Resonance®
Educating for better tomorrow

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)	01JA	TOTAL PAGES	1	BATCH CODE(S)	01JA

Target Examination & Year:

JEE (MAIN+ADVANCED) 2025

TEST PATTERN	TEST TYPE	TEST CODE & SEQUENCE
JEE (ADVANCED)	PART TEST (PT)	APT 03

DATE & DAY:
19th November 2023 | Sunday

Duration & Time:
Paper-1 : 3 Hrs | 10:00 AM to 01:00 PM
Paper-2 : 3 Hrs | 02:00 PM to 05:00 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) ☐

Scan QR Code for Video Solutions → Coming Soon

Resonance Eduventures Ltd.
Kota Study Centre & Registered Corporate Office:
CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Tel. No.: 0744-2777777, 2777700 | www.resonance.ac.in | CIN: U80302RJ2007PLC024029

Resonance®
Educating for better tomorrow

Academic Session: 2023-24

PAT : TOPIC-WISE WEIGHTAGE SHEET (WS)

	P-1	P-2	Total		P-1	P-2	Total
Total Qs	54	54	108	Subject wise Qs.	18	18	36
Max. Marks	186	186	372	Subject wise Marks	62	62	124

PAPER1-MATHEMATICS								
S.No.	Topic Name	Question Type & Sequencing				Total Qs. (Topic-wise)	Total Marks (Topic-wise)	% Weightage (Topic-wise)
		MSQ		CBQ				
		No. of Qs.	Qs. Sequencing	No. of Qs.	Qs. Sequencing			
	Class-11	**14**		**4**		**18**	**68**	**100.00%**
1	Trigonometry	3	1,11,12	_	_	3	12	17.65%
2	Binomial Theorem	6	2,3,4,5,9,14	2	17,18	8	30	44.12%
3	Basics	4	6,7,8,10	2	15,16	6	22	32.35%
4	Sequence and Series	1	13	_	_	1	4	5.88%
	Total	**14**		**4**		**18**	**68**	**100%**

Resonance®
Educating for better tomorrow

Academic Session: 2023-24

PAT : TOPIC-WISE WEIGHTAGE SHEET (WS)

PAPER1-PHYSICS								
S.No.	Topic Name	Question Type & Sequencing				Total Qs. (Topic-wise)	Total Marks (Topic-wise)	% Weightage (Topic-wise)
		MSQ		CBQ				
		No. of Qs.	Qs. Sequencing	No. of Qs.	Qs. Sequencing			
	Class-11	**14**		**4**		**18**	**68**	**100.00%**
1	Newton's laws of Motion	1	19	_	_	1	4	5.88%
2	Friction	5	20,24,25,27,32	2	35,36	7	26	38.24%
3	Circular Motion	4	21,22,28,31	_	_	4	16	23.53%
4	Work, Power & Energy	4	23,26,29,30	2	33,34	6	22	32.35%
	Total	**14**		**4**		**18**	**68**	**100%**

Resonance®
Educating for better tomorrow

Academic Session: 2023-24

PAT : TOPIC-WISE WEIGHTAGE SHEET (WS)

PAPER1-CHEMISTRY								
S.No.	Topic Name	Question Type & Sequencing				Total Qs. (Topic-wise)	Total Marks (Topic-wise)	% Weightage (Topic-wise)
		MSQ		CBQ				
		No. of Qs.	Qs. Sequencing	No. of Qs.	Qs. Sequencing			
Physical Chemistry								
	Class-11	**7**		**2**		**9**	**34**	**50.00%**
1	Gaseous State	4	37,39,40,42	_	_	4	16	23.53%
2	Mole concept	3	38,41,43	2	51,52	5	18	26.47%
Inorganic Chemistry								
	Class-11	**7**		**2**		**9**	**34**	**50.00%**
3	Chemical Bonding	4	44,46,47,48	2	53,54	6	22	32.35%
4	Periodic Table Periodicity	3	45,49,50	_	_	3	12	17.65%
	Total	**14**		**4**		**18**	**68**	**100%**

Resonance®
Educating for better tomorrow

Academic Session: 2023-24

PAT : TOPIC-WISE WEIGHTAGE SHEET (WS)

PAPER2-MATHEMATICS								
S.No.	Topic Name	Question Type & Sequencing				Total Qs. (Topic-wise)	Total Marks (Topic-wise)	% Weightage (Topic-wise)
		MSQ		NVQ				
		No. of Qs.	Qs. Sequencing	No. of Qs.	Qs. Sequencing			
	Class-11	**10**		**8**		**18**	**64**	**100.00%**
1	Binomial Theorem	4	1,2,3,5	3	12,13,18	7	25	39.06%
2	Sequence and Series	3	4,9,10	1	17	4	15	23.44%
3	Basics	2	6,7	2	14,16	4	14	21.88%
4	Trigonometry	1	8	2	11,15	3	10	15.62%
	Total	**10**		**8**		**18**	**64**	**100%**

Resonance®
Educating for better tomorrow

Academic Session: 2023-24

PAT : TOPIC-WISE WEIGHTAGE SHEET (WS)

PAPER2-PHYSICS								
S.No.	Topic Name	Question Type & Sequencing				Total Qs. (Topic-wise)	Total Marks (Topic-wise)	% Weightage (Topic-wise)
		MSQ		NVQ				
		No. of Qs.	Qs. Sequencing	No. of Qs.	Qs. Sequencing			
	Class-11	**10**		**8**		**18**	**64**	**100.00%**
1	Friction	3	19,21,27	3	30,33,35	6	21	32.81%
2	Work, Power & Energy	4	20,23,25,26	2	31,36	6	22	34.38%
3	Circular Motion	2	22,24	3	29,32,34	5	17	26.56%
4	Newton's laws of Motion	1	28	_	_	1	4	6.25%
	Total	**10**		**8**		**18**	**64**	**100%**

PAT : TOPIC-WISE WEIGHTAGE SHEET (WS)

PAPER2-CHEMISTRY								
S.No.	Topic Name	Question Type & Sequencing				Total Qs. (Topic-wise)	Total Marks (Topic-wise)	% Weightage (Topic-wise)
		MSQ		NVQ				
		No. of Qs.	Qs. Sequencing	No. of Qs.	Qs. Sequencing			
Physical Chemistry								
	Class-11	**5**		**4**		**9**	**32**	**50.00%**
1	Mole concept	2	37,39	_	_	2	8	12.50%
2	Gaseous State	3	38,40,41	4	47,48,49,50	7	24	37.50%
Inorganic Chemistry								
	Class-11	**5**		**4**		**9**	**32**	**50.00%**
3	Periodic Table Periodicity	3	42,44,45	1	52	4	15	23.44%
4	Chemical Bonding	2	43,46	3	51,53,54	5	17	26.56%
	Total	**10**		**8**		**18**	**64**	**100%**

ANSWER KEY (AK)

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

PAPER-2											
PART-I : MATHEMATICS	Q.No.	1	2	3	4	5	6	7	8	9	10
	Ans.	AD	ABC	AB	ABCD	ABCD	BD	ABD	BC	ABD	ABC
	Q.No.	11	12	13	14	15	16	17	18		
	Ans.	00.00	11.00	28.00	02.00	05.00	12.50	25.00	03.00		
PART-II : PHYSICS	Q.No.	19	20	21	22	23	24	25	26	27	28
	Ans.	AD	BC	A	ABC	ABCD	BD	BCD	AC	AC	BD
	Q.No.	29	30	31	32	33	34	35	36		
	Ans.	30.00	25.00	07.00	02.00	08.00	06.00	04.00	80.00		
PART-III : CHEMISTRY	Q.No.	37	38	39	40	41	42	43	44	45	46
	Ans.	AD	BCD	ACD	ABD	AD	CD	AC	ABCD	AD	ABC
	Q.No.	47	48	49	50	51	52	53	54		
	Ans.	44.00	07.00	05.00	96.00	13.00	19.00	16.00	04.00		

STUDENT'S SPACE

PAPER-1

PART-I: MATHEMATICS

1. $x^2 - 2x + 4 = -3\cos(ax + b)$

Minimum value of

$x^2 - 2x + 4$ is $-\frac{D}{4a} = 3$

which occur at x = 1

Range of RHS part is [–3, 3] so this is boundary problem.

cos(ax + b) must be –1 for solution to exist.

cos(ax + b) = – 1

ax + b = π, 3π,.....

$\because$ x = 1, a + b = π, 3π, ...

हल: $x^2 - 2x + 4 = -3\cos(ax + b)$

$x^2 - 2x + 4$ का न्यूनतम मान $-\frac{D}{4a} = 3$ है।

जो कि x = 1 पर आता है।

RHS का परिसर [–3, 3] है इसलिए यह परिबद्ध समस्या है।

cos(ax + b) अवश्य –1 होगा जबकि

cos(ax + b) = – 1

ax + b = π, 3π,.....

$\because$ x = 1, a + b = π, 3π, ...

