let, } AB = BC = CD = DA = x$$

$$\text{Then, } AC = \sqrt{2} x$$

$$\text{Let } BE = a$$

In $\triangle AEB$

$$\cos 45^\circ = \frac{\frac{2x^2}{9} + x^2 - a^2}{2 \cdot \frac{\sqrt{2}x}{3} \cdot x}$$

$$\frac{1}{\sqrt{2}} = \frac{\frac{11x^2}{9} - a^2}{\frac{2\sqrt{2}x^2}{3}}$$

$$\frac{2x^2}{3} = \frac{11x^2}{9} - a^2$$

$$a^2 = \frac{11x^2}{9} - \frac{2x^2}{3}$$

$$a^2 = \frac{11x^2 - 6x^2}{9} = \frac{5x^2}{9}$$

$$a = \frac{\sqrt{5}}{3} x$$

$$\text{Similarly } BF = a = \frac{\sqrt{5}x}{3}.$$

In $\triangle BEF$

$$BE = BF = \frac{\sqrt{5}x}{3}$$

$$\text{and } EF = \frac{\sqrt{2}x}{3}$$

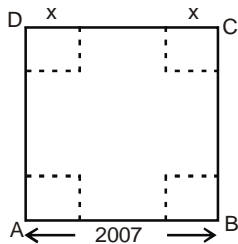
$$\cos\theta = \frac{BE^2 + BF^2 - EF^2}{2BE \times BF}$$

$$\cos\theta = \frac{\frac{5x^2}{9} + \frac{5x^2}{9} - \frac{2x^2}{9}}{2 \times \frac{\sqrt{5}x}{3} \times \frac{\sqrt{5}x}{3}}$$

$$\cos\theta = \frac{\frac{8x^2}{9}}{\frac{10x^2}{9}} = \frac{8}{10} = \frac{4}{5}$$

$$\therefore \tan\theta = \frac{3}{4}$$

86.



$$v = \text{Volume of box} = (2007 - 2x)^2 \times x$$

$$\begin{aligned} \frac{dv}{dx} &= 2(2007 - 2x)(-2x) + (2007 - 2x)^2 \\ &= (2007 - 2x)[-4x + 2007 - 2x] \\ &= (2007 - 2x)(2007 - 6x) \end{aligned}$$

For the maximum volume

$$\frac{dv}{dx} = 0$$

$$(2007 - 2x)(2007 - 6x) = 0$$

$$x = \frac{2007}{2} \text{ or } x = \frac{2007}{6}$$

$$\begin{aligned} \frac{d^2v}{dx^2} &= (2007 - 6x)(-2) + (2007 - 2x)(-6) \\ &= -4014 + 12x - 12042 + 12x \\ &= 24x - 16056 \end{aligned}$$

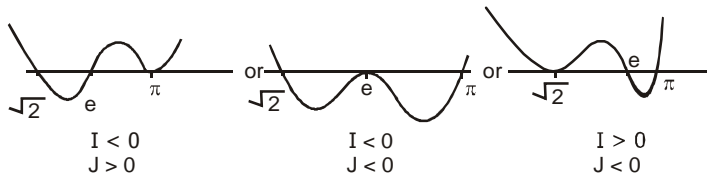
$$\left(\frac{d^2v}{dx^2}\right)_{x=\frac{2007}{6}} = 24 \times \frac{2007}{6} - 16056$$

$$= 8028 - 16056 < 0$$

\therefore Volume is maximum when $x = \frac{2007}{6} = \frac{669}{2}$ cm.

87. $S = y^2 - 4x$
 $S(0, 2) = 4$, $S(1/2, 5/2) = 25/4 - 2 = 17/4$, $S(5/2, 9/2) = 81/4 - 20/2 = 41/4$ and $S(1, 3) = 9 - 4 = 5$
 It is clear that $(0, 2)$ is closest to parabola $y^2 = 4x$.

88.



So, I and J can be both negative but not both positive.

