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DIVISION: JEE (MAIN+ADVANCED)
ACADEMIC SESSION: 2023-24

PERIODIC ASSESSMENT TEST (PAT)

STUDENT SUPPORT BOOKLET (SSB)

Answer Key (AK) | Standard Hints (SH) | Text Solutions (TS) | Weightage Sheet (WS)

CLASS	XI	COURSE NAME	VIKAAS	COURSE CODE	JA
PHASE CODE(S)	02JA	TOTAL PAGES	1	BATCH CODE(S)	02JA

Target Examination & Year:

JEE (MAIN+ADVANCED) 2025

TEST PATTERN	TEST TYPE	TEST CODE & SEQUENCE
JEE (ADVANCED)	CUMULATIVE TEST (CT)	ACT 01

DATE & DAY:
03rd September 2023 | Sunday

Duration & Time:
Paper-1 : 3 Hrs | 9:30 AM to 12:30 PM
Paper-2 : 3 Hrs | 2:30 PM to 5:30 PM

Contents:

- Weightage Sheet (WS) ✓
- Answer Key (AK) ✓
- Standard Hints (SH) ☐
- Text Solutions (TS) ✓
- Resonance Student's Critical Analysis of Learning for Excellence (ResoSCALE) ☐
- Student Self Assessment Sheet (SAS) ☐
- Video Solutions (VS) ✓

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ANSWER KEY (AK)

PAPER-1											
PART-I : MATHEMATICS	Q.No.	1	2	3	4	5	6	7	8	9	10
	Ans.	C	A	C	C	ABC	AC	AB	ABC	ABD	AB
	Q.No.	11	12	13	14	15	16	17	18		
	Ans.	BC	BD	05.00	28.80	27.00	17.00	37.00	07.00		
PART-II : PHYSICS	Q.No.	19	20	21	22	23	24	25	26	27	28
	Ans.	B	B	D	C	ACD	ABC	BCD	ABC	ABC	CD
	Q.No.	29	30	31	32	33	34	35	36		
	Ans.	BC	ABCD	60.00	04.00	01.00	08.00	02.00	08.00		
PART-III : CHEMISTRY	Q.No.	37	38	39	40	41	42	43	44	45	46
	Ans.	A	C	B	B	AB	CD	ABC	ABD	ABC	AC
	Q.No.	47	48	49	50	51	52	53	54		
	Ans.	ABD	BC	40.00	10.00	75.00	03.00	06.00	09.00		

PAPER-2											
PART-I : MATHEMATICS	Q.No.	1	2	3	4	5	6	7	8	9	10
	Ans.	BCD	ABD	BC	AC	BCD	CD	AC	BD	12.00	14.00
	Q.No.	11	12	13	14	15	16	17	18		
	Ans.	04.25	00.00	24.00	05.00	C	C	C	D		
PART-II : PHYSICS	Q.No.	19	20	21	22	23	24	25	26	27	28
	Ans.	AC	BD	CD	BC	ABC	ACD	BC	BD	02.00	02.00
	Q.No.	29	30	31	32	33	34	35	36		
	Ans.	02.00	08.00	20.00	15.00	D	C	A	D		
PART-III : CHEMISTRY	Q.No.	37	38	39	40	41	42	43	44	45	46
	Ans.	BC	BD	ABD	AC	BC	ABC	BC	ABD	04.00	04.00
	Q.No.	47	48	49	50	51	52	53	54		
	Ans.	50.00	06.00	06.00	03.00	B	A	C	D		

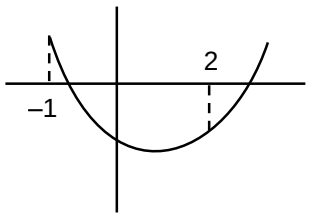
STUDENT'S SPACE

PAPER-1

PART-I: MATHEMATICS

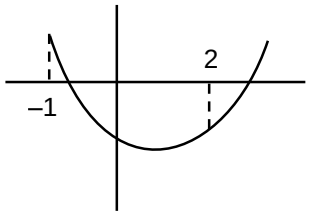
1. $(x - a)(x - 10) = -1$
$x - a = 1, x - 10 = -1$
or या $x - a = -1, x - 10 = 1$
$\Rightarrow a = 8, 12$

2.



Clearly, $f(-1) > 0, f(2) < 0$
Now $f(0) = -4 < 0$
$\Rightarrow f(-1) = 1 - a - 4 > 0$
and $f(2) = 4 + 2a - 4 < 0$
$\Rightarrow a < -3$ and $a < 0$
$\Rightarrow a \in (-\infty, -3)$

हल.



स्पष्टतया $f(-1) > 0, f(2) < 0$
अब $f(0) = -4 < 0$
$\Rightarrow f(-1) = 1 - a - 4 > 0$
और $f(2) = 4 + 2a - 4 < 0$
$\Rightarrow a < -3$ और $a < 0$
$\Rightarrow a \in (-\infty, -3)$

3. $\log_{x+1}(x^2 + x - 6)^2 = 4$
$\Rightarrow$ $x + 1 > 0$ and और $x \neq 0$
$x \in (-1, \infty) - \{0\}$
Now अब $(x^2 + x - 6)^2 = (x + 1)^4$
$\Rightarrow$ $(x^2 + x - 6)^2 - (x + 1)^4 = 0$
$\Rightarrow$ $(x + 7)(2x + 5)(x - 1) = 0$
$\therefore$ $x = -7, 1, -\frac{5}{2}$ Only केवल $1 \in (-1, \infty) - \{0\}$

4. $N = (75)^{-10}$
$\log_{10} N = (-10) \log_{10} 75$
$= (-10) \log (5^2.3)$
$= (-10) [2 \log 5 + \log 3]$
$= (-10) [2x\ 0.699 + 0.477]$
$(\because \log_{10} 5 = 1 - \log_{10} 2)$
$= -18.75 = \overline{19}\cdot 25$
$\therefore$ no. of zeros शून्यों की संख्या $= 19-1= 18$

5. $x^2 - ax + 1 = 0$ has no real root
$x^2 - ax + 1 = 0$ वास्तविक मूल रखता है।
$\therefore$ $D < 0$ $\Rightarrow$ $a^2 - 4 < 0$
$\Rightarrow a \in (-2, 2)$
$\therefore$ $A = \{x : -2 < x < 2\}$
$f(x) = bx^2 + bx + 0.5 > 0\ \forall\ x \in R$, if यदि $b > 0$
$\therefore$ $D < 0 \Rightarrow b^2 - 4.b.\frac{1}{2} < 0$
$\Rightarrow$ $b^2 - 2b < 0 \Rightarrow b \in (0, 2)$

Also तथा $b = 0$ then तब $f(x) > 0\ \forall x \in R$
$\therefore$ $b \in [0, 2)$
$\therefore$ $B = \{x : 0 \le x < 2\}$
$\therefore$ $A \cap B = \{x : 0 \le x < 2\}$

6. For real roots $4a^2 - 4b(a-1) \ge 0$
$\Rightarrow a^2 - ba + b \ge 0$
Now for above inequality to hold for all values of a,
$b^2 - 4b \le 0$ or $0 \le b \le 4$.

हल. वास्तविक मूलों के लिए $4a^2 - 4b(a-1) \ge 0$
$\Rightarrow a^2 - ba + b \ge 0$
अब असमिका सभी a के मानों के लिए संतुष्ठ होती है।
$b^2 - 4b \le 0$ or या $0 \le b \le 4$.

7. We can write the given equation as
$$\frac{P}{2x} = \frac{(a+b)x + c(b-a)}{x^2 - c^2}$$
or $p(x^2 - c^2) = 2(a+b)x^2 - 2c(a-b)x$
or
$(2a + 2b - p)x^2 - 2c(a-b)x + pc^2 = 0$
For this equation to have equal roots,
$(2a + 2b - p)x^2 - 2c(a-b)x + pc^2 = 0$
or $(a-b)^2 - 2p(a+b) + p^2 = 0$
or
$[p - (a+b)]^2 = (a+b)^2 - (a-b)^2 = 4ab$
or $p - (a+b) = \pm 2\sqrt{ab}$
or $p = a + b \pm 2\sqrt{ab} = (\sqrt{a} \pm \sqrt{b})^2$

हल. दी गई समीकरण से
$$\frac{P}{2x} = \frac{(a+b)x + c(b-a)}{x^2 - c^2}$$
या $p(x^2 - c^2) = 2(a+b)x^2 - 2c(a-b)x$
या $(2a + 2b - p)x^2 - 2c(a-b)x + pc^2 = 0$
इस समीकरण,
$(2a + 2b - p)x^2 - 2c(a-b)x + pc^2 = 0$
के मूल बराबर है

या $(a-b)^2-2p(a+b)+p^2=0$

या

$[p-(a+b)]^2=(a+b)^2-(a-b)^2=4ab$

या $p-(a+b)=\pm 2\sqrt{ab}$

या $p=a+b\pm 2\sqrt{ab}=(\sqrt{a}\pm\sqrt{b})^2$

8. Since each pair has common root, let the roots be α,β for

Eq. (1)$;\beta,\gamma$ for Eq.(2) and γ,α for Eq.(3) Therefore,

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

$\beta+\gamma=-b, \beta\gamma=ca$

$\gamma+\alpha=-c, \gamma\alpha=ab$

Adding, we et

$2(\alpha+\beta+\gamma)=-(a+b+c)$

$\Rightarrow\ \alpha+\beta+\gamma=-\frac{1}{2}(a+b+c)$

Also by conditions of common roots we have a + b + c = 0

Also by multiplying product of roots, we have

$\alpha^2\beta^2\gamma^2=a^2b^2c^2$ or $\alpha\beta\gamma=abc$

हल. चूकि प्रत्येक युग्म उभयनिष्ठ मूल रखती है माना α,β के लिए

(1)$;\beta,\gamma$ सभी (2) के लिए γ,α समीकरण (3) के लिए

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

$\beta+\gamma=-b, \beta\gamma=ca$

$\gamma+\alpha=-c, \gamma\alpha=ab$

जोडने पर

$2(\alpha+\beta+\gamma)=-(a+b+c)$

$\Rightarrow\ \alpha+\beta+\gamma=-\frac{1}{2}(a+b+c)$

साथ ही उभयनिष्ठ मूल के प्रतिबन्धों से हमें a + b + c = 0 प्राप्त होता है।

तथा मूलों का गुणनफल

$\alpha^2\beta^2\gamma^2=a^2b^2c^2$ or $\alpha\beta\gamma=abc$

9. $2\sqrt{\alpha_1-1}+4\sqrt{\alpha_2-4}+6\sqrt{\alpha_3-9}+8\sqrt{\alpha_4-16}$