2. $\ell = {}^{33}C_1 + {}^{33}C_2 + ... + {}^{33}C_{33} = 2^{33} - 1$

$m = {}^{66}C_0 + {}^{66}C_4 + ... + {}^{66}C_{66} = 2^{66-1} = 2^{65}$

$n = {}^{99}C_0 + {}^{99}C_1 + ... + {}^{99}C_{49} = 2^{98}$

3. $\left(x^3 + 3\cdot 2^{-\log_{\sqrt{2}}\sqrt{x^3}}\right)^{11} = \left(x^3 + 3\cdot 2^{\log_2 (x^3)^{-1}}\right)^{11} = \left(x^3 + \frac{3}{x^3}\right)^{11}$

general term =

$${}^{11}C_r \left(x^3\right)^{11-r}\left(\frac{3}{x^3}\right)^r = {}^{11}C_r \cdot 3^r \cdot x^{33-6r}$$

Now, $33 - 6r = 2 \Rightarrow r = \frac{31}{6} \Rightarrow$ No term appear with power x^2

33 + 3 $\Rightarrow$ r = 6

$\Rightarrow$ term appear with power of x^{-3}

For x^3, r = 5 and for $x^{-3=,\ r=6}$

$\Rightarrow$ ratio of coefficient of x^3 to that of

$$x^{-3} = \frac{{}^{11}C_5 \cdot 3^5}{{}^{11}C_6 \cdot 3^6} = \frac{1}{3}$$

हल. $\left(x^3 + 3\cdot 2^{-\log_{\sqrt{2}}\sqrt{x^3}}\right)^{11} = \left(x^3 + 3\cdot 2^{\log_2 (x^3)^{-1}}\right)^{11} = \left(x^3 + \frac{3}{x^3}\right)^{11}$

व्यापक पद =

$${}^{11}C_r \left(x^3\right)^{11-r}\left(\frac{3}{x^3}\right)^r = {}^{11}C_r \cdot 3^r \cdot x^{33-6r}$$

अब, $33 - 6r = 2 \Rightarrow r = \frac{31}{6} \Rightarrow$ x^2 का कोई पद नही आता है।

33 + 3 $\Rightarrow$ r = 6 $\Rightarrow$ x^{-3} का कोई पद नही आता है।

x^3, r = 5 और $x^{-3=,\ r=6}$

$\Rightarrow$ x^3 का कोई पद नही आता है

$$x^{-3} = \frac{{}^{11}C_5 \cdot 3^5}{{}^{11}C_6 \cdot 3^6} = \frac{1}{3}$$

4. $(101)^{100} - 1 = (100 + 1)^{100} - 1 = {}^{100}C_0(100)^{100} + {}^{100}C_1(100)^{99} + ... + {}^{100}C_{99}\,100 + {}^{100}C_{100} - 1 = {}^{100}C_0(100)^{100} + {}^{100}C_1(100)^{99} + ... + (100)(100)$

last term contain 10^4 and other terms contain power of 10 more than 4.

$\Rightarrow$ it is divisible by 100, 1000 and 10000.

हल. $(101)^{100} - 1 = (100 + 1)^{100} - 1 = {}^{100}C_0(100)^{100} + {}^{100}C_1(100)^{99} + ... + {}^{100}C_{99}\,100 + {}^{100}C_{100} - 1 = {}^{100}C_0(100)^{100} + {}^{100}C_1(100)^{99} + ... + (100)(100)$

अन्तिम पद 10^4 रखता है तथा 10 की अधिक घात के पद 4 से अधिक है।

$\Rightarrow$ यह 100, 1000 और 10000 से विभाजित है।

5. $2.\ {}^nC_5 = {}^nC_4 + {}^nC_6$

$$2.\frac{n!}{5!(n-5)!} = \frac{n!}{4!(n-4)!} + \frac{n!}{6!(n-6)!}$$

$$\frac{2}{5.(n-5)} = \frac{1}{(n-4)(n-5)} + \frac{1}{6\times 5}$$

$$\frac{2}{5.(n-5)} - \frac{1}{30} = \frac{1}{(n-4)(n-5)}$$

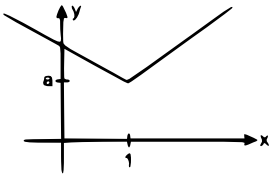
$$\Rightarrow \quad \frac{12-(n-5)}{30(n-5)} = \frac{1}{(n-4)(n-5)}$$

$\Rightarrow$ (17– n)(n – 4) = 30

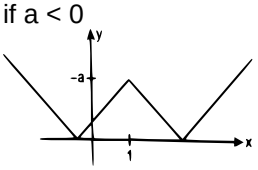
n = 7, 14

6. ||x - 1| + a| = 4

if a > 0



if a < 0



(a) if eq. has three distinct real root then a < 0 and a = -4

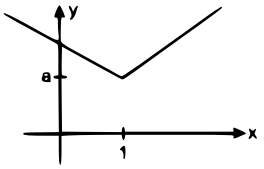
(b) 4 distinct roots for $\alpha \in (-\infty, -4)$

(c) if - 4 < α < 4, there are two distinct real roots

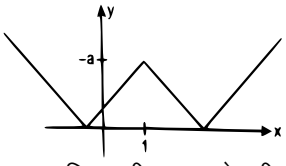
(d) if $\alpha > 4$, no real root

हल. ||x - 1| + a| = 4

यदि a > 0



यदि a < 0



(a) यदि समीकरण के तीन भिन्न-भिन्न वास्तविक मूल है तब a < 0 तथा a = –4

(b) चार भिन्न-भिन्न मूलों के लिए $\alpha \in (-\infty, -4)$

(c) यदि –4 < α < 4 दो भिन्न भिन्न वास्तविक मूल है।

(d) यदि $\alpha > 4$ को वास्तविक मूल नहीं

7. Let माना $\log_2 x = t$

$\Rightarrow t + \frac{1}{t} = 4$

$\Rightarrow t^2 - 4t + 1 = 0$

$\Rightarrow t = \frac{4 \pm \sqrt{16-4}}{2}$

$\Rightarrow t = 2 \pm \sqrt{3}$

$\therefore \log_2 x = 2 \pm \sqrt{3}$ or या $2 - \sqrt{3}$

$\because \tan\frac{\pi}{12} = \cot\frac{5\pi}{12} = 2 - \sqrt{3}$

$\tan \frac{5\pi}{12} = \cot \frac{\pi}{12} = 2 + \sqrt{3}$

8. |4 –|x – 2| | = 3

$\Rightarrow$|x – 2| = 7 or 1$\Rightarrow$ x = 9, – 5, 3, 1

P = 8, Q = – 135

$\therefore$|P| + |Q| = 143

9. $\sum_{r=0}^{n}(r+1)\,{}^nC_r(-3/2)^r = n\sum_{r=0}^{n}{}^{n-1}C_{r-1}(-3/2)^r + \sum_{r=0}^{n}{}^nC_r(-3/2)^r =$

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

$= \frac{1}{(-2)^n}(3n+1)$

10. For domain प्रान्त के लिए $21 - 4x - x^2 \geq 0$

$\Rightarrow x^2 + 4x - 21 \leq 0 \Rightarrow (x + 7)(x - 3) \leq 0$

$\Rightarrow \quad x \in [-7, 3]$

case-I : (स्थिति I) **:** –7 $\leq$ x < –2 then

तब $1 - \sqrt{21 - 4x - x^2} \leq 0$

$\Rightarrow \quad 1 \leq \sqrt{21 - 4x - x^2}$

$\Rightarrow \quad x^2 + 4x - 20 \leq 0 \Rightarrow (x + 2)^2 - 24 \leq 0$

$\Rightarrow \quad (x + 2 + 2\sqrt{6})(x + 2 - 2\sqrt{6}) \leq 0$

$\Rightarrow \quad x \in [-2 - 2\sqrt{6}, 2\sqrt{6} - 2]$

$\therefore \quad x \in [-2 - 2\sqrt{6}, -2)$

case-II : (स्थिति II) **:** –2 < x $\leq$ 3 then

तब $1 \geq 21 - 4x - x^2$

$\Rightarrow \quad x^2 + 4x - 20 \geq 0$

$\Rightarrow x \in (-\infty, -2 - 2\sqrt{6}] \cup [2\sqrt{6} - 2, \infty)$

$\therefore \quad x \in \left[2\sqrt{6} - 2, \ 3\right]$

$x \in \left[-2 - 2\sqrt{6}, -2\right] \cup \left[2\sqrt{6} - 2, 3\right]$

11. As $\tan(2\pi - \theta) > 0$, $-1 < \sin\theta < -\frac{\sqrt{3}}{2}$,

$\theta \in [0, 2\pi] \quad \Rightarrow \ \frac{3\pi}{2} < \theta < \frac{5\pi}{3}$

Now $2\cos\theta(1 - \sin\phi) = \sin^2\theta(\tan\theta/2 + \cot\theta/2)\cos\phi - 1$

$\Rightarrow 2\cos\theta(1 - \sin\phi) = 2\sin\theta\cos\phi - 1$

$\Rightarrow 2\cos\theta + 1 = 2\sin(\theta + \phi)$

As $\theta \in \left(\frac{3\pi}{2}, \frac{5\pi}{3}\right) \Rightarrow 2\cos\theta + 1 \in (1, 2)$

$\Rightarrow 1 < 2\sin(\theta + \phi) < 2 \quad \Rightarrow \ < \sin(\theta + \phi) < 1$

As $\theta + \phi \in [0, 4\pi] \quad \Rightarrow \theta + \phi \in \left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$

or $\theta + \phi \in \left(\frac{13\pi}{6}, \frac{17\pi}{6}\right)$

$\Rightarrow \frac{\pi}{6} - \theta < \phi < \frac{5\pi}{6} - \theta$ or

$\frac{13\pi}{6} - \theta < \phi < \frac{17\pi}{6} - \theta$

$\Rightarrow \phi \in \left(-\frac{3\pi}{2}, \frac{-2\pi}{3}\right) \cup \left(\frac{2\pi}{3}, \frac{7\pi}{6}\right)$

हल. चूंकि $\tan(2\pi - \theta) > 0$, $-1 < \sin\theta < -\frac{\sqrt{3}}{2}$,

$\theta \in [0, 2\pi] \quad \Rightarrow \ \frac{3\pi}{2} < \theta < \frac{5\pi}{3}$

अब $2\cos\theta(1 - \sin\phi) = \sin^2\theta(\tan\theta/2 + \cot\theta/2)\cos\phi - 1$