89. $|z_1 z_2 + z_2 z_3 + z_3 z_1| = |z_1 z_2 z_3| \left| \frac{1}{z_1} + \frac{1}{z_2} + \frac{1}{z_3} \right|$
 $= |\bar{z}_1 + \bar{z}_2 + \bar{z}_3|$ [$\because |z_1| = |z_2| = |z_3|$]
 $= |z_1 + z_2 + z_3|$

90. So, the angles will be 99, 108,, 153, 162
 \therefore Sum of largest two angles = 153 + 162 = 315.

PHYSICS

91. Rotational inertia does not depend on speed so rotational inertia of the cylinder about its axis will be

$$\frac{1}{2} MR^2.$$

92. Air column is closed at one end, so fundamental frequency

$$n = \frac{v}{4\ell} = \frac{330}{4 \times 66 \times 10^{-2}} = 125 \text{ Hz}$$

$\therefore n_1 : n_2 : n_3 \dots\dots = 1 : 3 : 5 \dots\dots$

So, possible frequencies are

$$125, 375, 675, 875, 1125 (> 1\text{kHz})$$

So only possible frequencies are 3.

93. Time period of pendulum on the surface of the earth

$$T_0 = 2\pi \sqrt{\frac{\ell}{g}} \quad \dots\dots(i)$$

At a depth d, $g' = g \left(1 - \frac{d}{R}\right)$ and $\ell' = \ell(1 + \alpha\theta)$

So new time period,

$$T = 2\pi \sqrt{\frac{\ell'}{g'}} = 2\pi \sqrt{\frac{\ell(1 + \alpha\theta)}{g(1 - d/R)}} = (1 + \alpha\theta)^{1/2} (1 - d/R)^{-1/2} = \left(1 + \frac{1}{2}\alpha\theta\right) \left(1 + \frac{d}{2R}\right)$$

94. For first darkness,

$$d \sin \theta = \lambda \quad \Rightarrow \sin \theta = \frac{6 \times 10^{-7}}{2 \times 10^{-6}} = 0.3 \quad \theta = 17^\circ$$

95. In LC circuit time period, $T = 2\pi\sqrt{LC}$

$$t = \frac{T}{4} = \frac{\pi}{2}\sqrt{LC}$$

96. For insulated material capacity,

$$C = \frac{\epsilon_0 A}{(d - a + a/\epsilon_r)}$$

But of metal, $\epsilon_r = \infty$

$$\text{So, } C = \frac{\epsilon_0 A}{(d - a)}$$

97. $A_{\max} = g$ (block and piston remains together)

$$A\omega^2 = g$$

$$A_{\max} = \frac{g}{\omega^2} = \frac{g}{4\pi^2 f^2}$$

98. $z = 0$, as \vec{P} and \vec{E} in same direction

$$\frac{dE}{dZ} = 10^5 \quad \Rightarrow F = P \frac{dE}{dZ} = 10^{-7} \times 10^5 = 10^{-2} \text{ N}$$

99. Inside the atom,

$$\text{Electric field due to +ve charge, } E(r) = \frac{kz_e}{r^2}$$

$$\text{Due to -ve charge, } E(r) = -K \frac{ze r}{r^3}$$

$$\text{So, } E(r) = \frac{ze}{4\pi\epsilon_0} \left(\frac{1}{r^2} - \frac{r}{R^3} \right) \quad r < R$$

For out side atom

$$Q_{\text{net}} = 0$$

$$E(r) = 0 \quad r > R$$

100. $\Delta Q = c_p \Delta T$

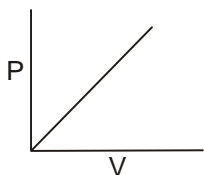
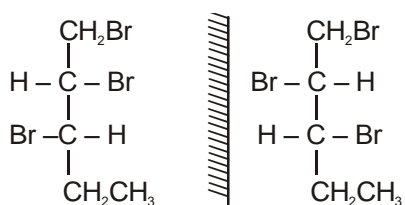
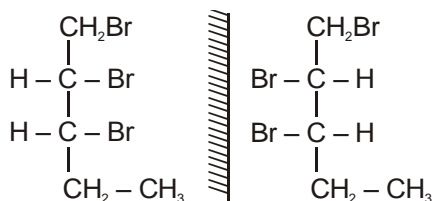
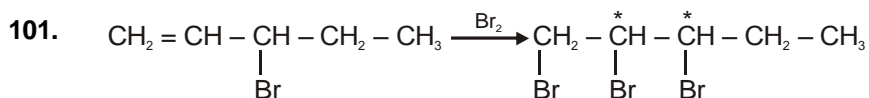
$$= \left(\frac{f}{2} + 1 \right) R \Delta T = \left(\frac{f}{2} + 1 \right) P \Delta V$$

$$\left(\frac{f}{2} + 1 \right) = \frac{\Delta Q}{P \Delta V} = \frac{10.61}{1.01 \times 10^5 \times 3 \times 10^{-5}}$$

$$f = 4.3$$

So, gas is a mixture of mono and diatomic molecules.