$=(\alpha_1-1)+1+(\alpha_2-4)+4+(\alpha_3-9)+9+(\alpha_4-16)+16$

$\Rightarrow \left(\sqrt{\alpha_1-1}-1\right)^2+\left(\sqrt{\alpha_2-4}-2\right)^2+\left(\sqrt{\alpha_3-9}-3\right)^2+\left(\sqrt{\alpha_4-16}-4\right)^2=0$

$\Rightarrow\ \sqrt{\alpha_1-1}=1,\ \sqrt{\alpha_2-4}=2,\ \sqrt{\alpha_3-9}=3,\ \sqrt{\alpha_4-16}=4$

$\Rightarrow\ \alpha_1=2,\ \alpha_2=8,\ \alpha_3=18,\ \alpha_4=32$

10. $3^{2x^2}-4.3^{x^2+x+6}+3^{2x+13}=0$

$3^{2x^2-2x-12}-4.3^{x^2-x-6}+3=0$

$3^{x^2-x-6}=t$

$t^2-4t+3=0$

$t=1$ or $t=3$

$3^{x^2-x-6}=3^0$ or $3^{x^2-x-6}=3^1$

$x^2-x-6=0$ or $x^2-x-6=1$

$x^2-x-7=0$

Product of roots is divisible by (2) & (3) only

केवल (2) और (3) से मूलों का गुणन

Hence (A) & (B) are correct.

11. $\log_{\frac{x}{2}} x^2-14\log_{16x}x^3+40\log_{4x}\sqrt{x}=0$

$\log_x 2=t$

$\frac{2}{-t+1}-\frac{42}{1+4t}+\frac{20}{1+2t}=0$

$\frac{1}{1-t}-\frac{21}{1+4t}+\frac{10}{1+2t}=0$

$(1+4t)(1+2t)-21(1-t)(1+2t)+10(1-t)(1+4t)=0$

$8t^2+6t+1-21(1+2t-t-2t^2)+10(1+4t-t-4t^2)=0$

$10t^2+15t-10=0$

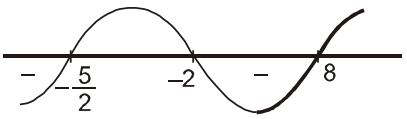
$2t^2+3t-2=0 \qquad \Rightarrow t=-2,\frac{1}{2}$

$\log_x 2=-2,\frac{1}{2}$

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

$x=4,\ x_2=1,\ x_3=\frac{1}{\sqrt{2}}$

12.



$\frac{x^2-1}{2x+5}-3<0 \quad\Rightarrow\quad \frac{x^2-1-6x-15}{2x+5}<0$

$\Rightarrow\quad \frac{x^2-6x-16}{2x+5}<0$

$\Rightarrow\quad \frac{x^2-8x+2x-16}{\left(x+\frac{5}{2}\right)}<0$

$\Rightarrow\quad \frac{x(x-8)+2(x-8)}{x+\frac{5}{2}}<0$

$\Rightarrow\quad \frac{(x-8)(x-2)}{x+\frac{5}{2}}<0$

$x\in(-\infty,-5/2)\cup(-2,8)$

$\therefore\ a=\frac{5}{2},\ b=-2,\ c=8$

13. $\alpha^2 - 5\alpha + 1 = 0 \Rightarrow \alpha^2 + 1 = 5\alpha$
$\beta^2 - 5\beta + 1 = 0 \Rightarrow \beta^2 + 1 = 5\beta$

$$\frac{a_3 + a_1}{a_2} = \frac{\alpha^3 + \beta^2 + \alpha + \beta}{\alpha^2 + \beta^2}$$

$$= \frac{\alpha(\alpha^2+1) + \beta(\beta^2+1)}{\alpha^2 + \beta^2} = \frac{5\alpha^2 + 5\beta^2}{\alpha^2 + \beta^2} = 5$$

14. $(x + 2)(x + 12)(x + 3)(x + 8) = 4x^2$
$(x^2 + 14x + 24)(x^2 + 11x + 24) = 4x^2$

$$\left(x + \frac{24}{x} + 14\right)\left(x + \frac{24}{x} + 11\right) = 4$$

Let माना $x + \frac{24}{x} = t$
$(t + 14)(t + 11) = 4$
$t^2 + 25t + 150 = 0$
$(t + 15)(t + 10) = 0$

$$\left(x + \frac{24}{x} + 15\right)\left(x + \frac{24}{x} + 10\right) = 0$$

$(x^2 + 15x + 24)$ $(x^2 + 10x + 24) = 0$
↓ ↓
d is not perfect square integral root
d पूर्ण वर्ग नहीं है। पूर्णांक मूल
not an integral root पूर्णांक मूल नहीं
Product गुणनफल = 24

15. p, q are roots of $3x^2 - 5x - 2 = 0$
p, q समीकरण $3x^2 - 5x - 2 = 0$ के मूल है।

$p + q = \frac{5}{3}$ $p.q = -2/3$
$(3p + 2q) + (2p + 3q) = 5p + 5q$
$= 5(p+q) = \frac{25}{3}$
product गुणन $(3p + 2q)(2p + 3q)$

$$= \left(p + \frac{10}{3}\right)\left(q + \frac{10}{3}\right)$$

$$= pq + \frac{10}{3}(p + q) + \frac{100}{9}$$

$$= -\frac{2}{3} + \frac{50}{9} + \frac{100}{9} = \frac{144}{9}$$

equation समीकरण

$$x^2 - \frac{25}{3}x + \frac{144}{9} = 0$$

$a = -\frac{25}{3}$ $b = \frac{144}{9}$

$\Rightarrow a + b = \frac{23}{3}$

$$\frac{23}{a+b} = 3$$

16. $3^{4(\log_3 5)} + 3^{3\log_3 6} + 3^{4\log_9 7}$
$= 5^4 + 6^3 + 7^2$
$= 625 + 216 + 49$
$= 890$

17. $\alpha = +2 + 3 \times \frac{1}{3} = 6$
$\beta = \sin\theta \times \cos\theta [\tan\theta + \cot\theta] = 1$
$\therefore \alpha^2 + \beta^2 = 37$

18. As $3 + 2\sqrt{2} = \left(\sqrt{2}+1\right)^2$ and
$3 - 2\sqrt{2} = \left(\sqrt{2}-1\right)^2$
$\therefore$ Expression $= \log_{2^9}\left((\sqrt{2}+1) + (\sqrt{2}-1)\right)$

$$= \log_{2^9}(2\sqrt{2}) = \log_{2^9} 2^{3/2} = \frac{3}{2\times 9}$$

$$= \frac{1}{6} = \frac{p}{q}$$

$\therefore p + q = 7$

PART-II: PHYSICS

19. $a = -4x(-1 + 0.25x^2)$

$$\int_{17}^{v} v\,dv = \int_{0}^{4} (4x - x^3)\,dx$$

$$\frac{1}{2}(v^2 - 17^2) = \frac{4}{2}(x^2)_0^4 - \frac{1}{4}(x^4)_0^4$$

$v^2 - 17^2 = 4(4^2) - \frac{1}{2}(4^4) = 64 - 128$
$V^2 = 289 - 64 = 225$
$V = 15$ m/sec.

20. Let velocity of the aeroplane be $\vec{v}_P = u\cos 30^0 \hat{i} + u\sin 30^0 \hat{j}$ and velocity of the wind be v, then
माना कि हवाई जहाज का वेग $\vec{v}_P = u\cos 30^0 \hat{i} + u\sin 30^0 \hat{j}$ तथा आँधी का वेग v है, तब

$$u\frac{\sqrt{3}}{2}t\hat{i} + \left(\frac{u}{2}t - 5t^2\right)\hat{j} + vt\hat{k}$$

$$= 400\sqrt{3}\hat{i} + 80\hat{j} + 200\hat{k}$$

$\Rightarrow$ $u\frac{\sqrt{3}}{2}t = 400\sqrt{3}$, $\frac{u}{2}t - 5t^2 = 80$, $vt = 200$

$ut = 800$ and $\frac{u}{2}t - 5t^2 = 80$

$\Rightarrow$ $400 - 5t^2 = 80$ $\Rightarrow$ $t^2 = 64$
$\Rightarrow$ $t = 8$ sec.
$\Rightarrow$ $v = \frac{200}{8} = 25$ m/s

21. $H = -u\sin\theta\, t + \frac{1}{2}gt^2$

$R = u\cos\theta t$

$H = -R\tan\theta + \frac{gR^2}{2u^2}(1 + \tan^2\theta)$

$\frac{gR^2}{2u^2}\tan^2\theta - R\tan\theta + \left(\frac{gR^2}{2u^2} - H\right) = 0$

Real roots वास्तविक मूल के लिए

$R^2 - r\frac{gR^2}{2u^2}\left(\frac{gR^2}{2u^2} - H\right) \geq 0$

$1 - \frac{g}{u^4}(gR^2 - 2u^2H) \geq 0$

$\frac{u^4}{g} + 2u^2H \geq gR^2$

$R \leq \frac{u}{g}\sqrt{u^2 + 2gH}$

$R_{max} = \frac{u}{g}\sqrt{u^2 + 2gH}$

Corresponding θ $\tan\theta = \frac{u}{\sqrt{u^2 + 2gH}} < 45^o$.