$\Rightarrow 2\cos\theta(1 - \sin\phi) = 2\sin\theta\cos\phi - 1$

$\Rightarrow 2\cos\theta + 1 = 2\sin(\theta + \phi)$

चूंकि $\theta \in \left(\frac{3\pi}{2}, \frac{5\pi}{3}\right) \Rightarrow 2\cos\theta + 1 \in (1, 2)$

$\Rightarrow 1 < 2\sin(\theta + \phi) < 2$

$\Rightarrow \ < \sin(\theta + \phi) < 1$

चूंकि $\theta + \phi \in [0, 4\pi]$

$\Rightarrow \theta + \phi \in \left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$ या $\theta + \phi \in \left(\frac{13\pi}{6}, \frac{17\pi}{6}\right)$

$\Rightarrow \frac{\pi}{6} - \theta < \phi < \frac{5\pi}{6} - \theta$ या

$\frac{13\pi}{6} - \theta < \phi < \frac{17\pi}{6} - \theta$

$\Rightarrow \phi \in \left(-\frac{3\pi}{2}, \frac{-2\pi}{3}\right) \cup \left(\frac{2\pi}{3}, \frac{7\pi}{6}\right)$

$\therefore$ [सही विकल्प (A, C, D) है।]

12. $P_n - P_{n-2} = \cos^n\theta + \sin^n\theta - \cos^{n-2}\theta - \sin^{n-2}\theta$
$= \cos^{n-2}\theta(\cos^2\theta - 1) + \sin^{n-2}\theta(\sin^2\theta - 1)$
$= \cos^{n-2}\theta(-\sin^2\theta) + \sin^{n-2}\theta(-\cos^2\theta)$
$= (-\sin^2\theta\cos^2\theta)\{\cos^{n-4}\theta + \sin^{n-4}\theta\}$
$= (-\sin^2\theta\cos^2\theta) P_{n-4}$
put n = 4 (रखने पर)
$\Rightarrow P_4 - P_2 = (-\sin^2\theta\cos^2\theta) P_0$
$\Rightarrow P_4 = P_2 - 2\sin^2\theta\cos^2\theta$
$= 1 - 2\sin^2\theta\cos^2\theta$
similarly we can prove the other result also.
(इसी प्रकार हम दुसरे परिणाम सिद्ध कर सकते है।)

13. (A) $\frac{a}{b} + \frac{b}{c} \geq 2\sqrt{\frac{a}{c}}$

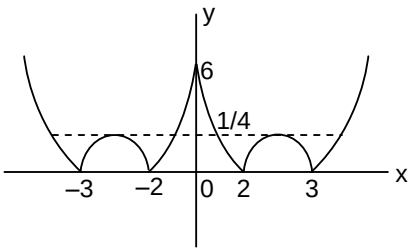
$\Rightarrow \frac{c}{d} + \frac{d}{e} \geq 2\sqrt{\frac{c}{e}}$

(B) multiply both these दोनों को गुणा करने पर $\left(\frac{a}{b}+\frac{b}{c}\right)\left(\frac{c}{d}+\frac{d}{e}\right) \geq 4\sqrt{\frac{a}{c}.\frac{c}{e}} \geq 4\sqrt{\frac{a}{e}}$

(D) $\frac{bc}{a} + \frac{ca}{b} \geq 2\left(\frac{bc}{a}.\frac{ca}{b}\right)^{1/2} = 2c$

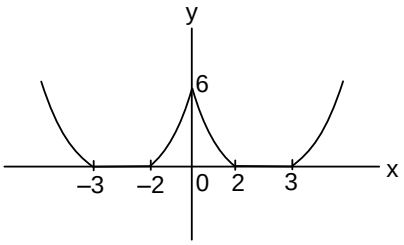
14. $x^2 + 19x - x! = 0$
$\Rightarrow x(x + 19 - (x-1)!) = 0$
$\Rightarrow x = 0$ or $x + 19 = (x - 1)!$
but x = 0 not satisfies the given equation so
$x + 19 = (x - 1)!$
$\Rightarrow (x-1)! - (x-1) = 20$
clearly $(x-1)! \geq 20 \Rightarrow x - 1 \geq 4$
when $(x - 1) = 4 \Rightarrow 4! - 4 = 20$ which is true
So x = 5
when $x - 1 = 5 \Rightarrow 5! - 5 = 115 \neq 20$

15.



h(x) = |f(|x|)|
$\therefore x \in \left(0, \frac{1}{4}\right)$

16. g(x) + |g(x)| is



$\Rightarrow x \in [-3, -2] \cup [2, 3]$

Sol. (17 – 18)
(i) we have यहाँ

$$(1 + x + x^2)^n = \sum_{r=0}^{2n} a_r x^r \quad \ldots(A)$$

$$\therefore \quad \left(1 + \frac{1}{x} + \frac{1}{x^2}\right)^n = \sum_{r=0}^{2n} a_r \left(\frac{1}{x}\right)^r$$

$$\Rightarrow (x^2 + x + 1)^n = \sum_{r=0}^{2n} a_r x^{2n-r}$$

$$\Rightarrow \sum_{r=0}^{2n} a_r x^r = \sum_{r=0}^{2n} a_r x^{2n-r} \quad \text{[using (A) से]}$$

Equating the coefficient of x^{2n-r} on both sides, we get
x^{2n-r} के गुणांक की दोनों तरफ तुलना करने पर

$$a_{2n-r} = a_r \text{ for } 0 \leq r \leq 2n$$

Hence अतः $a_r = a_{2n-r}$
(ii) Putting x = 1 in given series, then
दी गई श्रेणी में x = 1 रखने पर तब

$a_0 + a_1 + a_2 + a_3 + \ldots + a_{2n} = (1 + 1 + 1)^n$
$a_0 + a_1 + a_2 + a_3 + \ldots + a_{2n} = 3^n \quad \ldots(1)$

But परन्तु $a_r = a_{2n-r}$ for $0 \leq r \leq 2n$ के लिए

$a_0 = a_{2n}$
$a_1 = a_{2n-1}$
$a_2 = a_{2n-2}$
…….
$a_n = a_n$
……
$a_{2n} = a_0$

then series (1) reduces to,
तब श्रेणी (1) से

$2(a_0 + a_1 + a_2 + \ldots + a_{n-1}) + a_n = 3^n$

$\therefore a_0 + a_1 + a_2 + \ldots + a_{n-1} = \frac{1}{2}(3^n - a_n)$

PART-II: PHYSICS

19. For m_2, $a_2 = \frac{kx}{m_2}$

For m_1, $a_1 = \frac{F - kx}{m_1}$

For $(m_1 + m_2)$, $F = m_1a_1 + m_2a_2$

At natural length $a_2 = 0$, $a_1 = \frac{F}{m_1}$.

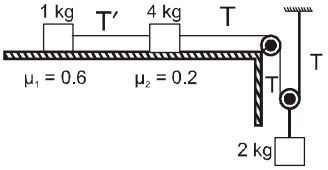
m_2 के लिए, $a_2 = \frac{kx}{m_2}$

m_1 के लिए, $a_1 = \frac{F - kx}{m_1}$

$(m_1 + m_2)$ के लिए, $F = m_1a_1 + m_2a_2$

प्राकृत लम्बाई पर $a_2 = 0$, $a_1 = \frac{F}{m_1}$.

20.



f_{man} =0.6 × g + 0.2 × 4g
= 6 + 8 = 14 N
& 2T = 2g = 20
T = 10 N
So system will be in equilibrium. Now fricition on 4 kg
अतः निकाय साम्यावस्था में होगा अब 4 kg पर घर्षण
f = 0.2 × 4 × 10
= 8 N
friction on 1kg (1kg पर घर्षण) = T′ = T – 8 = 2 kg

21. For normal reaction at points A and B.
बिन्दुओं A तथा B पर अभिलम्ब प्रतिक्रिया बल के लिए

$mg - N = \frac{mv^2}{r}$

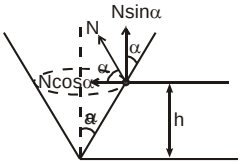
$N = mg - \frac{mv^2}{r}$

$\Rightarrow$ $N_A > N_B$ and normal reaction at C is $N_C = mg$, so $N_C > N_A > N_B$ **Ans.**

$\Rightarrow$ $N_A > N_B$ तथा बिन्दु C पर अभिलम्ब प्रतिक्रिया बल $N_C = mg$, अतः $N_C > N_A > N_B$ **Ans.**

22. As N sin α = mg
N cos $\alpha = m\omega^2 r$

$\tan\alpha = \frac{g}{\omega^2 r}$ $\quad \therefore T^2 \propto \tan\alpha$



$\therefore$ when α increases T also increases
$\therefore$ जब α बढ़ेगा तो T भी बढ़ेगा।
Also $T^2 \propto r \tan\alpha$
but परन्तु $r = h \tan\alpha$
$\therefore T^2 \propto h \tan^2\alpha$
for constant α
नियत α के लिए
$T^2 \propto h$
Thus when h increases T also increases
अतः जब h बढ़ेगा T भी बढ़ेगा।

23. $a_n = kt^2$

$\frac{v^2}{R} = kt^2$

$v = \sqrt{kR}\, t$

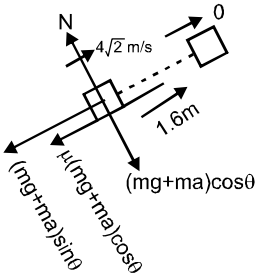
$a_t = \frac{dv}{dt} = \sqrt{kR}$ constant नियतांक

$\tan\phi = \frac{a_t}{a_n} \propto \frac{1}{t^2}$

$p = F_t v$
$\propto t$
$\langle p \rangle \propto t$.