CHEMISTRY



according to above graph $P \propto V$
This contradicts Boyle's law

103. \therefore Molarity of acetic acid = 0.1 M [Suppose volume of acetic acid = x]
 \therefore no. of millimoles present in x ml of acetic acid = 0.1x
 \therefore Molarity of sodium acetate = 0.2
 \therefore no. of millimoles present in 10 ml of sodium acetate = $0.2 \times 10 = 2$

$$\text{pH} = \text{pK}_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$4.91 = 4.76 + \log \frac{2}{\frac{10+x}{0.1x}}$$

[\therefore total volume = (10 + x) ml]

$$0.15 = \log \frac{2}{0.1x}$$

$$0.15 = \log 20 - \log x$$

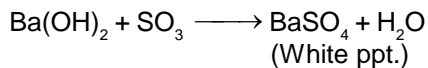
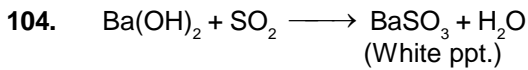
$$0.15 = 1.3010 - \log x$$

$$\log x = 1.151$$

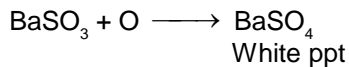
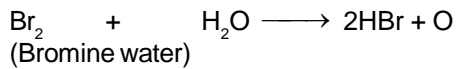
$$x = \text{antilog}(1.151)$$

$$x = 14.16 \text{ ml}$$

$$x \approx 14.2 \text{ ml}$$



BaSO_3 is soluble in dil HCl but BaSO_4 is not soluble in dil HCl. After filtration, filtrate contains BaSO_3



105. $\lambda \propto \frac{1}{\sqrt{V}}$

according to question given potential energy = kinetic energy

$eV = \frac{1}{2}mv^2$ ----- (1)

$eV = \frac{p^2}{2m}$ [$\because P = mv$]

$eV = \frac{h^2}{\lambda^2 2m}$ [$\because p = \frac{h}{\lambda}$]

$\lambda^2 = \frac{h^2}{2meV}$

$\lambda = \frac{h}{\sqrt{2meV}}$

$\because e, m, h$ are constants

so $\lambda \propto \frac{1}{\sqrt{V}}$

106. $K_b = 0.52 \text{ k Kg mol}^{-1}$ (given)

$\Delta T_b = 0.052 \text{ K}$ (given)

$m = \text{given}$

$\therefore \Delta T_b = \frac{1000 K_b w_0}{mW}$

It means we can calculate $\frac{w_0}{W} = \frac{\Delta T_b \times m}{1000 K_b}$ ----- (i)

Relative lowering of vapour pressure of water

$\Rightarrow \frac{P_o - P_s}{P_o} = \frac{w_0}{W} \times \frac{M}{m}$ ----- (ii)

$M = \text{molecular mass of water} = 18$

$m = \text{given}$

$\frac{w_0}{W} = \text{by equation (i)}$

so we can calculate relative lowering of V.P. of water by equation (ii)

osmotic pressure $\pi = \frac{n}{V} ST$

But V is unknown, so we can't find out the value of osmotic pressure.

freezing point depression $\Delta T_f = \frac{1000 K_f w_0}{mW}$

But value of K_f is not given so we can't calculate the magnitude of freezing point depression.

107. Test of Nitrogen

Organic compound	no ppt.	Nitrogen
Fused with Na + FeSO ₄	observed	absent
+ FeCl ₃		

Test of sulphur

Organic compound fused	violet	S present
with Na + sodium nitroprusside	colour	
	observed	

Thus according to question organic compound contains sulphur only.

108.