आवश्यक कोण θ $\tan\theta = \frac{u}{\sqrt{u^2 + 2gH}} < 45^o$

22. $(\vec{a} + \vec{b}) = k(\vec{a} - \vec{b})$ (k > 1)

$\Rightarrow \quad \vec{a} = \left(\frac{K+1}{K-1}\right)\vec{b}$

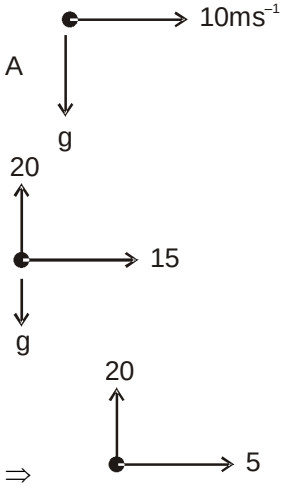
$\Rightarrow$ $\vec{a}$ is in same direction of $\vec{b}$

$\vec{a}$ की दिशा $\vec{b}$ के समान है।

$\vec{a} \times \vec{b} = 0$ & तथा $|\vec{a}| > |\vec{b}|$.

$= \frac{7}{\sqrt{2}}$

23.



$\Rightarrow$

$V_{3s} = 5\sqrt{17}$

= constant

24. $v_x = \frac{dx}{dt} = \frac{3t^2}{3} = t^2$

$v_y = \frac{dx}{dt} = \frac{t^2}{2}$

at t = 1, पर $v_x = 1$,

$v_y = \frac{1}{2}$, $\vec{v} = 1\hat{i} + \frac{1}{2}\hat{j}$

$a_x = \frac{dv_x}{dt} = 2t$

$a_y = \frac{dv_y}{dt} = t$

at t = 1 पर $\vec{a} = (2\hat{i} + \hat{j})$

at t = 1 पर $\vec{a}.\vec{v} = (2)(1) + \frac{1}{2}(1)$

= 2.5 > 0

Therefore, particle is speeding up.

अतः कण की चाल बढेगी

25. All statements except (a) are correct.

विकल्प (a) के अलावा सभी कथन सही है।

26. Direction of instantaneous velocity is always tangential to the path and direction of average velocity is along the secent of path.

तात्क्षणिक वेग की दिशा हमेशा पथ खींची गई स्पर्श रेखा के अनुदिश होती है, जबकि औसत वेग की दिशा पथ के ढाल के अनुदिश होती है।

27. $t_1 = 2\sqrt{\frac{2h}{g}}$ for 1st ball (at h)

$t_1 = 2\sqrt{\frac{2h}{g}}$ 1st गेंद के लिए (h पर)

$t_2 = 2\sqrt{\frac{2h}{4g}}$ for 2nd ball $\left(\text{at } \frac{h}{4}\right)$

$t_2 = 2\sqrt{\frac{2h}{4g}}$, 2nd गेंद के लिए $\left(\frac{h}{4} \text{ पर}\right)$

$\therefore\ t_1 = 2t_2$

Velocity of two balls will be equal for a time interval $t_2 = t_1/2$ i.e., second ball starts journey from ground in upward direction

$t_2 = t_1/2$ समयान्तराल के लिए दोनों गेदों का वेग समान होगें अर्थात् दूसरी गेंद धरातल से ऊपर की ओर चलना प्रारम्भ करेगीं

Velocity will be equal if $t = nt_1$ or $t_1/2 + nt_1$

वेग बराबर होगा यदि $t = nt_1$ या $t_1/2 + nt_1$

n = 1, 2, 3, 4 ……

for other starting points of second ball we don't have common points on superposition due to different time periods of motion.

दूसरे गेंद के और प्रारम्भिक बिन्दुओं के लिए हमारे पास अलग–अलग आवर्तकाल की वजह से समान बिन्दु नहीं है।

28. $\frac{d}{dx}(\tan^{-1}x) = \frac{1}{1+x^2}$ [by Formula सूत्र से]

$y = \tan^{-1}x$

$\Rightarrow \quad x = \tan y$

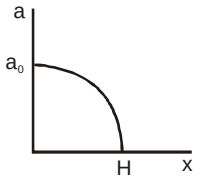
$\Rightarrow \quad \frac{1}{1+\tan^2 y} = \frac{1}{\sec^2 y} = \cos^2 y$

$= \left[\cos(\tan^{-1}x)\right]^2$

29. The graph should be
आरेख होना चाहिए

$\alpha = v\frac{dv}{dx} = a_0\sqrt{1-\frac{x}{H}}$

$\frac{v^2}{2} = a_0\left(-\frac{2H}{3}\right)\left(1-\frac{x}{H}\right)^{3/2} + c$



$\xi = 0, \varpi = 0 \Rightarrow c = \frac{2a_0H}{3}$

$\therefore \quad v^2 = \frac{4a_0H}{3}\left[1-\left(1-\frac{x}{H}\right)^{3/2}\right]$

At x = H पर, $v^2 = \frac{4a_0H}{3}$, $v = 2\sqrt{\frac{a_0H}{3}}$

30. $h_1 = \frac{u^2\sin^2\alpha}{2g\cos\beta} = h_2$; $T_1 = \frac{2u\sin^2\alpha}{g\cos\beta} = T_2$

$R_1 = u\cos\alpha\ T_1 - \frac{1}{2}\ g\beta T_1^2$

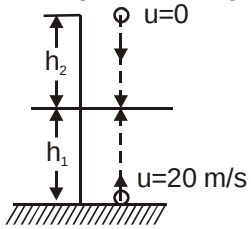
$R_2 = u\cos\alpha\ T_2 + \frac{1}{2}\ g\sin\beta T_2^2$

$R_2 - R_1 = g\sin\beta\ T_1^2 = g\sin\beta\ T_2^2$

31. Height of the building
मकान की ऊँचाई

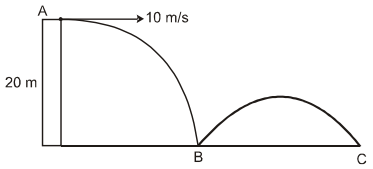
$H = h_1 + h_2$

$= 1/2\ gt^2 + ut - 1/2gt^2$



$= ut = 60$ m.

32.



$t_{AB} = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times 20}{10}} = 2$ sec

Before collision at B
टक्कर से पहले B पर

$V_x = 10$ m/s $\quad V_y = 20$ m/s

After collision at B.
B पर टक्कर के बाद

$V_x' = 10$ m/s $\quad V_y' = eV_y = 1/2 \times 20 = 10$ m/s

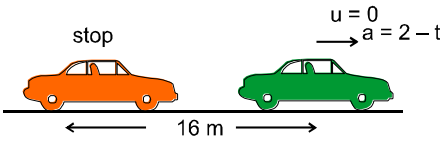
$t_{BC} = \frac{2V_y'}{g} = 2$ sec

$T = t_{AB} + t_{BC} = 4$ sec.

33. $\int \sin^2 x dx = \frac{x}{2} - \frac{\sin 2x}{4} + c$

$\Rightarrow \frac{1}{\pi}\int_0^{2\pi}\sin^2 x\,dx = \frac{1}{\pi}\left[\frac{2\pi}{2} - \frac{0}{4}\right] - 0 = 1.$

34.



w.r.t car A (कार A के सापेक्ष) $\frac{dv_{rel.}}{dt} = 2 - t$

$\Rightarrow \int_o^v dv_{rel.} = \int_o^t (2-t)\ dt \Rightarrow v = 2t - \frac{t^2}{2}$

$v = 0 \Rightarrow t = 4$ sec. ; $\frac{dx}{dt} = 2t - \frac{t^2}{2}$

$\Rightarrow x_{rel} = 16 + 4^2 - \frac{4^3}{6}$

at t = 6 पर $\rightarrow x_{rel} = 16 + 36 - \frac{6^3}{6} = 16$m ; at

t = 4 पर $\rightarrow x_{rel.} = 16 + 4^2 - \frac{4^3}{6} = \frac{64}{3}$ m

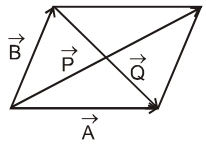
$\Rightarrow x = 8.$

35. $\vec{P} = \vec{A}+\vec{B}$ & $\vec{Q} = \vec{A}-\vec{B}$

$\vec{P}\times\vec{Q} = (\vec{A}+\vec{B})\times(\vec{A}-\vec{B})$

$= -\vec{A}\times\vec{B} + \vec{B}\times\vec{A}$

$\vec{B}\times\vec{A} = \frac{\vec{P}\times\vec{Q}}{2} = \frac{1}{2}\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 3 & 1 & 1\\ 1 & -1 & -1\end{vmatrix}$



$= \frac{1}{2}[4\hat{j} - 4\hat{k}] = 2\hat{j} - 2\hat{k}$

Area क्षेत्रफल $= |\vec{B} \times \vec{A}| = 2\sqrt{2}$

$x = 2$

36. $a = 3t^2$

$\int_0^v dv = 3\int_0^2 t^2 dt$

$v = 8$ m/s.

PART-III: CHEMISTRY

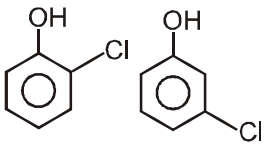
37. (A) RAM

38. No. of moles of Na $= \frac{115}{23} = 5$ mol

No. of atoms of Na $= 5\ N_A$

हल. Na के मोल्स की संख्या $= \frac{115}{23} = 5$ मोल

Na के परमाणुओं की संख्या $= 5\ N_A$

39. 

Total (कुल)

$= 3$

40. (B) 4

41.