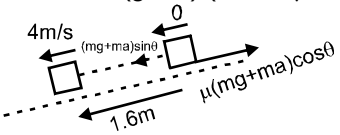
24. as explain in theory

25.



$0 = (4\sqrt{2})^2 - 2(g + a)(\sin\theta + \mu\cos\theta) \times 1.6$

$4^2 = 0^2 + 2(g + a)(\sin\theta - \mu\cos\theta) \times 1.6$



Solving, हल करने पर $a = 2.5\ m/s^2$
$\mu = 0.25$.

26. If the springs are compressed to same amount :
यदि स्प्रिंगों को समान मात्रा में संपीडित किया जाता है

$W_A = \frac{1}{2} K_A x^2$; $W_B = \frac{1}{2} K_B x^2$

$\because K_A > K_B \Rightarrow W_A > W_B$

If the springs are compressed by same force.

यदि स्प्रिंगों को समान बल द्वारा संपीडित किया जाता है।

$F = K_A x_A = K_B x_B$; $x_A = \frac{F}{K_A}$; $x_B = \frac{F}{K_B}$;

$$\frac{W_A}{W_B} = \frac{\frac{1}{2}K_A \cdot \frac{F^2}{K_A^2}}{\frac{1}{2}K_B \frac{F^2}{K_B^2}} = \frac{K_B}{K_A}$$

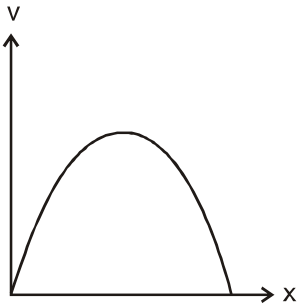
Hence इसलिये, $W_A < W_B$

27. $a = g(\sin\theta - kx\cos\theta)$

θ = constt. नियतांक

$a = v\frac{dv}{dx}$

$v = g(\sin\theta.x - \frac{kx^2}{2}\cos\theta)$



Hence required graph will be as

इसलिए आवश्यक ग्राफ निम्न प्रकार होगा।

28. (A) $\alpha = 4t$

$a \neq 0$ ∴ Non uniform circular motion असमान वृत्तीय गति

(B) $a_\tau = \alpha R = 12t$

$\frac{dv}{dt} = 12t$

$V = \frac{12t^2}{2}$ V at t = 1 v = 6 m/s.

$\frac{ds}{dt} = 6t^2$

$S = \frac{6t^3}{3} = 2t^3$

t = 1 sec.

S = 2 m

(C) After 1 sec. 1 sec के पश्चात्.

$\tan\theta = \frac{ac}{a_\tau} = \frac{6^2}{3(4)} = 3$

(D) speed at t = ⊥ 6 m/s.

t पर चाल = ⊥ 6 m/s.

29. The forces with their work which are integrable without the knowledge of path are conservative. In this sense option (A) and (C) are true.

जिस कार्य का समाकलन बिना पथ की जानकारी के निकाला जा सकता है, उस बल को संरक्षी बल कहते। इस कारण (A) तथा (C) सही हैं।

30. Acceleration of block is (ब्लॉक का त्वरण) = 10 m/s^2

∴ displacement (विस्थापन)

$s = \frac{1}{2}at^2 = \frac{1}{2} \times 10 \times \frac{4}{10} = 2m$

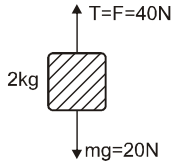
Tension in the string is 40 N

Work done by gravity is

रस्सी में तनाव 40 N है।

गुरूत्व द्वारा किया कार्य

– 20 × 2 = – 40 J



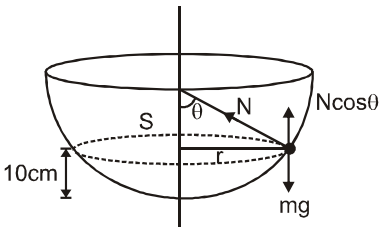
and work done by tension is

तनाव द्वारा किया कार्य

40 × 2 = 80 J

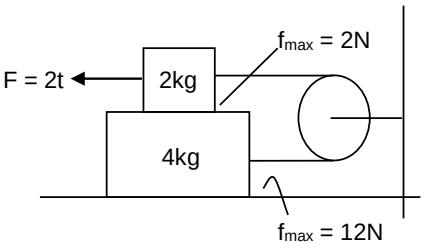
31. $N\cos\theta = mg$, $N = \frac{0.5 \times 10 \times 15}{5} = 15N$

$N\sin\theta = m\omega^2 r$



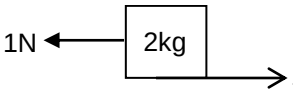
$N\frac{r}{R} = m\omega^2 r \Rightarrow \omega^2 = \frac{15}{0.5 \times 15 \times 10^{-2}} = 200.$

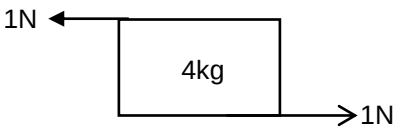
32.



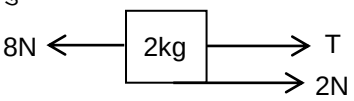
At $t = \frac{1}{2}$ sec, the system is in eq.

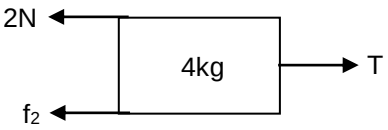
$t = \frac{1}{2}$ sec पर, निकाय साम्यावस्था में है।





At t = 4 sec, F = 8N
t = 4 sec पर, F = 8N
Again system does not move
पुनः निकाय गति नही करता है।



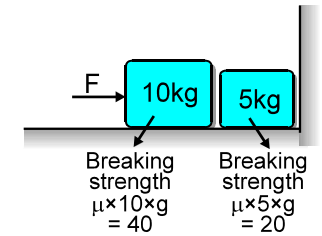


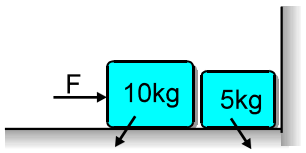
T+2 = 8
T = 6
$f_2 + 2 = 6$
$f_2 = 4N$

33. At maximum speed acceleration is zero.
अधिकतम वेग पर त्वरण शून्य होगा
$Kx + \mu_1 m_1 g \cos\theta = m_1 g \sin\theta \Rightarrow x = 20cm$

34. $\mu_2 m_2 g \cos\theta > m_2 g \sin\theta$
$\Rightarrow$ m_2 will not move m_2 गति नहीं करेगा।

35. If F = 20 N, 10 kg block will not move and it would not press 5 kg block So N = 0.
यदि F = 20 N, 10 kg के गुटका नहीं चलेगा तथा यह 5 kg गुटके को नहीं दबायेगी अतः N = 0.





भंजन सामर्थ्य भंजन सामर्थ्य
$\mu \times 10 \times g$ $\mu \times 5 \times g$
$= 40$ $= 20$

36. If F = 80 N then friction force on B is 20 N
यदि F = 80 N है तब B पर घर्षण बल 20 N है।

PART-III: CHEMISTRY

37. (A) Expansion takes place
(B) Process is not isothermal
(D) Process is not isochoric
(A) प्रसार होता है।
(B) प्रक्रम समतापीय नही है।
(D) प्रक्रम समआयतनिक नही है।

38. 20 mL liq A + 40 ml liq B → final solution d = 1.33g/mL
d = 1.5g/mL d=1.25 g/mL

$$V = \frac{80}{1.33} = \frac{80}{\frac{4}{3}} = 60 \text{ mL}$$

$\Rightarrow$ % contraction in volume = 0

$\Rightarrow$ molality of A = $\dfrac{\frac{30}{60}}{\frac{50}{1000}} = 10$

$\Rightarrow$ mole fraction of A = $\dfrac{0.5}{0.5 + \frac{50}{25}} = 0.2$

$\Rightarrow$ $\%\dfrac{w}{v} = \dfrac{30}{60} \times 100 = 50$

हल: 20 mL द्रव A + 40 ml द्रव B → अन्तिम विलयन d = 1.33g/mL
d = 1.5g/mL d=1.25 g/mL

$$V = \frac{80}{1.33} = \frac{80}{\frac{4}{3}} = 60 \text{ mL}$$

$\Rightarrow$ आयतन में प्रतिशत संकुचन = 0

$\Rightarrow$ A की मोललता = $\dfrac{\frac{30}{60}}{\frac{50}{1000}} = 10$

$\Rightarrow$ A का मोल प्रभाज = $\dfrac{0.5}{0.5 + \frac{50}{25}} = 0.2$

$\Rightarrow$ $\%\dfrac{w}{v} = \dfrac{30}{60} \times 100 = 50$

39. Theory based

40. $r \propto \dfrac{1}{\sqrt{M}}$
(at same T & P) (समान T व P पर)

41. $NaOH + SO_2 \rightarrow NaHSO_3$
$NaOH = 0.15$ mole
$SO_2 = 0.1$ mole
$2NaOH + SO_2 \rightarrow Na_2SO_3 + H_2O$
If no $NaHSO_3$ is formed, NaOH is LR
If no Na_2SO_3 is formed, SO_2 is LR
Equal moles of $NaHSO_3$ & Na_2SO_3 are formed by given moles of NaOH & SO_2.

हल: $NaOH + SO_2 \rightarrow NaHSO_3$
$NaOH = 0.15$ mole
$SO_2 = 0.1$ mole
$2NaOH + SO_2 \rightarrow Na_2SO_3 + H_2O$
यदि $NaHSO_3$ नहीं बनता है, तो NaOH सीमान्त अभिकर्मक है।

42. Theory based

43.

