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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	XII	COURSE NAME	VIJETA	COURSE CODE	JP
PHASE CODE(S)	05JP	TOTAL PAGES	1	BATCH CODE(S)	05JP

Target Examination & Year:

JEE (MAIN+ADVANCED) 2024

TEST PATTERN	TEST TYPE	TEST CODE & SEQUENCE
JEE (ADVANCED)	PART TEST (PT)	APT 04

DATE & DAY:
22th October 2023 | Sunday

Duration & Time:
Paper-1 : 3 Hrs | 11:30 AM to 02:30 PM
Paper-2 : 3 Hrs | 03:00 PM to 06:00 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)

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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.	AC	AC	BC	AC	AC	BCD	D	C	E	A
	Q.No.	11	12	13	14	15	16	17	18		
	Ans.	C	C	A	C	D	A	B	A		
PART-II : PHYSICS	Q.No.	19	20	21	22	23	24	25	26	27	28
	Ans.	BD	BD	CD	ABD	ABC	ACD	A	A	C	C
	Q.No.	29	30	31	32	33	34	35	36		
	Ans.	D	B	A	C	C	A	B	C		
PART-III : CHEMISTRY	Q.No.	37	38	39	40	41	42	43	44	45	46
	Ans.	AB	ABC	BCD	A	ABC	ACD	C	C	C	C
	Q.No.	47	48	49	50	51	52	53	54		
	Ans.	A	B	C	B	B	D	B	C		
PAPER-2											
PART-I : MATHEMATICS	Q.No.	1	2	3	4	5	6	7	8	9	10
	Ans.	02.00	02.00	17.10	07.00	53.00	44.00	13.10	03.25	18.00	05.00
	Q.No.	11	12	13	14	15	16	17	18		
	Ans.	12.25	53.00	ABC	AB	AB	AB	AC	BC		
PART-II : PHYSICS	Q.No.	19	20	21	22	23	24	25	26	27	28
	Ans.	04.00	08.00	0067 or 00.66	03.00	25.00	01.41	04.00	02.00	15.00	12.50
	Q.No.	29	30	31	32	33	34	35	36		
	Ans.	00.50	30.00	ACD	AD	AB	BD	ABC	ABD		
PART-III : CHEMISTRY	Q.No.	37	38	39	40	41	42	43	44	45	46
	Ans.	05.00	12.00	05.00	02.00	05.00	27.00	05.00	04.00	06.00	04.00
	Q.No.	47	48	49	50	51	52	53	54		
	Ans.	01.00	03.00	ABC	AB	ABC	ABC	BC	AD		

STUDENT'S SPACE

TEXT SOLUTIONS (TS)

PAPER-1

PART-I: MATHEMATICS

1. $I_1 = \int_0^{\pi} e^t(\sin^6 at + \cos^4 at)\,dt + \int_{\pi}^{2\pi} e^t(\sin^6 at + \cos^4 at)\,dt + \int_{2\pi}^{3\pi} e^t(\sin^6 at + \cos^4 at)\,dt + \int_{3\pi}^{4\pi} e^t(\sin^6 at + \cos^4 at)\,dt$

$= (1 + e^{\pi} + e^{2\pi} + e^{3\pi}) \int_0^{\pi} e^t(\sin^6 at + \cos^4 at)\,dt$

$\Rightarrow \frac{I_1}{I_2} = 1 + e^{\pi} + e^{2\pi} + e^{3\pi} = \frac{e^{4\pi} - 1}{e^{\pi} - 1}$

2. $x_1 + x_2 + x_3 + ... + x_7 + x_8 = 93$

$x_1 \geq 0, x_2 \geq 6, x_3 \geq 6, ... x_7 \geq 6, x_8 \geq 0$

$x_1 + x_2' + x_3' + ... + x_7' + x_8 = 57$

No. of ways क्रमचयों की संख्या $= {}^{64}c_7$

3. $T_n = \frac{\sqrt[4]{n} - \sqrt[4]{(n+1)}}{\left(\sqrt{n} + \sqrt{n+1}\right)\left(\sqrt{n} - \sqrt{n+1}\right)}$

$T_n = \sqrt[4]{n+1} - \sqrt[4]{n}$

$T_1 = \sqrt[4]{2} - 1$

$T_2 = \sqrt[4]{3} - \sqrt[4]{2}$

$\frac{T_n = \sqrt[4]{n+1} - \sqrt[4]{n}}{S_n = \sqrt[4]{n+1} - 1}$

4. $(1 + x)^{15} = C_0 + C_1x + ...+ C_{15}x^{15}$

Divide by x & then differentiating both side

$\frac{(1+x)^{15}}{x}$

$= \frac{C_0}{x} + C_1 + C_2x + C_3x^2 + ...+ C_{15}x^{14}$

$\frac{1}{x}.15(1 + x)^{14} - \frac{(1+x)^{15}}{x^2}$

$= -\frac{C_0}{x^2} + C_2 + ...+ 14\,C_{15}x^{13}$

Put x = 1 then $C_2 + 2C_3 + ...+ 14C_{15}$

$= 15.2^{14} - 2^{15} + 1 \qquad = 13.2^{14} + 1$

5. $x^2 - bx + c = 0 \;\nearrow \alpha \;\searrow \beta$

$\alpha + \beta = b$

$\therefore$ b is an odd positive integer and α, β are prime one of then must be 2

$\alpha\beta = c$

Let $\beta = 2$

$\Rightarrow \alpha + 2 = b$ and $2(\alpha)$

$= c \Rightarrow 4 - 2b + c = 0$ .....(i)

$\Rightarrow b + c = 35$ .....(ii)

from (i) and (ii) $\Rightarrow$ c = 22, b = 13

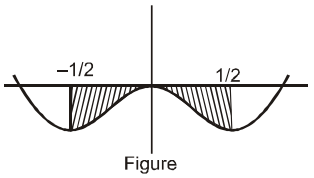
$\Rightarrow f(x) = x^2 - 13x + 22$

$\Rightarrow f(1) = 10$

$\Rightarrow f(-1) = 36$

$\Rightarrow f_{min}\left(\frac{13}{2}\right) = \left(-\frac{81}{4}\right)$

7.



Figure

$\frac{dy}{dx} = 8x^3 - 2x.\ \frac{dy}{dx}$

$= 0$

$\Rightarrow \quad (4x^2 - 1)\,x = 0$

$\Rightarrow \quad x = -\frac{1}{2}, 0, \frac{1}{2}$

Required area अभीष्ट क्षेत्रफल

$= -2\int_0^{1/2} (2x^4 - x^2)\ dx = \frac{7}{120}$

8. Let (माना) $5^{5^x} = t$

$\Rightarrow 5^{5^x}.\ \ell n\ 5\ .\ 5^x.\ \ell n\ 5\ dx = dt$

$I = \int \frac{5^t\,dt}{(\ell n\ 5)^2} = \frac{5^t}{(\ell n\ 5)^3} + C = \frac{5^{5^x}}{(\ell n\ 5)^3} + C$

9. $3 + \frac{1}{4}(3+d) + \frac{1}{4^2}(3+2d) + ...+ \infty = 8$

$S = 3 + (3+d) + (3+2d) + ...+ \infty$ ….(i)

$\frac{1}{4}S = \frac{3}{4} + \frac{1}{4^2}(3 + d) + ...\infty .....(II)$

(i) – (ii) we get से

$\frac{3}{4}S = 3 + \frac{1}{4}d + \frac{1}{4^2}d + \ldots\ldots\ldots \infty$;