C_2F_4	C_2F_4	C_2F_4
$C^{12}C^{12}F_4 = 100$	$C^{13}C^{13}F_4 = 102$	$C^{12}C^{13}F_4 = 101$

% of C_2F_4 of molar mass $\frac{100g}{mol} =$

$\frac{99}{100} \times \frac{99}{100} \times 100 = 98.01\%$

% of C_2F_4 of molar mass $\frac{102g}{mol} =$

$\frac{1}{100} \times \frac{1}{100} \times 100 = 0.01\%$

% of C_2F_4 of molar mass $\frac{101g}{mol} = 100 - (98.01 + 0.01) = 1.98\%$

हल.

C_2F_4	C_2F_4	C_2F_4
$C^{12}C^{12}F_4 = 100$	$C^{13}C^{13}F_4 = 102$	$C^{12}C^{13}F_4 = 101$

100 ग्राम/मोल, मोलर द्रव्यमान के C_2F_4 का %

$= \frac{99}{100} \times \frac{99}{100} \times 100 = 98.01\%$

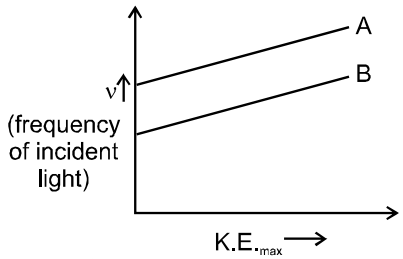
102 ग्राम/मोल, मोलर द्रव्यमान के C_2F_4 का % $=$

$\frac{1}{100} \times \frac{1}{100} \times 100 = 0.01\%$

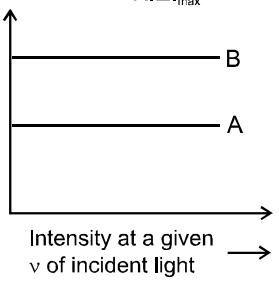
101 ग्राम/मोल, मोलर द्रव्यमान के C_2F_4 का %

$= 100 - (98.01 + 0.01) = 1.98\%$

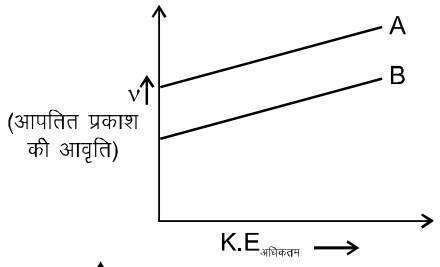
42. (C)



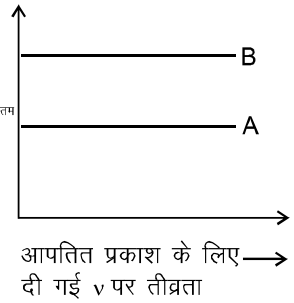
(D)



(C)



(D)



43.

	Electron	Proton	Neutron
Protium ($_1H^1$)	1	1	0
Deuterium ($_1H^2$)	1	1	1
Tritium ($_1H^3$)	1	1	2

$v \propto n$ (for same P,T)

हल.

	इलेक्ट्रॉन	प्रोटॉन	न्यूट्रॉन
प्रोटियम ($_1H^1$)	1	1	0
ड्यूटेरियम ($_1H^2$)	1	1	1
ट्रिटियम ($_1H^3$)	1	1	2

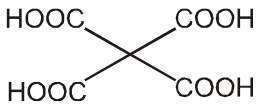
$v \alpha n$ (समान P,T के लिये)

44. α-particle is repelled by the nucleus (not attracted).

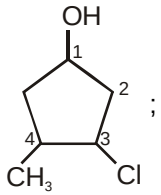
हल. नाभिक द्वारा α-कण प्रतिकर्षित होते है। (आकर्षित नहीं).

45. The number of σ bonds are 14 and DU = 4.

हल. σ बंधों की संख्या 14 तथा DU = 4.

46. A is :  ;

C is : $Cl–CH_2–\underset{\underset{O}{\|}}{C}–Cl$

47. A is :  ;

(B) should have amide as the functional group.
(D) has incorrect main chain.

48. A, D have different functional groups. So, cannot be homologous.

हल. A, D भिन्न क्रियात्मक समूह रखते है। इसलिए, यह समजात नहीं हो सकते।

49. $2(p+n)+3p=140$

$7p=140,\ p=20$

so अतः $= p + n = 40$

50. Let the power be x watts.

No. of photons emitted per second × Energy of 1 photon = Total energy

$\therefore 3.125 \times 10^{19} \times \frac{12400}{6200} = \frac{x}{1.6\times10^{-19}}$

$\therefore x = 10$

हल. माना कि शक्ति x वॉट है।

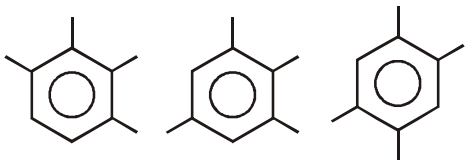
प्रति सैकण्ड उत्सर्जित होने वाले फोटोनों की संख्या × 1 फोटोन की ऊर्जा = कुल ऊर्जा

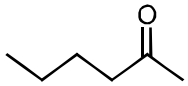
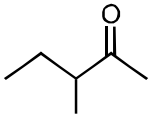
$\therefore 3.125 \times 10^{19} \times \frac{12400}{6200} = \frac{x}{1.6\times10^{-19}}$

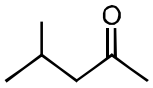
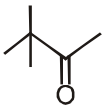
$\therefore x = 10$

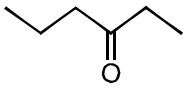
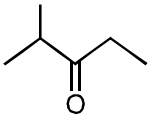
51. $40 = \frac{16\times1+17\times2+2\times M}{5}$

M = 75

52. 

53. (i)  (ii) 

(iii)  (iv) 

(v)  (vi) 

54. (i) $H–\underset{\underset{O}{\|}}{C}–O–CH_2–CH_2–CH_2–CH_3$

(ii) $H–\underset{\underset{O}{\|}}{C}–O–\underset{\underset{CH_3}{|}}{CH}–CH_2–CH_3$

(iii) $H–\underset{\underset{O}{\|}}{C}–O–CH_2–\underset{\underset{CH_3}{|}}{CH}–CH_3$

(iv) $H–\underset{\underset{O}{\|}}{C}–O–\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}–CH_3$

(v) $CH_3–\underset{\underset{O}{\|}}{C}–O–CH_2–CH_2–CH_3$

(vi) $CH_3–\underset{\underset{O}{\|}}{C}–O–\underset{\underset{CH_3}{|}}{CH}–CH_3$

(vii) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–O–CH_2–CH_3$

(viii) $CH_3–CH_2–CH_2–\underset{\underset{O}{\|}}{C}–O–CH_3$

(ix) $CH_3–\underset{\underset{CH_3}{|}}{CH}–\underset{\underset{O}{\|}}{C}–O–CH_3$

PAPER-2

PART-I: MATHEMATICS

1. $r_1 + r_2 + r_3 = -4$, $r_1r_2 + r_2r_3 + r_3r_1 = -a$, $r_1r_2r_3 = -1$

$\therefore \sum r_1^2 + \sum \frac{1}{r_1^2} + 6 = \left(\sum r_1\right)^2 - 2\sum(r_1r_2) + \left[\frac{(r_2r_1)^2+(r_3r_1)^2+(r_1r_2)^2}{1}\right] + 16$

$= 22 + 2a + [(\Sigma r_1r_2)^2 - 2(r_1^2r_2r_3 + r_2^2r_1r_3 + r_3^2r_1r_2)]$

$= 22 + 2a + [a^2 - 2(4)] = 22 - 8 + a^2 + 2a$

$= (a+1)^2 + 13 \ \therefore \min = 13$

2. Roots are purely imaginary
i.e. $i\beta$ and $-i\beta$
$\therefore$ sum of roots = 0 incorrect (3)
product of roots = $-i^2\beta^2 = \beta^2$
$\Rightarrow$ product > 0 ; $\frac{c}{a} > 0 \Rightarrow$ c = + ve]

हल. मूल विशुद्ध काल्पनिक है।
अर्थात्. $i\beta$ और $-i\beta$
$\therefore$ मूलों का योग = 0
(3) गलत है।
मूलों का गुणन = $-i^2\beta^2 = \beta^2$
$\Rightarrow$ गुणन > 0 ; $\frac{c}{a} > 0 \Rightarrow$ c = + ve]

3. Parabola upward a > 0,
ऊपरी परवलय a > 0,
y intercept = positive $\Rightarrow$ c > 0
y अन्तखण्ड = धनात्मक $\Rightarrow$ c > 0
$\frac{-b}{2a} > 0 \Rightarrow$ b < 0

4. Here यहाँ $y = \frac{2x^2+4x+7}{x^2+2x+4}$
or या, $(y-2)x^2 + 2(y-2)x + (4y-7) = 0$
If यदि $y \neq 2$, $D \geq 0$
or, या $(y-2)^2 - (y-2)(4y-7) \geq 0$
$\therefore (y-2)(5-3y) \geq 0$ Or, या $y \in \left[\frac{5}{3}, 2\right)$
If y = 2, there does not exist any real x
यदि y = 2 किसी वास्तविक x में विद्यमान नहीं है।
Hence Range अतः परिसर = $\left[\frac{5}{3}, 2\right)$