NO	+ ½ O_2	⟶	NO_2
a	a		0
0	a/2		a

Initially $M_{avg} = \frac{a \times 30 + a \times 32}{2a} = 31$
"after reaction" LR is NO
Hence M_{avg}
$= \frac{\frac{a}{2} \times 32 + a \times 46}{\frac{a}{2} + a}$

हल.

NO	+ ½ O_2	⟶	NO_2
a	a		0
0	a/2		a

प्रारम्भ में $M_{औसत} = \frac{a \times 30 + a \times 32}{2a} = 31$
''अभिक्रिया के पश्चात्'' सीमान्त अभिकर्मक NO है।
अतः, $M_{औसत} = \frac{\frac{a}{2} \times 32 + a \times 46}{\frac{a}{2} + a}$

44. Because s-p sidewise overlapping is considered zero overlap.
क्योंकि s-p पार्श्वीय अतिव्यापन (sidewise overlapping) को शून्य अतिव्यापन (overlap) माना जाता है।

45. It is fact.

46. H_3O^+, PCl_4^+, NO_3^-, ICl
→ central atoms of all species have 8 electrons.
H_3O^+, PCl_4^+, NO_3^-, ICl
→ सभी स्पीशीज के केन्द्रिय परमाणु 8 इलेक्ट्रॉन रखते हैं।

47. (C) sp^3d^2 hybridization involved d_{x2-y2} and d_{z^2} atomic orbitals
(C) sp^3d^2 संकरण में d_{x2-y2} तथा d_{yz} परमाण्वीय कक्षक उपस्थित होते है।

48. N is central atom.
N केन्द्रिय परमाणु है।

49. (B) Li < Be < B
(C) C < N < O

50. (A) Cu^+ (B) Cu^{2+}
(C) Fe^{3+} (D) Zn^{2+}

51. Balanced reaction: $6Fe^{+2} + Cr_2O_7^{2-} + 14H^+ \rightarrow 2Cr^{+3} + 6Fe^{+3} + 7H_2O$
Milimole of dichromate ion is 2.35 hence millimole of Fe^{+2} ion = 6x2.35 = 14.1
सन्तुलित अभिक्रिया: $6Fe^{+2} + Cr_2O_7^{2-} + 14H^+ \rightarrow 2Cr^{+3} + 6Fe^{+3} + 7H_2O$
डाईक्रोमेट आयन के मिली मोल 2.35 है इसलिए Fe^{+2} आयन के मिली मोल = 6x2.35 = 14.1

52. Milimole of $FeSO_4.7H_2O$ = 14.1
So, weight of $FeSO_4.7H_2O$ = 1.41 x 10^{-2} x 278= 3.91g
Hence % purity = (3.91/4.2) x 100 = 93.0
$FeSO_4.7H_2O$ के मिलीमोल = 14.1
अतः $FeSO_4.7H_2O$ का भार = 1.41 x 10^{-2} x 278= 3.91g
इसलिए % शुद्धता = (3.91/4.2) x 100 = 93.0

53. sp3d hybridisation in XeF_2 does not involve $d_{x^2-y^2}$ orbital.
XeF_2 में sp^3d संकरण में $d_{x^2-y^2}$ कक्षक सम्मिलित नहीं है।

54. ICl_2^- → d-orbital is used.
ICl_2^- → d-कक्षक प्रयुक्त होता है।

PAPER-2

PART-I: MATHEMATICS

1. $1+x+x^2+x^3=(1+x)+x^2(1+x)=(1+x)(1+x^2)$

$(1+x+x^2+x^3)^{11}=(1+x)^{11}(1+x^2)^{11}$

$(1+{}^{11}C_1.x+{}^{11}C_2.x^2+{}^{11}C_3.x^3+{}^{11}C_4.x^4+...)$
$\times(1+{}^{11}C_1.x^2+{}^{11}C_2.x^4+.....)$

$\therefore$ The coefficient of x^4 is

$\therefore$ x^4 का गुणांक है -

${}^{11}C_2+{}^{11}C_2\ \ {}^{11}C_1+{}^{11}C_4=55+605+330=990$

2. $\sum_{r=0}^{23}(r+1)\ {}^{25}C_r\ .\ {}^{25}C_{r+2}$

$=25\sum_{r=1}^{23}{}^{24}C_{r-1}\ .\ {}^{25}C_{23-r}+\sum_{r=0}^{23}{}^{25}C_r\ .\ {}^{25}C_{23-r}$

$=25\ .\ {}^{49}C_{22}+{}^{50}C_{23}$

$\Rightarrow 2k-\lambda-\mu=5$

3. $\left(x+x^{\log_{10}x}\right)^5$

$T_3={}^5C_2\ .\ x^3\ .\ (x^{\log_{10}x})^2=10.\ x^3(x^{\log_{10}x})^2$

Now $10\cdot x^3\cdot\left(x^{\log_{10}x}\right)^2=10^6$

Taking log both side

$\log\left(10\cdot x^3\cdot\left(x^{\log_{10}x}\right)^2\right)=\log(10^6)$

$1+3\log_{10}x+2\log_{10}x\cdot\log_{10}x=6$

Taking $\log_{10}x=t$

$2t^2+3t-5=0$

$(t-1)(2t+5)=0$

$\Rightarrow\ t=1,-\frac{5}{2}\Rightarrow\log_{10}x=1,-\frac{5}{2}\Rightarrow x=10,10^{-\frac{5}{2}}$

हल. $\left(x+x^{\log_{10}x}\right)^5$

$T_3={}^5C_2\ .\ x^3\ .\ (x^{\log_{10}x})^2=10.\ x^3(x^{\log_{10}x})^2$

अब $10\cdot x^3\cdot\left(x^{\log_{10}x}\right)^2=10^6$

दोनों तरफ log लेने पर

$\log\left(10\cdot x^3\cdot\left(x^{\log_{10}x}\right)^2\right)=\log(10^6)$

$1+3\log_{10}x+2\log_{10}x\cdot\log_{10}x=6$

$\log_{10}x=t$ लेने पर

$2t^2+3t-5=0$

$(t-1)(2t+5)=0$

$\Rightarrow\ t=1,-\frac{5}{2}\Rightarrow\log_{10}x=1,-\frac{5}{2}\Rightarrow x=10,10^{-\frac{5}{2}}$

4. $1+n+n^2+.....+n^{127}$

$=\frac{n^{128}-1}{n-1}=\frac{(n^{64}-1)(n^{64}+1)}{(n-1)}$

$=(1+n+n^2+.....+n^{63})(n^{64}+1)$

$\therefore$ the largest value of m for which (n^m+1)

$\therefore$ m का अधिकतम मान 64 है जबकि (n^m+1), $1+n+n^2.....+n^{127}$ से विभाजित है।

$\Rightarrow k=8$

5. General term व्यापक पद

$=\frac{10!}{r_1!\ r_2!\ r_3!}(1)^{r_1}(2x)^{r_2}(3x^2)^{r_3}$

a_1 = Coeff. of x (x का गुणांक)

$r_2+2r_3=1\Rightarrow\ r_2=1,\ r_1=9,\ r_3=0$

$\therefore\ a_1=\frac{10!}{1!\ 9!}(2)^1=20$

a_2 = Coeff. of x^2 (x^2 का गुणांक)

$r_2+2r_3=2\ \Rightarrow\ r_2=2,\ r_1=8,\ r_3=0$

$r_2=0,\ r_1=9,\ r_3=1$

$a_2\ \frac{10!}{2!\ 8!}=(2)^2+\frac{10!}{9!\ 1!}(3)=210$

a_4 = coeff. of x^4 (x^4 का गुणांक)

$r_2+2r_3=4\ \Rightarrow\ r_2=4,\ r_1=6,\ r_3=0$

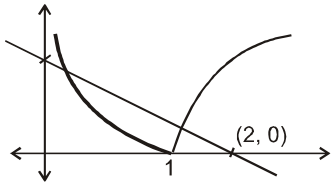
$r_2=2,\ r_1=7,\ r_3=1$

$r_2=0,\ r_1=8,\ r_3=2$

$a_4=\frac{10!}{4!\ 6!}(2)^4+\frac{10!}{2!7!1!}(2)^2(3)+\frac{10!}{8!2!}(3)^2=8085$

$a_{20}=3^{10}$

6.



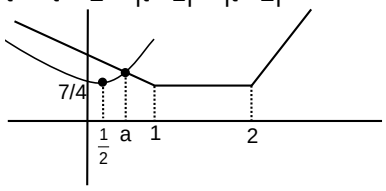
Two solutions one greater than unity and other less than unity.