$\frac{3}{4}S = 3 + \frac{\frac{1}{4}d}{1-\frac{1}{4}}$

$\frac{3}{4}S = 3 + \frac{d}{3}$;

$S = \frac{12}{3} + \frac{4}{9}d = 8 = 4 + \frac{4}{9}d = 8 \Rightarrow \frac{4}{9}d = 4 \Rightarrow d = 9$ **Ans**

10. Let α, β, γ be the roots of $x^3 - Ax^2 + Bx - C = 0$ ...(1)
the roots of $3x^3 + Px^2 + Qx - 37 = 0$ will be $(\alpha + 1), (\beta + 1), (\gamma + 1)$

$\therefore \quad (\alpha + 1)(\beta + 1)(\gamma + 1) = \frac{37}{3}$

$\Rightarrow \quad (\alpha\beta + \alpha + \beta + 1)(\gamma + 1) = \frac{37}{3}$

$\Rightarrow \quad \alpha\beta\gamma + \alpha\gamma + \beta\gamma + \alpha\beta + \alpha + \beta + \gamma + 1 = \frac{37}{3} \quad \Rightarrow \quad C + B + A = \frac{37}{3}$

[using (1)].

हल. माना समीकरण $x^3 - Ax^2 + Bx - C = 0$ के मूल α, β, γ है। ...(1)
तो समीकरण $3x^3 + Px^2 + Qx - 37 = 0$के मूल $(\alpha + 1), (\beta + 1)$ व $(\gamma + 1)$ होगें।

$\therefore \quad (\alpha + 1)(\beta + 1)(\gamma + 1) = \frac{37}{3}$

$\Rightarrow \quad (\alpha\beta + \alpha + \beta + 1)(\gamma + 1) = \frac{37}{3}$

$\Rightarrow \alpha\beta\gamma + \alpha\gamma + \beta\gamma + \alpha\beta + \alpha + \beta + \gamma + 1 = \frac{37}{3} \Rightarrow \quad C + B + A = \frac{37}{3}$ [समीकरण (1) के प्रयोग से]

11. $f(x) = \sum_{r=1}^{n}\left((r+1)^2\ {}^nC_r - r^2\ {}^nC_{r-1}\right)$

$= \left(2^2\ {}^nC_1 - 1^2\ {}^nC_0\right) + \left(3^2\ {}^nC_2 - 2^2\ {}^nC_1\right) +$

$+ \left(4^2\ {}^nC_3 - 3^2\ {}^nC_2\right) + \ldots\ldots\ldots\ldots (n+1)^2\ {}^nC_n - n^2\ {}^nC_{n-1}$

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

$= n^2 + 2n$

12. If 1 be unit digit then total no. of number is $3! = 6$
Similarly so on if 3, 5, or 7 be unit digit number
then total no. of no. is $3! = 6$
Hence sum of all unit digit no. is $= 6\times (1+3+5+7) = 6\times 16 = 96$
Hence total sum is
$= 96 \times 10^3 + 96 \times 10^2 + 96 \times 10^1 + 96 \times 10^0$
$= 96000 + 9600 + 960 + 96 = 106656 = 16 \times 1111 \times 3!$

हल. यदि इकाई का अंक 1 हो, तो कुल संख्याओं की संख्या $= 3! = 6$
इसी प्रकार यदि 3, 5 या 7 इकाई अंक हो, तो कुल संख्याओं की संख्या $= 3! = 6$
अतः सभी इकाई अंकों की संख्याओं का योग $= 6\times (1+3+5+7) = 6\times 16 = 96$
अतः कुल योग $= 96 \times 10^3 + 96 \times 10^2 + 96 \times 10^1 + 96 \times 10^0$
$= 96000 + 9600 + 960 + 96$
$= 106656 = 16 \times 1111 \times 3!$

13. $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 2 & \lambda \end{vmatrix} = \lambda - 3$; $\Delta_x = \begin{vmatrix} 6 & 1 & 1 \\ 10 & 2 & 3 \\ \mu & 2 & \lambda \end{vmatrix}$

$= 2\lambda + \mu - 16$

$\Delta_y = \begin{vmatrix} 1 & 6 & 1 \\ 1 & 10 & 3 \\ 1 & \mu & \lambda \end{vmatrix} = 4\lambda - 2\mu + 8$

; $\Delta_z = \begin{vmatrix} 1 & 1 & 6 \\ 1 & 2 & 10 \\ 1 & 2 & \mu \end{vmatrix} = (\mu - 10)$

(i) For unique solution $\Delta \neq 0 \ \therefore \lambda \neq 3$
(ii) For infinite no. of solution $\Delta = 0$, $\Delta_x = 0$, $\Delta_y = 0$, $\Delta_z = 0$.
$\therefore \lambda = 3, \mu = 10$
(iii) For no. solution $\Delta = 0$, & at least are of $\Delta_x, \Delta_y, \Delta_z$ is non-zero.
$\therefore \lambda = 3, \mu \neq 10$

हल. $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 2 & \lambda \end{vmatrix} = \lambda - 3$;

$\Delta_x = \begin{vmatrix} 6 & 1 & 1 \\ 10 & 2 & 3 \\ \mu & 2 & \lambda \end{vmatrix} = 2\lambda + \mu - 16$

$$\Delta_y = \begin{vmatrix} 1 & 6 & 1 \\ 1 & 10 & 3 \\ 1 & \mu & \lambda \end{vmatrix} = 4\lambda - 2\mu + 8 \quad ;$$

$$\Delta_z = \begin{vmatrix} 1 & 1 & 6 \\ 1 & 2 & 10 \\ 1 & 2 & \mu \end{vmatrix} = (\mu - 10)$$

(i) अद्वितीय हल के लिए $\Delta \neq 0 \therefore \lambda \neq 3$

(ii) अनन्त हलों की संख्या के लिए $\Delta = 0, \Delta_x = 0, \Delta_y = 0, \Delta_z = 0.$

$\therefore \lambda = 3, \mu = 10$

(iii) हलों की संख्या के लिए $\Delta = 0$, तथा $\Delta_x, \Delta_y, \Delta_z$ मे से कम से कम एक अशून्य है

$\therefore \lambda = 3, \mu \neq 10$

14. $M(x) = \int \frac{dx}{e^x + 8e^{-x} + 4e^{-3x}} - 2\int \frac{dx}{e^{3x} + 8e^x + 4e^{-x}}$

$$M(x) = \int \frac{e^x(e^{2x} - 2)}{e^{4x} + 8e^{2x} + 4} dx = \int \frac{t^2 - 2}{t^4 + 8t^2 + 4} dt$$

$$= \int \frac{1 - 2t^{-2}}{(t + 2t^{-1})^2 + 4} dt = \frac{1}{2}\tan^{-1}\left(\frac{t + \frac{2}{t}}{2}\right) + c$$

$$M(\ln 2) = \frac{1}{2}\tan^{-1}\left(\frac{e^{\ln 2} + 2e^{-\ln 2}}{2}\right) + c =$$

$$\frac{1}{2}\tan^{-1}\left(\frac{3}{2}\right) + c$$

$$M(\ln 1) = \frac{1}{2}\tan^{-1}\left(\frac{3}{2}\right) + c$$

15. $A^{-1}B^2 + AB = 0$

$AA^{-1}B^2 + A^2B = 0$

$B^2 + A^2B = 0$

$B.B.B^{-1} + A2.B.B^{-1} = 0$

$B + A^2 = 0$ .....(1)