5. Since $ax^2 + bx + c < 0 \ \forall\ x \in R$ and b > 0
चूंकि $ax^2 + bx + c < 0 \ \forall\ x \in R$ और b > 0
$\therefore$ a < 0 and और $-\frac{b}{2a} > 0$
$\therefore$ vertex is in IVth quadrant
$\therefore$ शीर्ष चौथे चतुर्थांश में है।
Since $ax^2 + bx + c < 0 \ \forall\ x \in R$ and b < 0
चूंकि $ax^2 + bx + c < 0 \ \forall\ x \in R$ और b < 0
$\therefore$ a < 0 and और $-\frac{b}{2a} < 0$
$\therefore$ vertex lie in IIIrd quadrant
$\therefore$ शीर्ष तीसरे चतुर्थांश में है।
Since $ax^2 + bx + c < 0$ for some x, a > 0 and b > 0
चूंकि $ax^2 + bx + c < 0$ किसी x के लिए , a > 0 और b > 0
$\therefore -\frac{b}{2a} < 0$
$\therefore$ vertex lie in IIIrd quadrant
$\therefore$ शीर्ष तीसरे चतुर्थांश में है।
Since $ax^2 + bx + c > 0$ for some x, a < 0 and b < 0
चूंकि $ax^2 + bx + c > 0$ किसी x के लिए , a < 0 और b < 0
$\therefore -\frac{b}{2a} < 0$
$\therefore$ vertex lies in IInd quadrant
$\therefore$ शीर्ष दूसरे चतुर्थांश में है।

6. Given abc < 0
product of roots of the given equation
$= \frac{a}{bc} \times \frac{bc}{bc} = \frac{abc}{(bc)^2} < 0$
$\because$ product of roots is < 0
$\therefore$ one roots is positive and one is negative real roots

हल. दिया गया है abc < 0
दी गई समीकरण के मूलों का गुणनफल
$= \frac{a}{bc} \times \frac{bc}{bc} = \frac{abc}{(bc)^2} < 0$
$\because$ मूलो का गुणनफल < 0
$\therefore$ एक मूल धनात्मक है तथा एक ऋणात्मक(वास्तविक मूल)

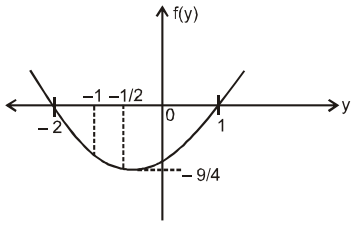
7. $x^2 - 8x + 12 + 4k - k^2 = 0,\ k \in R$
when both roots positive जब दोनो मूल धनात्मक है।
(i) $D \geq 0 \Rightarrow (k-2)^2 \geq 0 \Rightarrow k \in R$
(ii) $f(0) > 0 \Rightarrow 12 + 4k - k^2 > 0 \Rightarrow k \in (-2, 6)$
(i) $\cap$ (ii) $\Rightarrow$ $k \in (-2, 6)$
$f(4) = (k^2 - 4k + 4) = (k-2)^2$
$f(4)_{max} = 0$, at k = 2 पर

8. Refer to answer key

9. By observing
$f(x) = (6-x) + (x-1)(x-2)(x-3)(x-4)(x-5)$
then तब $f(6) = 5 \times 4 \times 3 \times 2 \times 1 = 120$

10. $\alpha + \beta + \gamma = 0$; $\sum\alpha\beta = 3$ $\alpha\beta\gamma = 1$
$\alpha^2 + \beta^2 + \gamma^2 + 2\sum\alpha\beta = (\alpha + \beta + \gamma)^2$
$\sum\alpha^2 = 0 - 2\sum\alpha\beta = -6$
$\alpha^2\beta^2\gamma^2 = (1)^2 = 1$
$\alpha^2\beta^2 + \beta^2\gamma^2 + \gamma^2\alpha^2 = (\alpha\beta + \beta\gamma + \gamma\alpha)^2 - 2\alpha\beta\gamma(\alpha + \beta + \gamma)$
$= 3^2 - 2.(1)(0) = 9$
Now equation नयी समीकरण $x^3 - (-6)x^2 + 9x - 1 = 0$
$\Rightarrow x^3 + 6x^2 + 9x - 1 = 0$

11.



$y = \frac{2x}{1+x^2} \Rightarrow x^2y - 2x + y = 0 \ \forall\ x \in R$
$D \geq 0$

$4 - 4y^2 \geq 0 \quad \Rightarrow y \in [-1, 1]$

Now अब $f(y) = 4y^2 + 13$

Maximum value of $\frac{f(y)}{4}$ is 4.25

$\frac{f(y)}{4}$ का अधिकतम मान 4.25 है।

12. The digit in the unit place of n(n + 1) + 1 is 1, 3 or 7.

$\Rightarrow$ 5 does not divides $n^2 + n + 1$

$\Rightarrow$ 105 is not a divisor of n(n + 1) + 1.

हल. n(n + 1) + 1 का इकाई स्थान का अंक 1, 3 या 7.

$\Rightarrow$ 5, $n^2 + n + 1$ को विभाजित नही करता है।

$\Rightarrow$ 105, n(n + 1) + 1 का भाजक नही है।

13. $\tan\theta = -\frac{5}{12} \quad \because \quad \frac{3\pi}{2} < \theta < 2\pi$

$\Rightarrow \quad \sin\theta = -\frac{5}{13}$ and $\cot\theta = -\frac{12}{5}$

$$\text{LHS} = \frac{-\sin\theta - \cot\theta}{-\text{cosec}\theta - \text{cosec}\theta}$$

$$= \frac{\sin\theta + \cot\theta}{2\ \text{cosec}\theta} = \frac{-\frac{5}{13} - \frac{12}{5}}{-2 \times \frac{13}{5}} = \frac{181}{338} = \text{RHS}$$

हल. $\tan\theta = -\frac{5}{12} \quad \because \quad \frac{3\pi}{2} < \theta < 2\pi$

$\Rightarrow \sin\theta = -\frac{5}{13}$ और $\cot\theta = -\frac{12}{5}$

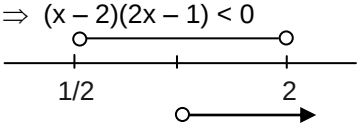
$$\text{LHS} = \frac{-\sin\theta - \cot\theta}{-\text{cosec}\theta - \text{cosec}\theta}$$

$$= \frac{\sin\theta + \cot\theta}{2\ \text{cosec}\theta} = \frac{-\frac{5}{13} - \frac{12}{5}}{-2 \times \frac{13}{5}} = \frac{181}{338} = \text{RHS}]$$

14. Case-1 : Let माना x > 1

$\Rightarrow \frac{5}{2} - \frac{1}{x} > x \quad \Rightarrow 2x^2 - 5x + 2 < 0$

$\Rightarrow (x - 2)(2x - 1) < 0$



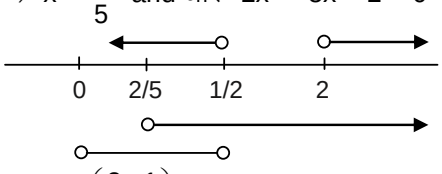
$\therefore \ x \in (1, 2)$

Case-2 : Let माना 0 < x < 1

$\therefore \ 0 < \frac{5}{2} - \frac{1}{x} < x \qquad \therefore \ x \in (0, 1)$

$\Rightarrow \ 0 < \frac{5x - 2}{2x} < x \quad \Rightarrow \ 0 < 5x - 2 < 2x^2$

$\Rightarrow \ x > \frac{2}{5}$ and और $2x^2 - 5x + 2 > 0$



$\therefore \ x \in \left(\frac{2}{5}, \frac{1}{2}\right)$

$\therefore$ Solution set is हल समुच्चय $\left(\frac{2}{5}, \frac{1}{2}\right) \cup (1, 2)$ है

$\therefore \ a = \frac{2}{5}, \ b = \frac{1}{2}, \ c = 1, d = 2$

$\therefore \ \frac{cd}{ab} = \frac{2}{\frac{1}{5}} = 10$

15. Refer to answer key

16. Refer to answer key

Sol. **(17–18)**

Will have real & distinct roots

$D = (m - 3)^2 - 4m > 0$

$\Rightarrow \quad m^2 - 10m + 9 > 0$

$\Rightarrow \quad m \in (-\infty, 1) \cup (9, \infty)$

roots are both positive

$\Rightarrow \quad D \geq 0, \ m - 3 > 0, \ m > 0$

$\Rightarrow \quad m \geq 9 \ , \ m > 3 \quad m \in [9, \infty)$

roots are both negative

$\Rightarrow \quad D \geq 0, \ m - 3 < 0$ and $m > 0$

$\Rightarrow \quad m \leq 1 \ , \ 0 < m < 3$

$\Rightarrow \quad m \in (0, 1]$

PART-II: PHYSICS

19. (A) If the man increases his speed of walking, then it is possible that the angle made by rain with vertical (as observed by man) goes on decreasing.

यदि व्यक्ति अपने चलने की चाल को बढ़ाता है, तो यह संभव है कि ऊर्ध्वाधर के साथ बारिश के द्वारा बनाया गया कोण (व्यक्ति के सापेक्ष) घटता जायेगा।

(C) Keeping his own velocity constant on horizontal, if the man observes rain to be falling vertically downwards but with variable magnitude then it is sure that velocity of rain with respect to ground is variable.

उसके स्वयं के वेग को क्षैतिज सतह पर नियत रखते हुए यदि व्यक्ति वर्षा को ऊर्ध्वाधर नीचे की ओर गिरते हुए देखता है, किन्तु परिवर्तित परिमाण के साथ, तो यह निश्चित है कि धरातल के सापेक्ष बारिश का वेग परिवर्तनशील है।

20. $h = 1/2\ gt^2 = 5n^2$

$S_n^{th} = u + 1/2\ a\ (2n - 1)$

$\Rightarrow \quad -h/2 = 0 + 1/2\ (-g)\ (2n - 1)$

$\Rightarrow \quad 5n^2 = 10\ (2n - 1)$

$\Rightarrow \quad n^2 - 4n + 2 = 0$

$n = (2 \pm \sqrt{2}\ )$

but लेकिन n > 1

$\Rightarrow \quad n = (2 + \sqrt{2}\ )$

Total height कुल ऊँचाई $h = 5n^2 = 10\ (\sqrt{2} + 1)^2$

21. $t = \frac{D}{v_s \cos\theta}$, θ is angle between swimmer velocity and vertical.