दो हलों में एक इकाई से बड़ा और एक इकाई से छोटा

7. Let $3^x = t$

$t(t-1) + 2 = |t-1| + |t-2|$

$t^2 - t + 2 = |t-1| + |t-2|$



one positive solution for t

$t = a$

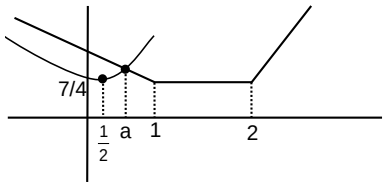
$3^x = a$

$x = \log_3 a$ so singleton set

हल. माना कि $3^x = t$

$t(t-1) + 2 = |t-1| + |t-2|$

$t^2 - t + 2 = |t-1| + |t-2|$



t का एक धनात्मक हल है।

$t = a$

$3^x = a$

$x = \log_3 a$ एकल समुच्चय

and $2\left|\sqrt{x}-3\right| + \sqrt{x}\left(\sqrt{x}-6\right) + 6 = 0$

case स्थिति-i $\sqrt{x} \geq 3 \Rightarrow 2\sqrt{x} - 6 +$

$x - 6\sqrt{x} + 6 = 0$

$\Rightarrow x - 4\sqrt{x} = 0$

$\Rightarrow \sqrt{x} = 4 \quad \Rightarrow \quad x = 16$

case स्थिति **-ii** $\sqrt{x} < 3 \Rightarrow -2\sqrt{x} + 6 + x$

$- 6\sqrt{x} + 6 = 0$

$\Rightarrow x - 8\sqrt{x} + 12 = 0 \quad \Rightarrow \left(\sqrt{x}-6\right)\left(\sqrt{x}-2\right)$

$= 0 \Rightarrow \sqrt{x} = 2 \Rightarrow x = 4$

8. $\Rightarrow 2(\sec^2\alpha - \text{cosec}^2\alpha) + (\text{cosec}^2\alpha + \sec^2\alpha)$

$(\text{cosec}^2\alpha - \sec^2\alpha) = \dfrac{3}{2}$

$\Rightarrow (\text{cosec}^2\alpha - \sec^2\alpha)\,[\text{cosec}^2\alpha + \sec^2\alpha - 2]$

$= \dfrac{3}{2}$

$\Rightarrow 2(\cot^2\alpha - \tan^2\alpha)(\cot^2\alpha + \tan^2\alpha) = 3$

$\Rightarrow 2(\cot^4\alpha - \tan^4\alpha) = 3$

$\Rightarrow 2\tan^8\alpha + 3\tan^4\alpha - 2 = 0$

$\Rightarrow \tan^4\alpha = \dfrac{1}{2}$

9. $T_r = \dfrac{r}{-rx}(1-x)(1-2x)\ .....[1-(r-1)x]$

$[(1-rx)-1]$

$T_r = -\dfrac{1}{x}\,[(1-x)(1-2x).....(1-rx) -$

$(1-x)(1-2x).....(1-(r-1)x)]$

$S_n = \sum T_r \Rightarrow S_n = -\dfrac{1}{x}\left[(1-x)^{-1}\right]$

$S_n = -\dfrac{1}{x}\left[(1-x)(1-2x) - (1-x)\right]$

$\vdots \qquad\qquad \vdots$

$\vdots \qquad\qquad \vdots$

$= -\dfrac{1}{x}\,[(1-x)(1-2x).....(1-nx) - (1-x)$

$(1-2x)\,(1-(n-1)x)]$

$= -\dfrac{1}{x}\left[(1-x)(1-2x).....(1-nx)^{-1}\right]$

10. $a_1 = \dfrac{1}{2}$, $(n-1)a_{n-1} = (n+1)a_n$ for $n \geq 2$

for $\quad n = 2, \quad a_1 = 3a_2, \qquad a_2 = \dfrac{1}{6}$

for $\quad n = 3, \quad 2a_2 = 4a_3, \qquad a_3 = \dfrac{1}{12}$

for $\quad n = 4 \quad 3a_3 = 5a_4 \qquad a = 4 = \dfrac{1}{20}$

$s_n = \dfrac{1}{2} + \dfrac{1}{6} + \dfrac{1}{12} + \dfrac{1}{20} + \dfrac{1}{30} + \dfrac{1}{42} + ...\pi_4$

$s_n = \sum_{n=1}^{n} \dfrac{1}{(n)(n+1)} = \sum_{n=1}^{n}\left(\dfrac{1}{n} - \dfrac{1}{n+1}\right)$

$= 1 - \dfrac{1}{2} + \dfrac{1}{2} - \dfrac{1}{3} + \dfrac{1}{3} - \dfrac{1}{4} + ... = 1$ Ans.

11. $3\sin x + \sin 3x + \sin^2 x = 5\sec^2 x$

Since LHS ≤ 5 and RHS ≥ 5

equality holds only $\sin x = \sin 3x = \sin^2 x = 1$

and $\sec^2 x = 1$

which is not possible

12. ${}^{(n+1)}C_6 + {}^nC_4 + {}^nC_5 < {}^{n+2}C_5$

$\Rightarrow {}^{n+1}C_6 + {}^{n+1}C_5 < {}^{n+2}C_5$

$\Rightarrow {}^{n+2}C_6 < {}^{n+2}C_5$

$\Rightarrow \dfrac{(n+2)!}{6!(n-4)!} < \dfrac{(n+2)!}{5!(n-3)!}$

$\Rightarrow n < 9$

13. $(1 + x + 2x^3)\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^9$

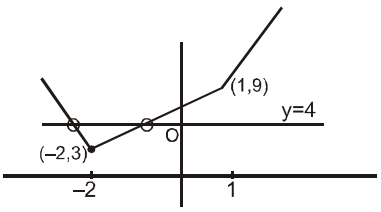
$= (1+x+2x^3)\left\{\left(\frac{3}{2}x^2\right)^9 - {}^9C_1\left(\frac{3}{2}x^2\right)^8 \cdot \frac{1}{3x} + {}^9C_2\left(\frac{3}{2}x^2\right)^7 \cdot \left(\frac{1}{3x}\right)^2 - {}^9C_3\left(\frac{3}{2}x^2\right)^6 \cdot \left(\frac{1}{3x}\right)^3 + {}^9C_4\left(\frac{3}{2}x^2\right)^5\left(\frac{1}{3x}\right)^4 - {}^9C_5\left(\frac{3}{2}x^2\right)^4\left(\frac{1}{3x}\right)^5 + {}^9C_6\left(\frac{3}{2}x^2\right)^3 \cdot \left(\frac{1}{3x}\right)^6 - {}^9C_7\left(\frac{3}{2}x^2\right)^2\left(\frac{1}{3x}\right)^7 + ...\right\}$

Hence coefficient of $x = {}^9C_6\left(\frac{3}{2}\right)^3 \cdot \frac{1}{3^6} = \frac{7}{18}$

अतः x का गुणांक $= {}^9C_6\left(\frac{3}{2}\right)^3 \cdot \frac{1}{3^6} = \frac{7}{18}$

coefficient of x^2 का गुणांक = 0

14.



15. $\log_{\sin x} x < 0$

$\Rightarrow x \in \left(1, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \pi\right) \cup (2\pi, 3\pi) - \left\{\frac{5\pi}{2}\right\}$

16. $2|x| = 10 - y \geq 0$

$\therefore \quad y \leq 10$

$\therefore$ the equation $2x - |y - 12| = -18$

becomes $2x + y = -6$

also $2|x| + y = 10$

case-1 when $x \geq 0$ the equation are $2x + y = -6$ and $2x + y = 10$

(which have no solution)

case-2 when $x \leq 0$ the equation are $2x + y = -6$ and $-2x + y = 10$

$\therefore \quad x = -4, y = 2$ is a solution

$\therefore \quad \frac{x-y}{x+y} = 3$

हल. $2|x| = 10 - y \geq 0$

$\therefore \quad y \leq 10$

$\therefore$ समीकरण $2x - |y - 12| = -18,$

समीकरण $2x + y = -6$ बन जाता है

साथ ही $2|x| + y = 10$

case-1 जब $x \geq 0$ हो, तो समीकरण

$2x + y = -6$ तथा $2x + y = 10$ है।

(जिनका कोई हल नहीं है।)

case-2 जब $x \leq 0$ हो, तो समीकरण

$2x + y = -6$ तथा $-2x + y = 10$ है।

$\therefore \quad x = -4, y = 2$ हल है।

$\therefore \quad \frac{x-y}{x+y} = 3$

17. Corresponding A.P.

$\frac{1}{5}, \ldots\ldots\ldots\ldots \frac{1}{25}$ (20^{th} term)

$\frac{1}{25} = \frac{1}{5} + 19\,d$

$\Rightarrow d = \frac{1}{19}\left(\frac{-4}{25}\right) = -\frac{4}{19 \times 25}$

$a_n < 0$

$\frac{1}{5} - \frac{4}{19 \times 25} \times (n-1) < 0$

$\Rightarrow \frac{19 \times 5}{4} < n - 1 \qquad \Rightarrow n > 24.75$

18. $\sum_{k=2}^{100} \left| (k^2 - 3k + 1)\ S_k \right|$

for $k = 2$ के लिए $|(k^2 - 3k + 1)\, S_k| = 1$

$\sum_{k=3}^{100} \left| \frac{k-1}{(k-2)\ !} - \frac{k-1+1}{(k-1)\ !} \right|$

$\sum_{k=3}^{100} \frac{1}{(k-3)\ !} + \frac{1}{(k-2)\ !} - \frac{1}{(k-2)\ !} - \frac{1}{(k-1)\ !}$

$\sum_{k=3}^{100} \left(\frac{1}{(k-3)\ !} - \frac{1}{(k-1)\ !} \right)$

$$S = 1+\left(1-\frac{1}{2!}\right)+\left(\frac{1}{1!}-\frac{1}{3!}\right)+\left(\frac{1}{2!}-\frac{1}{4!}\right)+\left(\frac{1}{3!}-\frac{1}{5!}\right)+\left(\frac{1}{4!}-\frac{1}{6!}\right)+....\left(\frac{1}{94!}-\frac{1}{96!}\right)$$

$$+$$

$$\left(\frac{1}{95!}-\frac{1}{97!}\right)+\left(\frac{1}{96!}-\frac{1}{98!}\right)+\left(\frac{1}{97!}-\frac{1}{99\ !}\right)$$

$$= 2 - \frac{1}{98!}-\frac{1}{99!}$$

$$\therefore \quad E = \frac{100^2}{100!}+3-\frac{1}{98!}-\frac{1}{99.98!}$$

$$= \frac{100^2}{100!}+3-\frac{100}{99!} = \frac{100^2}{100.99!}+3-\frac{100}{99!} = 3$$

PART-II: PHYSICS

19. Maximum value of friction force between 4m and inclined plane

4m तथा नत तल के मध्य घर्षण बल का अधिकतम मान

$= \mu$ (4mg) cos 45°

$= \frac{1}{\sqrt{2}}$ (4mg) $\frac{1}{\sqrt{2}} = 2mg$

Here pulling force तयहाँ खींचाव बल

$F_P = 4mg \cos 45 - mg$

$= (2\sqrt{2}-1)\,mg < 2\,mg$

$\therefore$ Block will not move.