$|A^6 - 2A^4B + A^2B^2|$

$= |A^6 - 2A^4.(-A^2) + A^2.(-A^2)$

$= |4A^6| = 4^3.|A|^6$

$= 2^6 5^6 = 10^6$

16. $A^2.|A^2| - adj(adjB)$ $\{\because B + A^2 = 0$

$= A^2.|A|^2 - |B|^{3-2}.B$ $B = -A^2$

$= 25A^2 - |B|.B$ $|B| = |-A^2|$

$= 25A^2 + 25(-A^2)$ $= (-1)^3 |A^2|$

$= 0$ $= -25]$

Sol. **(17 to 18)**

$$f(x) = x + 2x\int_0^x f(t)dt$$

$$\Rightarrow \quad \frac{f(x) - x}{x} = 2\int_0^x f(t)dt \qquad \text{D. w. r. to x}$$

$$\frac{xf'(x) - f(x)}{x^2} = 2\ f(x)$$

$$\Rightarrow \quad f'(x) = \left(\frac{2x^2 + 1}{x}\right) f(x)$$

$$\int \frac{f'(x)}{f(x)} dx = \int \left(2x + \frac{1}{x}\right) dx$$

$$\Rightarrow \quad \ln f(x) = x^2 + \ln x + c$$

$$\frac{f(x)}{x} = ke^{x^2}$$

$$f(x) = kxe^{x^2} \qquad (\because f(1) = e \Rightarrow k = 1)$$

$\therefore \quad f(x) = xe^{x^2}$

$\Rightarrow$ odd function & always increasing function

विषम फलन तथा सदैव वर्धमान फलन

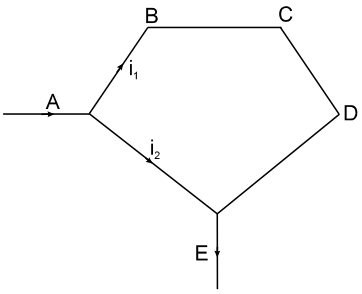
$$\int_0^1 f(x)\,dx = \int_0^1 xe^{x^2}\,dx$$

Let $x^2 = t$ $\qquad 2dx = dt$

$$\int_0^1 \frac{e^t}{2} dt = \frac{1}{2}(e - 1)$$

PART-II: PHYSICS

19.



$B_{AB} = B_{BC} = B_{CD} = B_{DE} = B_{EA}$

$\frac{i_1}{i_2} = \frac{1}{4}$ Because from V = IR

from above results $B_{ABCDE} = -B_{AE}$

So $B_{centre} = 0$

$B_{AB} = B_{BC} = B_{CD} = B_{DE} = B_{EA}$

$\frac{i_1}{i_2} = \frac{1}{4}$ क्योंकि V = IR

उपरोक्त परिणामों से $B_{ABCDE} = -B_{AE}$

So $B_{centre} = 0$

20. acceleration of each plate will be

$$\frac{F}{m} = \frac{q^2}{2A\varepsilon_0 m}$$

$$\Rightarrow a_{rel} = \frac{q^2}{A\varepsilon_0 m} \Rightarrow V_{rel} = \sqrt{2q_{rel}S_{rel}}$$

$$= \sqrt{2\left(\frac{q^2}{A\varepsilon_0 m}\right)(x_0 - x)}$$

$$V_{rel} = u_{rel} + a_{rel}\, t = 0 + \left(\frac{q^2}{A\varepsilon_0 m}\right)t \Rightarrow V_{rel} \propto t$$

$$C = \frac{\varepsilon_0 A}{x} \Rightarrow \frac{dc}{dt} = -\frac{\varepsilon_0 A}{x^2}\left(\frac{dx}{dt}\right) = -\left(\frac{\varepsilon_0 A}{x^2}\right)$$

$$(-v_{rel}) \propto \frac{t}{x^2}$$

21 For cylinder ;
बेलन के लिए

$$B = \frac{\mu_0 ir}{2\pi R^2} \quad ; \quad r < a$$

$$= \frac{\mu_0 i}{2\pi r} \quad ; \quad r \geq a$$

We can consider the given cylinder as a combination of two cylinders. One of radius 'R' carrying current I in one direction and other of radius $\frac{R}{2}$ carrying current $\frac{I}{3}$ in both directions.
हम दिये गये बेलन को दो बेलनों का संयोजन मान सकते है। एक 'R' त्रिज्या का है जिससे I धारा प्रवाहित है व दूसरा त्रिज्या $\frac{R}{2}$ का है जिससे $\frac{I}{3}$ धारा दोनों दिशाओं में प्रवाहित है।
At point A : (बिन्दु A पर)

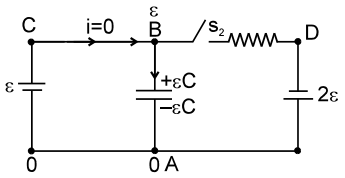
$$B = \frac{\mu_0 (I/3)}{2\pi(R/2)} + 0 = \frac{\mu_0 I}{3\pi R}$$

At point B : (बिन्दु B पर)

$$B = \frac{\mu_0}{2}\left(\frac{4I/3}{\pi R^2}\right)\left(\frac{R}{2}\right) + 0 = \frac{\mu_0 I}{3\pi R}$$

22. (i) Let Potential at point A is zero. Then at point B and C it will be □ □ (because current through the circuit is zero).
$V_B - V_A = (\varepsilon - 0)$
$\therefore$ Charge on capacitor = $C(\varepsilon - 0) = C\varepsilon$

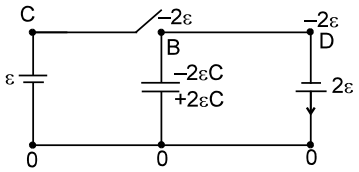
Now S_2 is closed and S_1 is open. (p.d. across capacitor and charge on it will not change suddenly)
Potential at A is zero so at D it is -2ε.



$\therefore$ current through the capacitor

$$= \frac{\varepsilon - (-2\varepsilon)}{R} = \frac{3\varepsilon}{R} \text{ (B to D)}$$

(ii) after a long time, i = 0



$V_B - V_A = V_D - V_A = -2\varepsilon$

$\therefore$ $Q = C(-2\varepsilon - 0) = -2\varepsilon C$

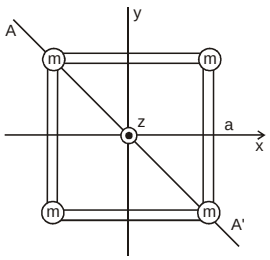
(iii) The charge on the lower plate (which is connected to the battery) changes from $-\varepsilon C$ to $2\varepsilon C$.
$\therefore$ this charge will come form the battery,
$\therefore$ charge flown from that cell is $3\varepsilon C$ downward.