$= \frac{200}{5 \times \cos 60°} = 80$ sec.

Diff. $\alpha = (v_r - v_s \sin\theta)t$

$= \left(2 - 4 \times \frac{\sqrt{3}}{2}\right) \times 80 = -186.4$ m

correct options is (C, D)

$t = \frac{D}{v_s \cos\theta}$, θ तैराक का वेग एवं लम्ब के मध्य का कोण है।

$= \frac{200}{5 \times \cos 60°} = 80$ sec. Diff. $\alpha = (v_r - v_s \sin\theta)t$

$= \left(2 - 4 \times \frac{\sqrt{3}}{2}\right) \times 80 = -186.4$ m

सही विकल्प (C, D) हैं।

22. Total time taken by the ball to reach at bottom = $\sqrt{\frac{2H}{g}} = \sqrt{\frac{2x80}{10}} = 4$ sec.

Let time taken in one collision is t
Then t × 10 = 7
t = .7 sec.

No. of collisions = $\frac{4}{.7} = 5\frac{5}{7}$ (5th collisions from wall B)

Horizontal distance travelled in between 2 successive collisions = 7 m

$\therefore$ Horizontal distance travelled in 5/7 part of collisions = $\frac{5}{7} x 7 = 5$ m

Distance from A is 2 m. **Ans.**

तल पर पहुँचने के लिए गेंद के द्वारा लिया गया कुल समय = $\sqrt{\frac{2H}{g}} = \sqrt{\frac{2x80}{10}} = 4$ sec.

माना कि एक टक्कर में लिया गया समय t है।

तब t × 10 = 7

t = 0.7 sec.

टक्करों की संख्या = $\frac{4}{.7} = 5\frac{5}{7}$

(5th टक्कर दीवार B से)

2 लगातार टक्कर के दौरान क्षैतिज दिशा में तय की गई दूरी = 7 m

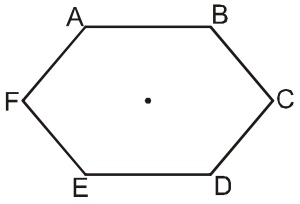
$\therefore$ टक्कर के 5/7 भाग के लिए क्षैतिज में तय की गई दूरी = $\frac{5}{7} x 7 = 5$ m

A से दूरी 2 m है। **Ans.**

23. If (यदि) $\frac{dr}{dt} < 0$

Then (तब) $\vec{r}.\vec{v} < 0$

24.



Let side length is a
माना भुजा की लम्बाई a है

From A to B

$\vec{v} = \frac{\text{displacement}}{\text{time}} = \frac{a}{a/v} = v$ (option D)

A से B

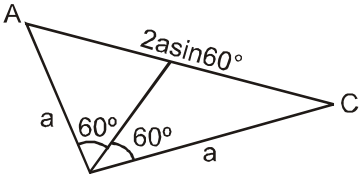
$\vec{v} = \frac{\text{विस्थापन}}{\text{समय}} = \frac{a}{a/v} = v$ (विकल्प D)

From A to C

$\vec{v} = \frac{2a\sin 60}{(2a/v)} = \frac{2a\frac{\sqrt{3}}{2}}{2a/v} = \frac{\sqrt{3}}{2}V$ (option C)

A से C

$\vec{v} = \frac{2a\sin 60}{(2a/v)} = \frac{2a\frac{\sqrt{3}}{2}}{2a/v} = \frac{\sqrt{3}}{2}V$ (विकल्प C)



From A to D

$\vec{v} = \frac{2a}{(3a/v)} = \frac{2v}{3}$

A से D

$\vec{v} = \frac{2a}{(3a/v)} = \frac{2v}{3}$

from A to F

A से F

A ——a—— F

$\vec{v} = \frac{a}{\left(\frac{5a}{v}\right)} = v/5$ (option विकल्प A)

25. Retardation
मंदन

$a = \frac{0.2g}{0.2+0.5} = \frac{2g}{7} = 2.8 \frac{m}{sec^2}$

In 5 sec. में

displacement विस्थापन $s = ut + \frac{1}{2}at^2 = 0$

In 2.5 sec. में

$s = ut + \frac{1}{2}at^2 = 8.75$ m

So total distance अतः कुल दूरी = 17.5 m

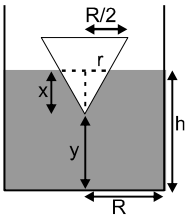
26. (B) AB > BC
(D) time from A to D is equal to D to C
A से D जाने में लगा समय D से C जाने में लगे समय के बराबर होगा

27. Let height of water level is h and depth of cone in water is x
r = x (since cone angle is 90°)

So total volume of water =
$V = V_{cylinder} - V_{cone}$

$V = \pi R^2 h - \frac{1}{3}\pi x^3$

Differentiating with respect to time



$0 = \pi R^2 \frac{dh}{dt} - \pi x^2 \frac{dx}{dt}$

$\frac{dh}{dt} = \frac{x^2}{R^2}\left(\frac{dx}{dt}\right)$ ...(i)

$x + y = h$

$\frac{dx}{dt} + \frac{dy}{dt} = \frac{dh}{dt}$

$\frac{dy}{dt} = -v$

$\Rightarrow \quad \frac{dx}{dt} = v + \frac{dh}{dt}$

...(ii)
Solving (i) and (ii) we get

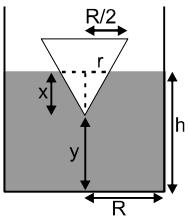
$\frac{dh}{dt} = \left(\frac{x^2}{(R^2 - x^2)}\right)v$

V = 30 cm/s

put $x = \frac{R}{4}$

Ans. $\frac{dh}{dt} = \frac{v}{15} = 2$ cm/s

माना पानी स्तर की ऊचाई h है तथा पानी में शंकु की गहराई x है।
r = x (चुंकि शीर्ष कोण 90° है।)



अतः पानी का कुल आयतन
$V = V_{cylinder} - V_{cone}$

$V = \pi R^2 h - \frac{1}{3}\pi x^3$

समय के सापेक्ष अवकलन करने पर

$0 = \pi R^2 \frac{dh}{dt} - \pi x^2 \frac{dx}{dt}$

$\frac{dh}{dt} = \frac{x^2}{R^2}\left(\frac{dx}{dt}\right)$ ...(i)

$x + y = h$

$\frac{dx}{dt} + \frac{dy}{dt} = \frac{dh}{dt}$

$\frac{dy}{dt} = -v$

$\Rightarrow \quad \frac{dx}{dt} = v + \frac{dh}{dt}$

...(ii)
(i) तथा (ii) को हल करने पर

$\frac{dh}{dt} = \left(\frac{x^2}{(R^2 - x^2)}\right)v$

V = 30 cm/s

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

Ans. $\frac{dh}{dt} = \frac{v}{15} = 2$ cm/s

28. At t = 2 sec. y component of velocity of A and B is zero and x-components are in opposite direction.
t = 2 सै. पर A तथा B के वेग के y घटक शून्य है एवं वेग के x घटक परस्पर विपरीत दिशा में होंगे।

29. $-\ell \sin 53^\circ = v_0 \cos 53^\circ t - \frac{1}{2} gt^2$

$-\frac{4\ell}{5} = \frac{3v_0}{5} t - 5t^2 - \frac{4}{5}(10)$

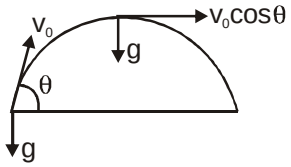
$= \frac{3}{5}(10)\, t - 5t^2$

$\Rightarrow \quad 5t^2 - 6t - 8 = 0$

$\Rightarrow \quad (5t + 4)(t - 2) = 0$

$\Rightarrow \quad t = 2$ second सैकण्ड

30. $R_1 = \frac{v_0^2}{g\cos\theta}$

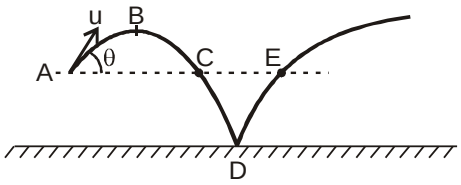


$R_2 = \frac{(v_0 \cos\theta)^2}{g}$

$\therefore \quad \frac{R_1}{R_2} = \frac{1}{(\cos\theta)^3} = 8$

31. Assume the wall to be absent. Let C and E be two points lying on trajectory at same horizontal level as point of projection.
Then the wall must be placed a distance d = $\frac{AE}{2}$ from A.
The maximum height of ball above ground at B is

$H = 15 + \frac{10^2}{2\times g} = 20$ m.



$\therefore$ Time taken to fall from B to C is

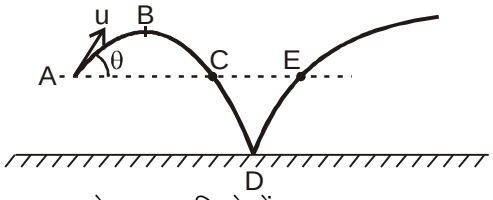
$5 = \frac{1}{2} gt^2$ or $t_1 = 1$ sec.

Time taken to fall from B to D is

$t_2 = \sqrt{\frac{2\times 20}{10}} = 2$ sec.

$\therefore$ Time taken by projectile to move from A to C = 4 sec.
Hence $2d = 4\cos\theta \times 4 = 40$ or d = 20 m **Ans.**
माना दीवार अनुपस्थित है। माना C व E एक ही क्षैतिज स्तर दो प्रक्षेप्य बिन्दु है।
तब दीवार दो प्रक्षेप्य बिन्दु है।
तब दीवार बिन्दु A से $d = \frac{AE}{2}$ दूरी पर रखी होगी
धरातल से गेंद की अधिकतम ऊँचाई पर बिन्दु B पर

$H = 15 + \frac{10^2}{2\times g} = 20$ m.