ब्लॉक गति नहीं करेगा

$\therefore$ Acceleration of 4m block

4m ब्लॉक का त्वरण

$= 0, T = mg$

$\therefore$ frictional force on 4m block

4m द्रव्यमान पर घर्षण बल

$= (2\sqrt{2}-1)\,mg$

20. Friction opposes relative motion.

No work is done by action reaction pair of friction. So, it can not be positive.

घर्षण सापेक्षिक गति का विरोध करता है। घर्षण के लिए किया प्रतिक्रिया युग्म द्वारा कोई कार्य नहीं किया जाता है। अतः यह धनात्मक नहीं हो सकता है।

21. Equation of motion of the block is

$ma = mg\sin\theta - 2\mu_k mg\cos\theta\cos 45^0$.

(Net force = Gravitational force + Frictional force)

In the second term on the right side of above equation factor 2 arises due to the fact that frictional force arises from two walls of the trough and the term cos 45^0 takes case of the fact that the walls are tilted at 45^0 to the axis of the channel. So that the normal reaction is accordingly reduced.

$\therefore a = g\left(\sin\theta - \sqrt{2}\mu_k\cos\theta\right)$

Hence, the correct answer is (A)

ब्लॉक की गति की समीकरण

$ma = mg\sin\theta - 2\mu_k mg\cos\theta\cos 45^0$.

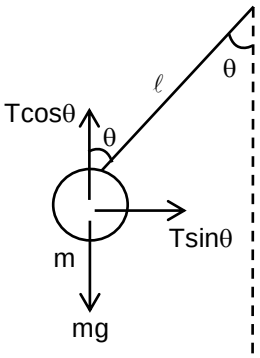
(कुल बल = गुरूत्वीय बल + घर्षण बल)

गर्त की दो दीवारो के कारण घर्षण बल का गुणांक 2 होगा दोनो दीवारों के 45^0 पर झुकाव के कारण cos45º का गुणांक आता है।

$\therefore a = g\left(\sin\theta - \sqrt{2}\mu_k\cos\theta\right)$

इस प्रकार (A) सही उतर है।

22.



(A) $T\cos\theta = mg$

$T = \frac{mg}{\cos\theta}$

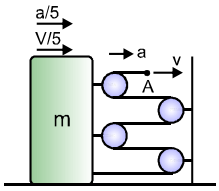
(B) $T\sin\theta = \frac{mv^2}{R}$

$V = \sqrt{\frac{T\sin\theta R}{m}} = \sqrt{\frac{mg}{\cos\theta}\frac{\sin\theta R}{m}}$

$= \sqrt{\frac{g\ell\sin^2\theta}{\cos\theta}}$

(C) $T = \frac{2\pi}{\omega} = \frac{2\pi L\sin\theta}{\sqrt{\frac{g\ell\sin^2\theta}{\cos\theta}}} = 2\pi\sqrt{\frac{\cos\theta L}{g}}$

23.



From constrain,
बन्धित गति से

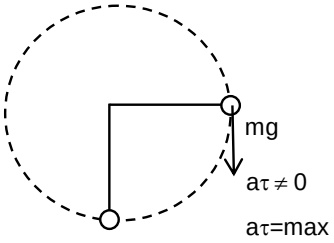
Speed of block ब्लॉक की चाल = v/5

$$\text{K.E.} = \frac{1}{2}m\left(\frac{v}{5}\right)^2 = \frac{mv^2}{50}$$

Power = Force × velocity
शक्ति = बल × वेग

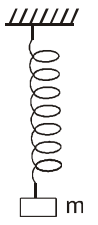
$$= \frac{ma}{5}\ \frac{v}{5} = \frac{mav}{25}.$$

24.



Radial acceleration is max when V is maximum at lowest point and mininum at P most point at these points $a_\tau = 0$
केन्द्रिय त्वरण अधिकतम है जब न्यूनतम बिन्दु पर V अधिकतम है तथा इन P बिन्दुओं पर सबसे अधिकतम न्यूनतम होता है $a_\tau = 0$

25. initial velocity आरम्भिक वेग
= final velocity अंतिम वेग = 0
from energy conservation
ऊर्जा संरक्षण से



(at Natural length)

$$mgx - \frac{1}{2}kx^2 = 0$$

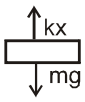
$$x = \frac{2mg}{k}$$

at descended length नीचे आने की लम्बाई

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

$$\frac{kx}{2} = k\,.\,\frac{2mg}{2k} = mg$$

Net force कुल बल= 0 $\Rightarrow$ a = 0
at lower most position
सबसे निचली स्थिति में



force बल $= Kx - mg = K\,\frac{2mg}{K} - mg = mg$

$\Rightarrow$ a = g ↑

26. By energy conservation $\frac{1}{2}kx^2 = mg(2x)$

$$\Rightarrow x = \frac{4mg}{k} \text{ (maximum elongation)}$$

ऊर्जा संरक्षण से $\frac{1}{2}kx^2 = mg(2x)$

$$\Rightarrow x = \frac{4mg}{k} \text{ (अधिकतम प्रसार)}$$

at equilibrium $kx = 2mg$

$$\Rightarrow x = \frac{2mg}{k}$$

साम्यावस्था पर $kx = 2mg$

$$\Rightarrow x = \frac{2mg}{k}$$

So अतः, $(\text{K.E.})_{max} = mg(2x) - \frac{1}{2}kx^2$

$$= 2mg\left(\frac{2mg}{k}\right) - \frac{1}{2}k\left(\frac{2mg}{k}\right)^2$$

$$\frac{1}{2}mv^2_{max} = \frac{2m^2g^2}{k}$$

$$\Rightarrow v_{max} = 2g\sqrt{\frac{m}{k}}.$$

27. For minimum time,
न्यूनतम समय के लिए

$a_{max} = \mu g$

$1000 = \frac{1}{2}\mu g t^2$

$t = 120$ second

$v = \mu g t = \frac{100}{6}$

So, work done by man
इसलिए धावक द्वारा किया गया कार्य

$= \frac{1}{2} \times 70 \times \left(\frac{100}{6}\right)^2 = 9.7$ kJ.

28. (B) the force of friction between the bodies is zero
दोनों वस्तुओं के मध्य घर्षण बल शून्य है।

(D) the bodies may be rough but they do not slip on each other
वस्तुऐं खुरदरी हो सकती है लेकिन दोनों एक दूसरे पर नही फिसलती है।

29. (i) for complete the loop minimum velocity at lowest point is $v = \sqrt{5gr}$
लूप पूर्ण करने के लिए निम्नतम बिन्दु पर न्यूनतम वेग $v = \sqrt{5gr}$

from energy conservation
उर्जा संरक्षण से

$\frac{1}{2} mv^2 = mgh$

$\frac{1}{2} m (\sqrt{5gr})^2 = mgh \Rightarrow h = \frac{5}{2} r$ **Ans.**

(ii) h is double then velocity at h position is
h दुगना है तब h स्थिति पर वेग होगा -

$mg2h - mg\ 2r = \frac{1}{2} mv^2$ (from energy conservation) (ऊर्जा संरक्षण से)

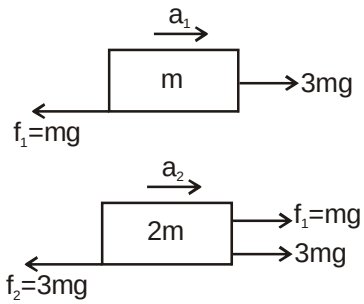
$v = \sqrt{6gr}$

Normal reaction at highest point.
उच्चतम बिन्दु पर अभिलम्ब प्रतिक्रिया बल

$F_R = N + mg = \frac{m(\sqrt{6gr})^2}{r}$

$F_R = 6$ mg **Ans.**

30. The F.B.D of both blocks is as shown.
दोनों गट्टों के FBD प्रदर्शित है



$a_1 = \frac{3mg - mg}{m} = 20$ m/s^2

$a_2 = \frac{4mg - 3mg}{2m} = 5$ m/s^2

$\therefore a_{pulley} = \frac{a_1 + a_2}{2} = \frac{25}{2} = \frac{X}{2}$. Hence (अतः)

$X = 25$

31. $W = \int \vec{F}.d\vec{r}$

$= \int (ydx + xydy)$

$\because \quad 2x = 3y$

$= \int_0^2 \left(\frac{3}{2} ydy + \frac{3}{2} y^2 dy\right)$

$\therefore \quad dx = \frac{3}{2} dy$

$= \left[\frac{3}{4} y^2 + \frac{y^3}{2}\right]_0^2 = 7$ Joule.