23. $$I_{xx} = m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2$$

$= ma^2$

$$I_{yy} = m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2$$

$= ma^2$



$$I_{AA'} = m\left(\frac{a}{2}\right)^2 + m\left(\frac{a}{2}\right)^2 + 0 + 0 = ma^2$$

$$I_{zz} = \left(m\left(\frac{a}{2}\right)^2\right) \times 4 = 2ma^2$$

24. (1) In arrangement–1, water of weight ρVg gas come out, but the buoyancy force is also equal to the weight of displaced liquid. So, reading of weighing machine is W.
(2) In arrangement–2, weight of the ball mg is added, but water of weight $\rho_w Vg$ is removed so reading of weighing machine is $W + mg - \rho Vg$.
(1) विन्यास–1 में, ρVg भार का जल बाहर आएगा, किन्तु उत्प्लावन बल, विस्थापित द्रव के भार के तुल्य होगा। अतः भार तुला का पाठयांक W है।
(2) विन्यास–2 में, गेंद का भार mg जुड़ जाएगा, किन्तु जल भार $\rho_w Vg$ हटाया गया है, अतः भार तुला का पाठ्यांक $W + mg - \rho Vg$ होगा।

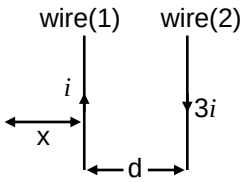
25. $\vec{B}_1 = \frac{\mu_o i}{4\pi R}(-\hat{k})$

$\vec{B}_2 = \frac{\mu_o i}{4\pi R}(-\hat{i})$

$\vec{B}_3 = \frac{\mu_o i}{4R}(-\hat{i})$

$\vec{B}_{net} = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

26.



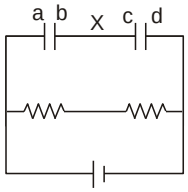
$\frac{\mu_o i}{2\pi x} = \frac{\mu_o (3i)}{2\pi(d+x)}$

$3x = d + x \Rightarrow x = \frac{d}{2}$

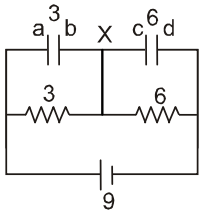
27. $Q = 3\,CV$
$Q_F = (kC + 2C)\,V^1$
$Q_i = Q_f$
$3CV\ (kC + 2C)\,V^1$

$V^1 = \frac{3V}{(k+2)}$

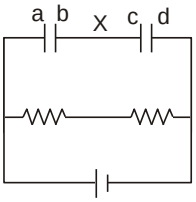
28. When switch is opened, the circuit is as following
since the capacitors are in series plates b and c will have equal and opposite charges



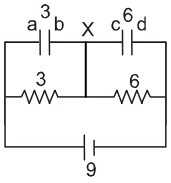
$\therefore\ q_b + q_c = 0$; also charge on each capacitor = 18μC
when switch is closed, the circuit is as following
In steady state, the current in the resistances is 1 amp. Potential difference across 3μF



= potential difference across 3Ω = 3 volt.
Similarly p.d. across 6 μF is 6 volt
$\therefore$ charge on plate b = – 9 μC
and charge on plate c = + 36 μC
$\therefore$ charge on plates b and c = +36 – 9 = +27 μC.
The change in charges on plates b and c goes through wire from Y to X.
and Δq = 27μC
जब स्विच को खोला जाता है, तो परिपथ चित्रानुसार है।
क्योकि संधारित्र श्रेणीक्रम में है। प्लेट b व c पर बराबर व विपरित आवेश होगा।



$\therefore\ q_b + q_c = 0$; प्रत्येक संधारित्र पर आवेश = 18μC है।
जब स्विच को बन्द किया जाता है। परिपथ चित्रानुसार है।
स्थायी अवस्था में प्रतिरोध में धारा 1 एम्पीयर है।
3μF के अनुदिश विभवान्तर = 3Ω के अनुदिश विभवान्तर = 3 वोल्ट
इसी प्रकार 6 μF के अनुदिश विभवान्तर 6 वोल्ट है।



$\therefore$ b प्लेट पर आवेश = – 9 μC

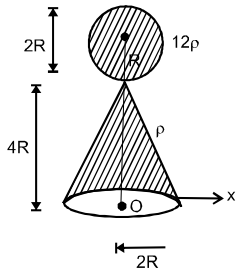
तथा c प्लेट पर आवेश = + 36 μC

$\therefore$ प्लेट b तथा c पर आवेश = +36 – 9 = +27 μC.

प्लेट b तथा c पर आवेशों में अन्तर तार Y से X में जाता है।

और $\Delta q = 27\mu C$

29.



Mass of cone $M_1 = \rho\left(\frac{1}{3}\pi(2R^2)\ \ 4R\right)$

शंकु का द्रव्यमान $M_1 = \rho\left(\frac{1}{3}\pi(2R^2)\ \ 4R\right)$

mass of sphere M_2

गोले का द्रव्यमान M_2

$= 12\rho\left(\frac{4}{3}\pi R^3\right) = \rho 16\pi\,(R^3)$

$y_1 = y_{com}(\text{Cone}) = \frac{H}{4} = \frac{4R}{4} = R$

$y_2 = y_{com}\,(\text{sphere}) = 4R + R = 5R$

$y_{com}(\text{toy}) = \frac{M_1y_1 + M_2y_2}{M_1 + M_2}$

$= \frac{16\rho\pi R^3}{3}\ (R) + 16\rho\pi\,(R^3)\,5R$

$= 16\ \pi\rho R^3$

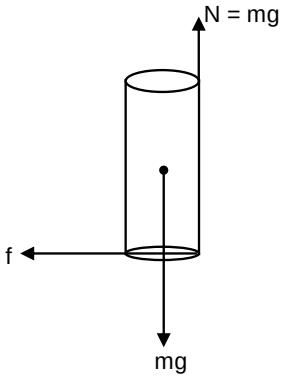
$\Rightarrow \qquad \frac{16\rho\pi R^3\left[\frac{R}{3} + 5R\right]}{16\rho\pi R^3\left[\frac{1}{3} + 1\right]} = 4R$

30. 60 cm of mercury column

60 cm पारे के स्तम्भ के बराबर।

31. FBD of cylinder at the instant when it is about to topple,

बेलन का FBD जब बेलन पलटने वाला है।



$f = m\omega^2 \times \frac{R}{2}$

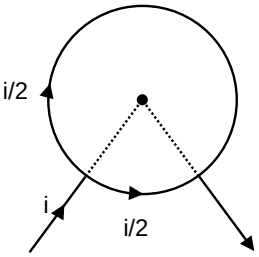
Applying condition of toppling about centre of mass of cylinder.

बेलन के COM के परितः पलटन की शर्त लगाने पर

$m\omega^2\ \frac{R}{2} \times \frac{R}{2} \le mg \times \frac{R}{4}$

$\omega \le \sqrt{\frac{g}{R}}$

32. $B_1 = \left(\frac{\mu_0(i/2)}{2R}\right) \times \frac{3}{4}$



$B_1 = \frac{3\mu_0 i}{16R}$

$B_2 = \left(\frac{\mu_0(i/2)}{2R}\right) \times \frac{1}{4} = \frac{\mu_0 i}{16R}$

$B_{net} = B_1 - B_2 = \frac{\mu_0 i}{8R}$

33. $B = \frac{\mu_0 i}{\pi^2 R},\ E = 0$

34. $B = \frac{\mu_0 i}{4\pi R}\,\ell n\left(1 + \frac{2R}{r}\right)$

35. $\frac{ML^2}{4}$

36. $\frac{3}{4}MR^2$

PART-III: CHEMISTRY

39. According to $K_P = \frac{P_{PCl_3(g)} \times P_{Cl_2(g)}}{P_{PCl_5(g)}}$

$= \frac{(n_{PCl_3(g)})_{eq.} \times (n_{Cl_2(g)})_{eq.}}{V \times (n_{PCl_5(g)})_{eq.}}$

And on adding inert gas at constant pressure effect on equilibrium will be similar to as if volume of container has been increased.