$\therefore$ B से C तक गिरने में लगा समय

$5 = \frac{1}{2} gt^2$ or $t_1 = 1$ sec.

B से D तक गिरने में लगा समय

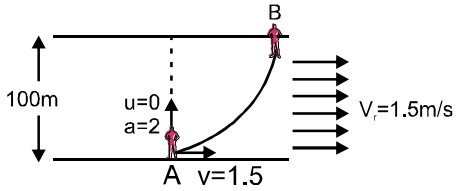
$t_2 = \sqrt{\frac{2\times 20}{10}} = 2$ sec.

$\therefore$ A से C तक गति करने में प्रक्षेप्य द्वारा गया समय = 4 secs.
अतः $2d = 4\cos\theta \times 4 = 40$
or d = 20 m **Ans.**

32. From A to B in y–direction,
y-दिशा में A से B के लिए,

$S_y = u_y t + \frac{1}{2} a_y y^2$

$100 = 0 + \frac{1}{2} (2) t^2$



t = 10 sec.
From A to B, in x–direction,
x-दिशा में A से B, के लिए,
$S_x = u_x t$
$S_x = (1.5) \times (10) = 15$ m.

33. (I - R), (II – Q)

34. (III – S), (IV – P)

35. (I – P), (II - S)

36. (II – S), (III – R)

PART-III: CHEMISTRY

37. $^{40}_{z}X^{2+}$

$n = e + \frac{23}{100} e$ & $n = 40 - z$

or $n = 40 - (e + 2)$

$40 - (e + 2) = e + \frac{23}{100} e$

$40 = \frac{123\ e}{100} + e + 2$

$40 - 2 = \frac{223\ e}{100}$

e = 17, Z = 19 or n = 21

38. Mole ratio = $\frac{3/48}{2/28} = 7 : 8$

मोल अनुपात = $\frac{3/48}{2/28} = 7 : 8$

39. (A) $\frac{V_1}{V_2} = \frac{A_1}{A_2} = \frac{2}{3}$.

(B) Helium ions are used in Rutherford is experiment.
हीलियम आयनों को रदरफोर्ड प्रयोग में प्रयुक्त करते है।

(C) Isobar has same mass number (i.e. number of nucleon)
समभारिक समान द्रव्यमान संख्या (अर्थात न्यूक्लिऑनों की संख्या) रखता है।

(D) PE = $\frac{K(+q_1)(-q_2)}{r} = -\frac{Kq_1q_2}{r}$

40. By using PV = nRT
moles of gas X = 3,
moles of gas Y = 1
moles of gas Z = 4.

(I) Mole % of gas Z = $\frac{\text{moles of Z}}{\text{Total mole}} \times 100 = \frac{4}{8} \times 100 = 50\%$

(II) 52.5 amu

(III) $\frac{n_x}{n_z} = \frac{3}{4}$

(IV) Molecules in mixture = 8 N_A

Atoms in 300 g Ca = $\frac{300}{40} \times N_A = 7.5\ N_A$.

Sol. PV = nRT प्रयुक्त करने पर

X गैस के मोल = 3,

Y गैस के मोल = 1

Z गैस के मोल = 4.

(I) Z गैस का मोल % = $\frac{\text{Z के मोल}}{\text{कुल मोल}} \times 100 = \frac{4}{8} \times 100 = 50\%$

(II) 52.5 amu

(III) $\frac{n_x}{n_z} = \frac{3}{4}$

(IV) मिश्रण में अणु = 8 N_A

300 g Ca में परमाणु = $\frac{300}{40} \times N_A = 7.5\ N_A$.

41. (A) $CH_3–CH_2–CH_3$

(B) $CH_3–CH_2–CH_2–CH_2–CH_3$;

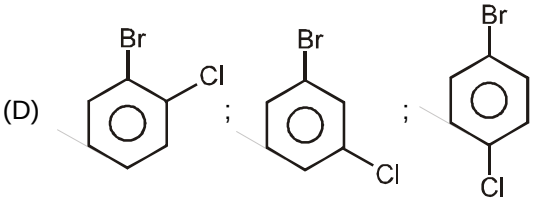
$CH_3–\underset{\underset{CH_3}{|}}{CH}–CH_2–CH_3$; $CH_3–\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}–CH_3$

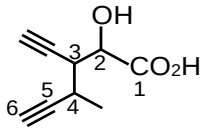
(C) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_3$;

$CH_3–\underset{\underset{CH_3}{|}}{CH}–CH_3–CH_2–CH_3$;

$CH_3–CH_2–\underset{\underset{CH_3}{|}}{CH}–CH_2–CH_3$; $CH_3–\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}–CH_2–CH_3$;

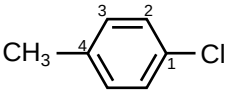
$CH_3–CH–\underset{\underset{CH_3}{|}}{CH}–CH_3$

(D) 

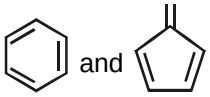
42. 

3-ethynyl-2-hydroxy-4-methylhex-3-en-5-ynoic acid

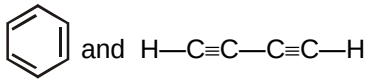
3-एथेनाइल-2-हाइड्रोक्सी-4-मिथाइलहेक्स-3-ईन-5-आइनोइक एसिड

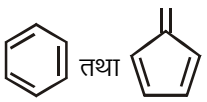
43. 

(C) 1-Chloro-4-methyl Benzene.
(C) 1-क्लोरो-4-मेथील बेंजीन
(B) 4-Chlorotoluene
(B) 4-क्लोरोटालुईन

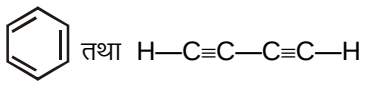
44. (A) 

(B) 

(D) 

(A)  तथा

(B)  तथा

(D) 

45. Time = 1 second LED 1 ; $\frac{\text{LED2}}{5 \times 1}$

Energy = X × 1 = XJ ; 5J

λ = 1000 nm ; λ = 400 nm

no. of photons = 2n; no. of photon = n

$\Rightarrow X = 2n \times \frac{hc}{1000}$; $5 = n \times \frac{hc}{400}$

$\Rightarrow X = \frac{2 \times 400 \times 5}{1000} = 4.$

हल. समय = 1 सैकण्ड LED 1 ; $\frac{LED2}{5\times1}$

ऊर्जा = X × 1 = XJ ; 5J

λ = 1000 nm ; λ = 400 nm

फोटॉनों की संख्या = 2n ; फोटॉनों की संख्या = n

$\Rightarrow X = 2n\times\frac{hc}{1000}$; $5 = n\times\frac{hc}{400}$

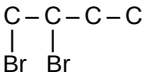
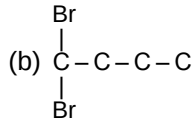
$\Rightarrow X = \frac{2\times400\times5}{1000} = 4.$

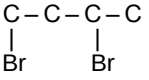
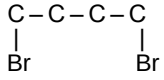
46. 04.00

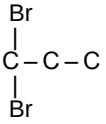
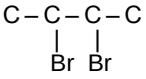
47. PV = nRT

$2.46 \times V_L = \left(\frac{1.5}{30}\right)\times0.0821\times300$

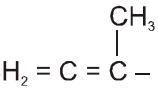
V_L = 0.5 L or 500 mL.

48. (a)  (b) 

(c)  (d) 

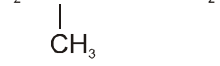
(e)  (f) 

49. (a) $CH_2=C=CH-CH_2-CH_3$

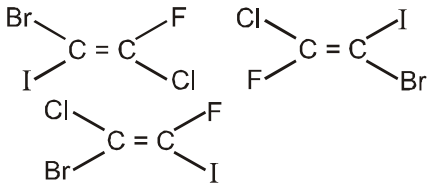
(b) 

(c) $CH_2=CH-CH=CH-CH_3$

(d) $CH_2=CH-CH-CH=CH_3$

(e) 

(f) $CH_3-CH=C=CH-CH_3$

50. 

51. (B) (III), (Q)

52. (A) Number of moles of gas X

$= \frac{\frac{4.052\times10^5}{1.013\times10^5}\times2.8}{0.082\times546} = 0.25$

(or 0.25 N_A molecules). So, number of gram molecules present in the gas sample is less than 1 and gas sample contains greater number of molecules than 10^{23}. Since the identity of gas is not revealed from the given data, each molecule of gas sample may or may not have mass less than 9×10^{-26} kg. Also, gas present in the sample could be O_2 gas.

(B) Number of moles of gas Y

$= \frac{\frac{22.8}{76}\times0.125\times1000}{0.082\times300} = 1.5$

(or 1.5 N_A molecules). So, number of gram molecules present in the gas sample is greater than 1 and gas sample contains greater number of molecules than 10^{23}. Mass of 1 mole of gas (GMM) = $\frac{24}{1.5}$ = 16 g. So, gas present in the sample could not be O_2 gas (GMM = 32 g). Mass of one molecule of gas = $16 \times 1.66 \times 10^{-24}$ g = 2.66×10^{-26} kg. So, each molecule of gas sample must have mass less than 9×10^{-26} kg.

(C) Number of moles of gas Z = $\frac{\frac{380}{760}\times\frac{2240}{1000}}{0.082\times136.5}$

= 0.1 (or 0.1 N_A molecules). So, number of gram molecules present in the gas sample is less than 1 and gas sample contains lesser number of molecules than 10^{23}. Since the identity of gas is not revealed from the given data, each molecule of gas sample may or may not have mass less than 9×10^{-26} kg. Also, gas present in the sample could be O_2 gas.