32. Using energy conservation :
ऊर्जा संरक्षण का उपयोग करते हुए

$\frac{1}{2} mv_B^2 = mgh$

$v_B = \sqrt{\frac{2mgh}{m}}$

$v_B = \sqrt{2hg}$ .....(1)

Also to complite vertical circle
ऊर्ध्वाधर वृत्त पूरा करने के लिए भी

$v_B = \sqrt{5gR}$ .....(2)

$\therefore \quad R = \frac{2}{5} h = 2$ cm

33. $a = \mu g$

$a = 2\ m/s^2$

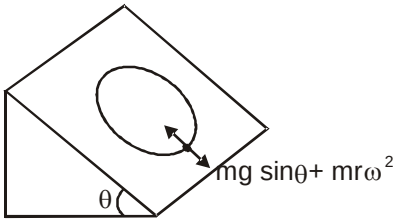
$\therefore\ v = 4a$

$v = 8\ m/s$

34. $f \geq mg \sin\theta + mr\omega^2$

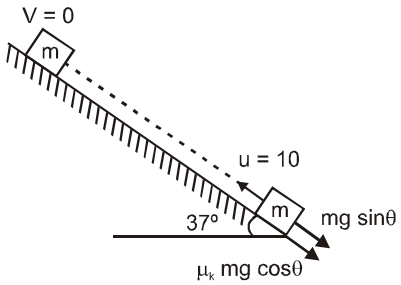
$\mu\ mg\cos\theta \geq mg\sin\theta + mr\omega^2$

or या $\mu \geq \tan\theta + \dfrac{\omega^2 r}{g\cos\theta}$



35. Displacement till it comes to rest

स्थिरावस्था में आने तक विस्थापन



$V^2 = u^2 + 2as$

$O^2 = (10)^2 + 2\ (-(g\sin\theta + \mu_k\ g\cos\theta))\ (s)$

$s = \dfrac{100}{24.8} \approx 4\ m$

time to reach the hishest point

उच्चतम बिन्दु तक पहुँचने में लगा समय

$V = u + at$

$O = 10 + (12.4)\ t$

$t = \dfrac{10}{12.4} \approx 0.8\ sec$

and after that the block will remain stationery a becouse $\tan\theta < \mu_s$. So in 2 sec distance travelled is 4 m.

तत्पश्चात् ब्लॉक स्थिर रह जाएगा क्योंकि $\tan\theta < \mu_s$, अतः 2 सैकण्ड में तय दूरी 4 m है।

36. By work energy theorem, कार्य ऊर्जा प्रमेय से

$W_F + W_f = \Delta K$

$\Rightarrow \quad 1000 \times 4 - 10 \times 4 = \dfrac{1}{2} m(10^2 - 1^2)$

$\Rightarrow \quad m = 80\ kg.$

PART-III: CHEMISTRY

37. Let no. of atom for M^{+2} = a,

So no. of atom for M^{+3} = 0.8-a

$2a + 3(0.8 - a) = 2$

So, a = 0.4

हल. माना M^{+2} के परमाणु = a,

अतः M^{+3} के परमाणु = 0.8-a

$2a + 3(0.8 - a) = 2$

अतः, a = 0.4

38. Theory based.

39. (A) The element A is under going reduction.

(C) The element B is under going oxidation.

(D) The element Y is under going oxidation.

(A) तत्व A अपचयन से गुजरता है।

(C) तत्व B ऑक्सीकरण से गुजरता है।

(D) तत्व Y ऑक्सीकरण से गुजरता है।

40. (C) Rate of effusion of 2 : 1 molar ratio of H_2 and O_2 is 8 : 1 at constant temperature.

नियत तापमान पर H_2 व O_2 के 2 : 1 मोलर अनुपात की निसरण की दर 8 : 1 होती है।

41.

	N_2	+	$3H_2 \rightarrow$	$2NH_3$
Initially प्रारम्भ में	a atm		b atm	0
Finally अन्त में	a – x		b – 3x	2x

$\therefore$ a + b = 1 and तथा a + b – 2x = 0.75

$\therefore\ P_{NH_3} = 2x = 0.25\ atm$

42. (C) Li > Be > B (D) N > O > F

43. B and N can not expend their octet due to absence of d-orbital.

B व N में d-कक्षक की अनुपस्थिति के कारण अपना अष्ठक प्रसारित नही कर सकता है।

44. (A) O (B) Pb

(C) Tℓ (D) Bi

45. (A) Al (D) Sc

46. Ionic bond is formed between metal and non metal.
आयनिक बंध धातु तथा अधातु के मध्य बनता है।

47. wt. of gas formed = 5 – 2.8 = 2.2 g
let the mol. mass of gas by M_0

$$\frac{2.2}{M_0} = \frac{1120}{22400} \quad M_0 = 44$$

हल. निर्मित गैस का भार = 5 – 2.8 = 2.2 g
माना कि गैस का अणुभार M_0 है।

$$\frac{2.2}{M_0} = \frac{1120}{22400} \quad M_0 = 44$$

48. $Z = \frac{PV}{nRT}$

or $n = \frac{PV}{ZRT} . = \frac{25 \times 7}{1.2 \times \frac{1}{12} \times 250} = 7$

49. $HCO_3^- \longrightarrow CO_2$

Mole of $HCO_3^- = \frac{6.1}{61} \times \frac{20}{100}$

= 0.02 mol of CO_2

PV = nRT

$1 \times V = 0.02 \times \frac{1}{12} \times 298$

or $V_{CO_2} = 0.49$ L

हल. $HCO_3^- \longrightarrow CO_2$

HCO_3^- के मोल = $\frac{6.1}{61} \times \frac{20}{100}$

= 0.02 CO_2 के मोल

PV = nRT

$1 \times V = 0.02 \times \frac{1}{12} \times 298$

or $V_{CO_2} = 0.49$ L

50. $\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$; $\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{2}{32}}$

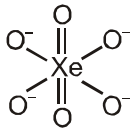
$\frac{r_{O_2}}{r_{H_2}} = \frac{1}{4}$ $r_{O_2} : r_{H_2} = 1 : 4$

$\frac{\frac{1}{t}}{\frac{1}{24}} = \frac{1}{4}$ or t = 96 S

51. a = 5
b = 4

52. x = 4 Period
y = 11 Group
8 + 11 = 19.

53. 16 lone pairs, hence 32 unshared electrons.
16 एकाकी युग्म, इसलिए 32 असाँझित इलेक्ट्रॉन

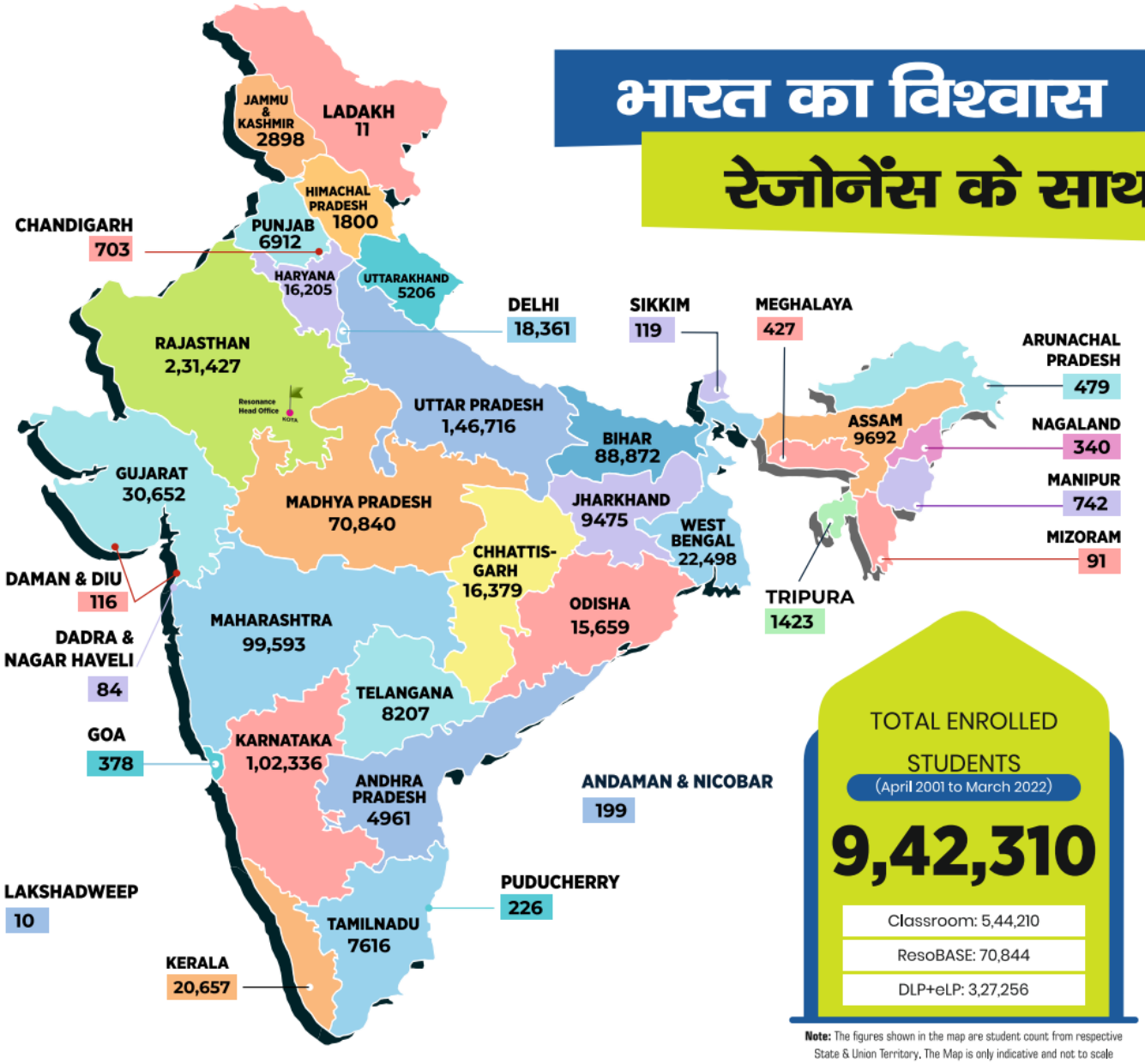


54. $:\ddot{O}=C=\ddot{O}:$

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

Resonance®
Educating for better tomorrow

भारत का विश्वास
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