हल. $K_P = \frac{P_{PCl_3(g)} \times P_{Cl_2(g)}}{P_{PCl_5(g)}}$

$= \frac{(n_{PCl_3(g)})_{eq.} \times (n_{Cl_2(g)})_{eq.}}{V \times (n_{PCl_5(g)})_{eq.}}$ के अनुसार

तथा नियत दाब पर अक्रिय गैस मिलाने पर तथा पात्र का आयतन बढ़ाने पर, दोनो परिस्थितयों में साम्य पर प्रभाव समान होगा।

41. (A) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–OH \xrightarrow{SOCl_2}$

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–H \xrightarrow{H_2,\ Pd / BaSO_4}$

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–H$

(B) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–OH \xrightarrow{ROH / H^+}$

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–OR \xrightarrow{DIBAL\text{-}H}$

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–H$

(C) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–OH \xrightarrow{LiAlH_4}$

$CH_3–CH_2–\underset{\underset{OH}{|}}{CH_2} \xrightarrow{Cu / 300°C}$

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–H$

(D) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–OH \xrightarrow{Red\ P + HI}$

$CH_3–CH_2–CH_3$

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–OH \xrightarrow{\text{लाल P + HI}}$

$CH_3–CH_2–CH_3$

42. (A) $CH_3–CH(O–CH_3)_2 \xrightarrow{H_3O^\oplus}$

(C) $CH_3–CH_2–CH_2–CN \xrightarrow[(2)H_2O]{(1)SnCl_2 / HCl}$

(D) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–O–CH_3 \xrightarrow{H_3O^\oplus}$

44. For reaction $\Delta n < 0$ so high pressure is favoured for forward reaction.

Reaction is endothermic so high temperature favours forward reaction.

हल. अभिक्रिया के लिए $\Delta n < 0$ अतः उच्च दाब अग्र अभिक्रिया के लिए अनुकूल होता है।

अभिक्रिया ऊष्माशोषी है अतः उच्च ताप अग्र अभिक्रिया के लिए अनुकूल होता है।

46. $Cl_2 + \underset{(\text{Hot \& Conc})}{NaOH} \rightarrow NaCl + NaClO_3 + H_2O$

47. $K_P = K_C (RT)^{\Delta ng}$

$\log \frac{K_P}{K_C} = \Delta n_g \log RT$

$\log \frac{K_P}{K_C} = -\Delta n_g \log RT = 0$

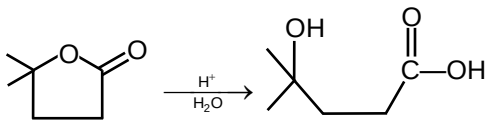
$\Delta n_g = 3$

$1 + \frac{n}{2} = 3$

$\Rightarrow \quad \frac{n}{2} = 2$

$\Rightarrow \quad n = 4$

48.



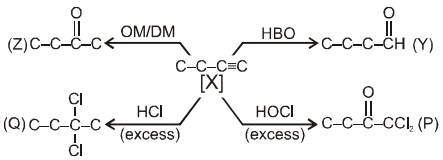
49. $KMnO_4/H^{\oplus}$ will not oxidise 3° alcohol. 2° alcohol will be oxidized to Ketone.

$KMnO_4/H^{\oplus}$, 3° एल्कोहल को ऑक्सीकृत नहीं करेगा। 2° एल्कोहल कीटोन को ऑक्सीकृत करेगा।

50. Amide reduced into amine by $LiAlH_4$.

$LiAlH_4$ द्वारा एमाइड का अपचयन ऐमीन में होता है।

53. **(53 to 54)**



PAPER-2

PART-I: MATHEMATICS

1. $x^2 + (a - b)x + (1 - a - b) = 0$

$\because \quad D > 0$

$\Rightarrow \quad (a - b)^2 - 4 \times 1 \times (1 - a - b) > 0$

$\Rightarrow \quad a^2 + b^2 - 2ab - 4 + 4a + 4b > 0$

$\because \quad b^2 + 2b(2 - a) + (a^2 + 4a - 4) > 0$

$\because \quad 4(2 - a)^2 - 4 \times 1 \times (a^2 + 4a - 4) < 0$

$4 + a^2 - 4a - a^2 - 4a + 4 < 0$

$\Rightarrow \quad 8a - 8 > 0$

$\Rightarrow \quad a > 1$

2. $= \sum_{r=1}^{10} \left(\frac{2r - 1 + 2r + 1}{r(2r-1)(2r+1)} \right) =$

$= 4 \sum_{r=1}^{10} \frac{1}{(2r-1)(2r+1)}$

$= \frac{4}{2} \sum_{r=1}^{10} \left(\frac{1}{2r-1} - \frac{1}{2r+1} \right) = 2\left[\left(1 - \frac{1}{3}\right) + \left(\frac{1}{3} - \frac{1}{5}\right) + \ldots\ldots\ldots + \left(\frac{1}{19} - \frac{1}{21}\right) \right]$

$= 2\left(1 - \frac{1}{21}\right) = \frac{40}{21}$

3. $(1 + 2x)^6 (1 - x)^7$

$= (1 + {}^6C_1 (2x) + {}^6C_2 (2x)^2 + {}^6C_3 (2x)^3 + {}^6C_4 (2x)^4 + {}^6C_5 (2x)^5 + (2x)^6)(1 - x)^7.$

$= (1 + 12x + 60x^2 + 160x^3 + 240x^4 + 192x^5 + 64x^6)(1 - x)^7$

= 1 × coeff of x^5 + 12 x coeff. of x^4 + 60 × coeff of x^3 + 160 × coeff of x^2 + 240 × coeff of x + 192 × constant term.

= 1 × x^5 का गुणांक + 12 (x^4 का गुणांक) + 60 (x^3 का गुणांक) + 160 (x^2 का गुणांक) + 240 (x^2 का गुणांक) + 192 × अचर पद

$= 1 \times (-1)^5 . {}^7C_5 + 12 \times {}^7C_4 - 60 \times {}^7C_3 + 160 \times {}^7C_2 - 240 \times {}^7C_1 + 192 \times 1$

$= -21 + 420 - 2100 + 3360 - 1680 + 192 = 171$

4. Let $x^2 + bx + c = 0$

$\Rightarrow \alpha^2 + b\alpha + c = 0$ and $\beta^2 + b\beta + c = 0$

hence $\alpha - 2 = \frac{1}{\alpha}$ and $\beta - 2 = \frac{1}{\beta}$

$\alpha^2 - 2\alpha - 1 = 0$ ..... (1)

$\beta^2 - 2\beta - 1 = 0$ ..... (2)

(1) and (2) $\Rightarrow \alpha, \beta$ are the roots of $x^2 - 2x - 1 = 0$

comparing this with $x^2 + bx + c = 0$,

$b = -2$ and $c = -1$

$b^2 + c^2 + bc = 4 + 1 + 2$

हल. माना $x^2 + bx + c = 0 \Rightarrow \alpha^2 + b\alpha + c = 0$ और $\beta^2 + b\beta + c = 0$