(D) Number of moles of gas W = $\frac{4.92\times\frac{500}{1000}}{0.082\times600}$

= 0.05 (or 0.05 N_A molecules). So, number of gram molecules present in the gas sample is less than 1 and gas sample contains lesser number of molecules than 10^{23}. Mass of 1 mole of gas (GMM) = $\frac{1.6}{0.05}$ = 32 g. So, gas present in the sample could be O_2 gas (GMM = 32 g). Mass of one molecule of gas = $32 \times 1.66 \times 10^{-24}$ g = 5.33×10^{-26} kg. So, each molecule of gas sample must have mass less than 9×10^{-26} kg.

हल. (A) गैस X के मोलों की संख्या

$= \frac{\frac{4.052\times10^5}{1.013\times10^5}\times2.8}{0.082\times546}$ = 0.25 (अथवा 0.25 N_A अणु)

अतः गैस प्रादर्श में उपस्थित ग्राम–अणुओं की संख्या 1

से कम है तथा गैस प्रादर्श, 10^{23} से अधिक अणुओं की संख्या रखता है। चूंकि दिये गये आंकड़ों से गैस की पहचान नहीं की जा सकती है अतः गैस प्रादर्श का प्रत्येक अणु 9×10^{-26} kg की तुलना में कम द्रव्यमान रख सकता है अथवा नहीं। साथ ही नमूने में उपस्थित गैस, O_2 हो सकती है।

(B) गैस Y के मोलों की संख्या

$= \frac{\frac{22.8}{76} \times 0.125 \times 1000}{0.082 \times 300} = 1.5$ (अथवा 1.5 N_A अणु)

अतः गैस प्रादर्श में उपस्थित ग्राम–अणुओं की संख्या 1 से अधिक है तथा गैस प्रादर्श, 10^{23} से अधिक अणुओं की संख्या रखता है। गैस के 1 मोल का द्रव्यमान (GMM) = $\frac{24}{1.5}$ = 16 g अतः, प्रादर्श में उपस्थित गैस, O_2 गैस नहीं हो सकती (GMM = 32 g) गैस के एक अणु का द्रव्यमान = $16 \times 1.66 \times 10^{-24}$ g = 2.66×10^{-26} kg अतः, गैस प्रादर्श का प्रत्येक अणु 9×10^{-26} kg की तुलना में कम द्रव्यमान रख सकता है।

(C) गैस Z के मोलों की संख्या = $\frac{\frac{380}{760} \times \frac{2240}{1000}}{0.082 \times 136.5}$

= 0.1 (अथवा 0.1 N_A अणु) अतः गैस प्रादर्श में उपस्थित ग्राम–अणुओं की संख्या 1 से कम है तथा गैस प्रादर्श 10^{23} से कम अणुओं की संख्या रखता है। चूंकि दिये गये आंकड़ों से गैस की पहचान नहीं की जा सकती है, गैस प्रादर्श का प्रत्येक अणु 9×10^{-26} kg की तुलना में कम द्रव्यमान रख सकता है अथवा नहीं साथ ही नमूने में उपस्थित गैस O_2 हो सकती है।

(D) गैस W की मोलों की संख्या = $\frac{4.92 \times \frac{500}{1000}}{0.082 \times 600}$

= 0.05 (अथवा 0.05 N_A अणु) अतः गैस प्रादर्श में उपस्थित ग्राम–अणुओं की संख्या 1 से कम है तथा गैस प्रादर्श 10^{23} से कम अणुओं की संख्या रखता है। गैस के 1 मोल का द्रव्यमान (GMM) = $\frac{1.6}{0.05}$ = 32 g अतः, प्रादर्श में उपस्थित गैस O_2 गैस हो सकती है (GMM = 32 g), गैस के एक अणु का द्रव्यमान = $32 \times 1.66 \times 10^{-24}$ g = 5.33×10^{-26} kg गैस प्रादर्श का प्रत्येक अणु, 9×10^{-26} kg की तुलना में कम द्रव्यमान रखता है।

53. (C) (III), (R)

54. I and II both have same positions for groups these are identical.
I and II have different sizes of side chains these are chain isomers.
I and II are 2º and 3º isomeric amines these are functional isomers.
I and II are esters with different group on two sides, these are metamers.

Sol. I तथा II दोनों में समूह समान स्थिति पर है, इसलिए समरूप है।

I तथा II दोनों में पार्श्व श्रृखंला की लम्बाई भिन्न–भिन्न है इसलिए ये श्रृंखला समावयवी है।

I तथा II क्रमशः 2º तथा 3º क्रियात्मक समावयवी एमीन है।

I तथा II में एस्टर के दोनों ओर विभिन्न एल्किल समूह उपस्थित है इसलिए यह मध्यावयवी है।

---- TEXT SOLUTIONS (TS) END ----

Resonance®
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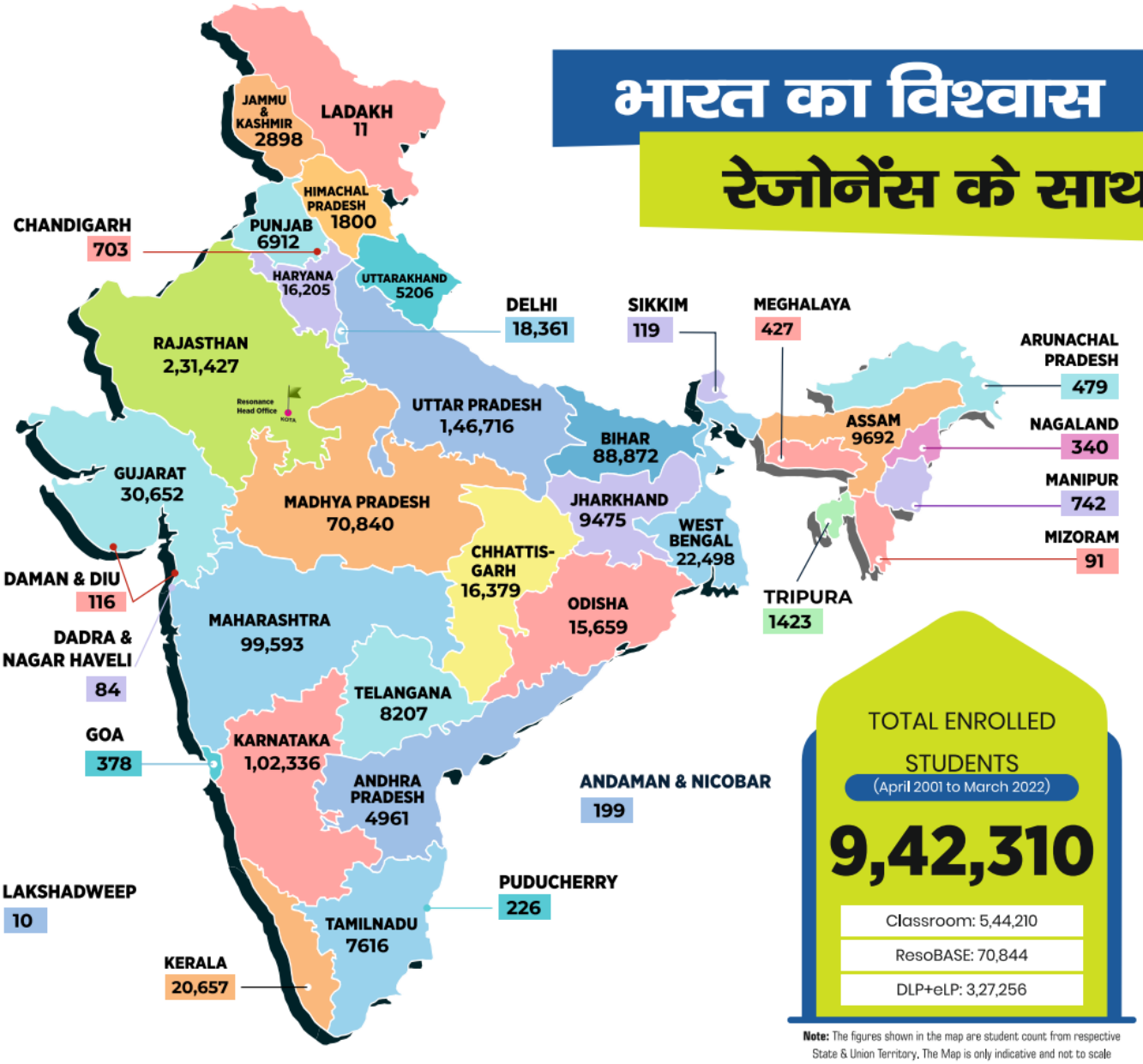
रेजोनेंस के साथ



TOTAL ENROLLED STUDENTS
(April 2001 to March 2022)

9,42,310

- Classroom: 5,44,210
- ResoBASE: 70,844
- DLP+eLP: 3,27,256

Note: The figures shown in the map are student count from respective State & Union Territory. The Map is only indicative and not to scale

Resonance : The Legacy of 21 Years (2001-2022) of Academic Excellence

- **JEE (Adv.) / IIT-JEE** ▸ **50 हजार +** SELECTIONS SINCE 2002
  229 AIRs in TOP-100 (Classroom + DLP)
- **JEE (Main) / AIEEE** ▸ **2.40 लाख+** SELECTIONS SINCE 2009
  136 AIRs in TOP-100 (Classroom + DLP)
- **NEET (UG) / AIPMT** ▸ **19 हजार+** SELECTIONS SINCE 2012
  19 AIRs in TOP-100 (Classroom + DLP)

- **NTSE** SINCE 2006 ▸ **2440** Scholars
- **KVPY** SINCE 2006 ▸ **2859** Fellowship Winners
- **OLYMPIADS** SINCE 2006 ▸ **52** Medalists (Gold/Silver/ Bronze) in International Olympiads
- **CA & CS** SINCE 2013 ▸ **4179** Selections — 5 Times AIR-1 in CA & CS Exams
- **CLAT, SET & GPTU** SINCE 2014 ▸ **77** Selections — AIR-1 in GPTU