अतः $\alpha - 2 = \frac{1}{\alpha}$ and $\beta - 2 = \frac{1}{\beta}$

$\alpha^2 - 2\alpha - 1 = 0$ ..... (1)

$\beta^2 - 2\beta - 1 = 0$ ..... (2)

(1) और (2) से $\Rightarrow \alpha, \beta$ समीकरण $x^2 - 2x - 1 = 0$ के मूल है।

तुलना करने पर $x^2 + bx + c = 0$,

$b = -2$ और $c = -1$

$b^2 + c^2 + bc = 4 + 1 + 2$

5. If P_3 sits on C_1

यदि P_3 कुर्सी C_1 पर बैठता है।

$$4!\left(1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}\right)$$

$= 4.3 - 4 + 1 = 9$

If P_3 does not sit on C_1

यदि P_3 कुर्सी C_1 पर बैठता है।

$$= 5!\left(1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}-\frac{1}{5!}\right) = 44$$

total number of ways = 44 + 9 = 53

$$\begin{cases} P_1 & C_1 \\ P_2 & C_2 \to P_1 \\ P_3 & C_3 \to P_2 \\ P_4 & C_4 \\ P_5 & C_5 \\ P_6 & C_6 \\ P_7 & C_7 \end{cases}$$

6. for A^{-1} exists $|A| \neq 0$

Case – I : Exactly one element is zero

$^5C_3 \times \lfloor\underline{4} = 240$

Case – II : No element is zero

$$A = \begin{vmatrix} a & b \\ c & d \end{vmatrix}$$

$|A| = ad - bc = 0$ $\quad ad = bc = 6$ $\boxed{8}$

$ad = bc = 12$ $\boxed{8}$

$\Rightarrow {}^5C_4 \times \lfloor\underline{4} - 16 = 120 - 16 = 104$

Total = 344

हल. A^{-1} विद्यमान होगे के लिए $|A| \neq 0$

स्थिति – I : ठीक एक आवयव शून्य है।

$^5C_3 \times \lfloor\underline{4} = 240$

स्थिति – II : कोई अवयव शून्य नही है।

$$A = \begin{vmatrix} a & b \\ c & d \end{vmatrix}$$

$|A| = ad - bc = 0$ $\quad ad = bc = 6$ $\boxed{8}$

$ad = bc = 12$ $\boxed{8}$

$\Rightarrow {}^5C_4 \times \lfloor\underline{4} - 16 = 120 - 16$

$= 104$

कुल = 344

7. $\int \sin^4 x \quad \cos^4 x \quad dx = \frac{1}{16}$

$$\int \sin^4 2x \quad dx = \frac{1}{16}\int\left(\frac{1-\cos 4x}{2}\right)^2 dx$$

$$= \frac{1}{64}\int\left(1+\cos^2 4x - 2\cos 4x\right) dx$$

$$= \frac{1}{64}\int dx - \frac{1}{32}$$

$$\int \cos 4x \quad dx + \frac{1}{64}\int\left(\frac{1+\cos 8x}{2}\right) dx$$

$$= \frac{x}{64} - \frac{\sin 4x}{128} + \frac{1}{64}\times\frac{x}{2} + \frac{1}{128}\frac{\sin 8x}{8} + C$$

$$= \frac{3}{128}x - \frac{1}{128}\sin 4x + \frac{\sin 8x}{128\times 8} + C$$

$$= \frac{1}{128}\left[3x - \sin 4x + \frac{\sin 8x}{8}\right] + C$$

8. $$I = \int \frac{2x-8}{(x^2-8x+7)\,(x^2-8x+15)+16}\,dx$$

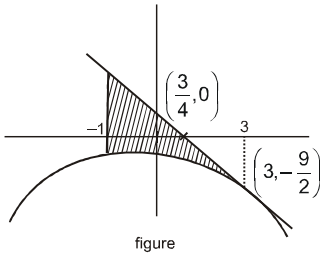
put $x^2 - 8x = t$ रखने पर

$$I = \int \frac{dt}{(t+7)\,(t+15)+16}$$

$$= \int \frac{dt}{(t+11)^2}$$

$$= -\frac{1}{t+11} + c \qquad = -\frac{1}{x^2-8x+11} + c$$

9. $x^2 + 2x - 4ky + 3 = 0$



figure

$$2x + 2 - 4k\frac{dy}{dx} = 0$$

put $x = 3$, $\quad \frac{dy}{dx} = -2$

$6 + 2 + 8k = 0$

$k = -1$

$y = -\frac{1}{4}(x^2 + 2x + 3)$

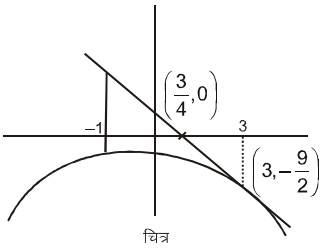
Tangent is $4x + 2y - 3 = 0$

Area =

$$\int_{-1}^{3}\left(\left(\frac{3-4x}{2}\right)-\left(-\frac{1}{4}(x^2+2x+3)\right)\right)\,dx$$

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

हल. $x^2 + 2x - 4ky + 3 = 0$



चित्र

$2x + 2 - 4k\frac{dy}{dx} = 0$

$x = 3$ रखने पर,

$\frac{dy}{dx} = -2$

$6 + 2 + 8k = 0$

$k = -1$

$y = -\frac{1}{4}(x^2 + 2x + 3)$

स्पर्श रेखा $4x + 2y - 3 = 0$

क्षेत्रफल

$$= \int_{-1}^{3}\left(\left(\frac{3-4x}{2}\right)-\left(-\frac{1}{4}(x^2+2x+3)\right)\right)\,dx$$

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

10. $$\lim_{n\to\infty}\sum_{r=1}^{n}\frac{n}{3}\left(\frac{3}{n}+\frac{9r}{n^2}\right)^2$$

$$\lim_{n\to\infty}\sum_{r=1}^{n}\frac{n}{3}.\frac{9}{n^2}\left(1+\frac{3r}{n}\right)^2$$

$$\lim_{n\to\infty}\sum_{r=1}^{n}\frac{3}{n}\left(1+\frac{3r}{n}\right)^2$$

$$3\int_0^1(1+3x)^2\,dx$$

$$\left(\frac{\cancel{3}(1+3x)^3}{\cancel{3}.3}\right)_0^1$$

$$\frac{64}{3}-\frac{1}{3}=21$$

11. $$I=\int_{\frac{1}{3}}^{3}\frac{\tan^{-1}x}{x}dx \quad \ldots.(1)$$

$$x=\frac{1}{t}$$

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

$$I=\int_{3}^{\frac{1}{3}}\frac{\tan^{-1}\left(\frac{1}{t}\right)}{\frac{1}{t}}\cdot\left(-\frac{dt}{t^2}\right)$$

$$I=-\int_{3}^{\frac{1}{3}}\frac{\tan^{-1}\left(\frac{1}{t}\right)}{t}dt$$

$$I=\int_{\frac{1}{3}}^{3}\frac{\cot^{-1}(t)}{t}dt \quad \ldots.(2)$$

$$2I=\int_{\frac{1}{3}}^{3}\frac{\tan^{-1}(x)+\cot^{-1}x}{x}dx$$

$$2I=\frac{\pi}{2}\int_{\frac{1}{3}}^{3}\frac{dx}{x}$$

$$I=\frac{\pi}{4}\ell n9$$

$$I=\frac{\pi}{8}\ell n81$$

12. First series is {1, 4, 7, 10, 13,……..}
Second series is {2, 7, 12, 17, …….}
Third series is {3, 10, 17, 24, ……}
See the least number in the third series which leaves remainder 1 on dividing by 3 and leaves remainder 2 on dividing by 5.
$\Rightarrow$ 52 is the least number of third series which leaves remainder 1 on dividing by 3 and leaves remainder 2 on dividing by 5
Now, A = 52
D is L.C. M. of (3, 5, 7) = 105
$\Rightarrow$ A + D = 52 + 105 = 157

हल. प्रथम श्रेणी {1, 4, 7, 10, 13,……..}
दुसरी श्रेणी {2, 7, 12, 17, …….}
तीसरी श्रेणी {3, 10, 17, 24, ……}
तीसरी श्रेणी में न्यूनतम संख्या 52 है जिसको 3 से विभाजित करने पर शेषफल 1 तथा 5 से विभाजित करने पर शेषफल 2 रहता है।
अब, A = 52
(3, 5, 7) का ल. स. प. D है = 105

$\Rightarrow A + D = 52 + 105 = 157$

13. $(101)^{100} - 1 = (100 + 1)^{100} - 1$
$= {}^{100}C_0(100)^{100} + {}^{100}C_1(100)^{99} + ... + {}^{100}C_{99}$ $100 + {}^{100}C_{100} - 1$
$= {}^{100}C_0(100)^{100} + {}^{100}C_1(100)^{99} + ... + (100)(100)$
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।

15. Each selection of 4 points, two on one line and two on its other will give one point of intersection.
$\therefore$ Required number of intersection = ${}^{m}C_2.{}^{n}C_2$
$= \frac{m(m-1)}{2}.\frac{n(n-1)}{2} = \frac{mn(m-1)(n-1)}{4}$

हल. 4 बिन्दुओं के प्रत्येक चयन में से दो, एक रेखा पर तथा अन्य दो दूसरी रेखा पर है जो एकप्रतिच्छेद बिन्दु होगा।
$\therefore$ R अभीष्ट प्रतिच्छेद बिन्दु = ${}^{m}C_2.{}^{n}C_2$
$= \frac{m(m-1)}{2}.\frac{n(n-1)}{2} = \frac{mn(m-1)(n-1)}{4}$

16.
$$\begin{vmatrix} \frac{1}{z} & \frac{1}{z} & -\left(\frac{x+y}{z^2}\right) \\ -\frac{(y+z)}{x^2} & \frac{1}{x} & \frac{1}{x} \\ -\frac{y(y+z)}{x^2z} & \frac{x+2y+z}{xz} & \frac{-y(x+y)}{xz^2} \end{vmatrix}$$

$$\frac{1}{x^4z^4}\begin{vmatrix} z & z & -(x+y) \\ -(y+z) & x & x \\ -yz(y+z) & xz(x+2y+z) & -xy(x+y) \end{vmatrix}$$

$C_1 \to c_1 + (-1)\, c_3$; $c_2 \to c_2 + (-1)\, c_3$

$$\frac{1}{x^4z^4}\begin{vmatrix} x+y+z & x+y+z & -(x+y) \\ -(x+y+z) & 0 & x \\ y(x^2+xy-yz-z^2) & x(xy+y^2+zx+2yz+z^2) & -xy(x+y) \end{vmatrix}$$

$$\frac{1}{x^4z^4}\begin{vmatrix} x+y+z & x+y+z & -(x+y) \\ -(x+y+z) & 0 & x \\ y(x-z)(x+y+z) & x(xy+y)(x+y+z) & -xy(x+y) \end{vmatrix}$$

$$\frac{(x+y+z)^2}{x^4z^4}\begin{vmatrix} 1 & 1 & -(x+y) \\ -1 & 0 & x \\ y(x-z) & x(y+z) & -xy(x+y) \end{vmatrix}$$

$$\frac{(x+y+z)^3}{x^4z^4}(0) = 0$$

17. $I = \int \frac{(x-1)\ dx}{x^2\sqrt{2x^2-2x+1}}$

$= \int \frac{(x-1)\ dx}{x^3\sqrt{2-\frac{2}{x}+\frac{1}{x^2}}}$

Put $2 - \frac{2}{x} + \frac{1}{x^2} = t^2$,

then $\left(\frac{x-1}{x^3}\right)dx = t\,dt$

$\Rightarrow \quad I = \int \frac{t\ dt}{t} = t + C$

$= \sqrt{2-\frac{2}{x}+\frac{1}{x^2}} + C = \frac{\sqrt{2x^2-2x+1}}{x} + C$

So $f(x) = \sqrt{2x^2-2x+1}$ and $g(x) = x$

हल. $I = \int \frac{(x-1)\ dx}{x^2\sqrt{2x^2-2x+1}}$

$= \int \frac{(x-1)\ dx}{x^3\sqrt{2-\frac{2}{x}+\frac{1}{x^2}}}$

माना $2 - \frac{2}{x} + \frac{1}{x^2} = t^2$, तो $\left(\frac{x-1}{x^3}\right)dx = t\,dt$

$\Rightarrow \quad I = \int \frac{t\ dt}{t}$

$= t + C$

$= \sqrt{2-\frac{2}{x}+\frac{1}{x^2}} + C = \frac{\sqrt{2x^2-2x+1}}{x} + C$

अतः $f(x) = \sqrt{2x^2-2x+1}$ and तथा $g(x) = x$

18. $I_{n+2} = \frac{1}{n+3}\, x^{n+3} \tan^{-1}x\Big]_0^1 - \frac{1}{n+3}$
$\int_0^1 \frac{x^{n+3}}{1+x^2}\,dx$

$$\Rightarrow (n+3)I_{n+2} = \frac{\pi}{4} - \int_0^1 \frac{x^{n+3}}{1+x^2}\,dx$$

$$\text{III}^{r}y\ (n+1)I_n = \frac{\pi}{4} - \int_0^1 \frac{x^{n+1}}{1+x^2}\,dx$$

$$\therefore (n+3)I_{n+2} + (n+1)I_n = \frac{\pi}{2} - \int_0^1 x^{n+1}\,dx$$

$$= \frac{\pi}{2} - \frac{1}{n+2}$$

$$\therefore a_n = n+3,\ b_n = n+1,\ c_n = -\frac{1}{n+2}$$

PART-II: PHYSICS

19. Magnetic field at the centre of a circular coil is

$B = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{r}$

where i is current flowing in the coil and r is radius of coil

At the centre of coil - 1,

$B_1 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_1}{r_1}$ ...(i)

At the centre of coil -2

$B_2 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_2}{r_2}$ ...(ii)

but $B_1 = B_2$

$\therefore \quad \frac{\mu_0}{4\pi}\frac{2\pi i_1}{r_1} = \frac{\mu_0}{4\pi}\frac{2\pi i_2}{r_2}$

or $\frac{i_1}{r_1} = \frac{i_2}{r_2}$

As $r_1 = 2r_2$

$\therefore \quad \frac{i_1}{2r_2} = \frac{i_2}{r_2}$ or $i_1 = 2i_2$

Now, ratio of potential differences

$\frac{V_2}{V_1} = \frac{i_2 \times r_2}{i_1 \times r_1} = \frac{i_2 \times r_2}{2i_2 \times 2r_2} = \frac{1}{4}$

$\therefore$ वृत्तीय कुण्डली के केन्द्र पर चुम्बकीय क्षेत्र

B =

where i is current flowing in the coil and r is radius of coil

At the centre of coil - 1,

$B_1 = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{r}$ ...(i)

At the centre of coil -2

$B_2 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_2}{r_2}$ ...(ii)

but $B_1 = B_2$

$\therefore \quad \frac{\mu_0}{4\pi}\frac{2\pi i_1}{r_1} = \frac{\mu_0}{4\pi}\frac{2\pi i_2}{r_2}$

or $\frac{i_1}{r_1} = \frac{i_2}{r_2}$

As $r_1 = 2r_2$

$\therefore \quad \frac{i_1}{2r_2} = \frac{i_2}{r_2}$

or $i_1 = 2i_2$

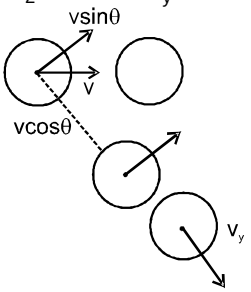
Now, ratio of potential differences

$\frac{V_2}{V_1} = \frac{i_2 \times r_2}{i_1 \times r_1} = \frac{i_2 \times r_2}{2i_2 \times 2r_2} = \frac{1}{4}$

$\therefore \quad \frac{V_1}{V_2} = \frac{4}{1}$

20. 08.00

21. $m_2 v\cos\theta = 3v_y$



$\frac{v_y}{v\cos\theta} = \frac{2}{3}$

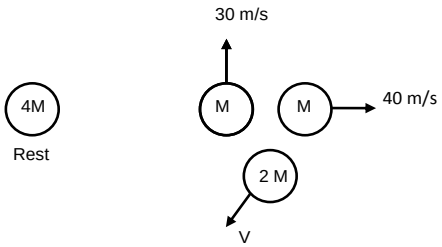
Also ओर $e = \frac{v_y}{v\cos\theta} = \frac{2}{3}$

22. $(10 \times 11 - 10 \times 6) \times 10^{-4} \times 2T = \Delta w$

$50 \times 10^{-4} \times 2T = 3 \times 10^{-4}$

$\Rightarrow \quad T = \frac{3}{100} = 3 \times 10^{-2}$ N/m.

23.



Applying C.O.L.M

$M(30\,\hat{j}) + M(40\,\hat{i}) = 2M\,\vec{v}$

$\vec{v} = \frac{30\hat{j} + 40\hat{i}}{2}$

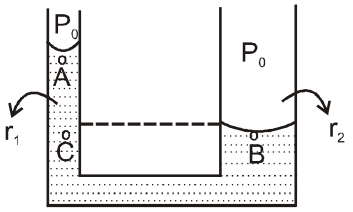
$= \frac{\sqrt{(32)^2 + (40)^2}}{2} = \frac{50}{2} = 25$ m/s

24. $R = \frac{mv}{qB} = \frac{\sqrt{2mq\Delta V}}{qB} \propto \sqrt{\frac{m}{q}}$

so $\frac{R_d}{R_P} = \sqrt{2}$

25. 04.00

26. In the shown diagram.



$P_C = P_B$

$P_0 - \frac{2T}{r_1} + \rho gh = P_0 - \frac{2T}{r_2}$

Here, we may not know in advance which tube will rise above the other, but lets say the liquid level is higher in thinner tube.

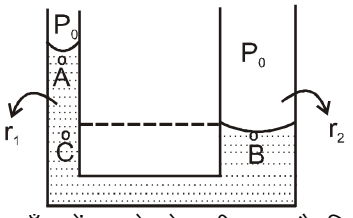
so $2T\left(\frac{1}{r_2} - \frac{1}{r_1}\right) = -\rho gh.$

$\Rightarrow \quad T = \frac{\rho gh\ r_1\ r_2}{2\ (r_2 - r_1)}$

दिये गये चित्र से

$P_C = P_B$

$P_0 - \frac{2T}{r_1} + \rho gh = P_0 - \frac{2T}{r_2}$



यहाँ हमें पहले से नही पता है कि कौनसी नली में द्रव स्तर, दूसरे की तुलना में ऊपर जायेगा लेकिन माना पतली ट्यूब (नली) में द्रव का तल ज्यादा है।

इसलिए $2T\left(\frac{1}{r_2} - \frac{1}{r_1}\right) = -\rho gh.$

$\Rightarrow \quad T = \frac{\rho gh\ r_1\ r_2}{2\ (r_2 - r_1)}$

27. $P_1 = 2.4 \times 10^{-26}$ kg–m/sec.

$P_2 = 7.0 \times 10^{-27}$ kg–m/sec

(b) $P_e = 2.4 \times 10^{-26}\,\hat{i}$, $\vec{P}_{an} = 7.0 \times 10^{-27}\,\hat{j}$

From momentum conservation, $\vec{P}_{electron} + \vec{P}_{anti\text{-}neutrino} + \vec{P}_{proton} = 0$;

so $\vec{P}_{proton} = -(\vec{P}_e + \vec{P}_{an}) = -(24 \times 10^{-27}\,\hat{i} + 7.0 \times 10^{-27}\,\hat{j})$

$\left|\vec{P}_P\right| = \sqrt{(24)^2 + (7.0)^2} \times 10^{-27}$

$V_p = \frac{|\vec{P}_p|}{m_p} = 15.0$ m/sec.

28. Tension in the string $= \frac{2m_1m_2}{(m_1 + m_2)}g$

$= \frac{2 \times 3 \times 5 \times 10}{8} = \frac{75}{2}$

Stress $= \frac{T}{A}$

$\Rightarrow \quad \frac{24}{\pi} \times 10^{-2} = \frac{75}{2(\pi r^2)}$

$\Rightarrow \quad r^2 = \frac{75}{48} \times 100$

$\Rightarrow \quad r^2 = \left(\frac{25}{2}\right)^2$

R = 12.5

29. $\frac{-dv}{v} = \frac{0.5}{100} = 0.005 = 0.005$

$B = \frac{-dP}{\frac{dv}{v}} = \frac{pgh}{\frac{-dv}{v}}$

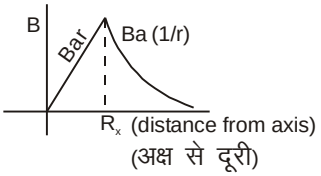
$9.8 \times 10^8 = \frac{10^3 \times 9.8 \times d}{5 \times 10^{-3}} \Rightarrow d = 500$ m

30. $h = \frac{2T\cos 45°}{r\ \rho\ g}$ ..... (i)

$\frac{h}{\sqrt{2}} = \frac{2T\cos\theta}{r\ \rho\ g}$ ..... (ii)

(i) & (ii) $\Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = 60°$

31.



$B_{in} \propto r \quad B_{oul} \propto \frac{1}{r}.$

Alternate Solution

B (inside the conductor) αr B (outside the conductor) $\alpha \frac{1}{r}$ $\therefore u = \frac{B^2}{2\mu_0} \alpha \frac{1}{r^2}$

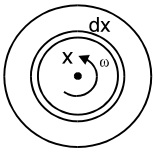
वैकल्पिक विधि :

B (चालक के अन्दर) αr B (चालक के बाहर) $\alpha \frac{1}{r}$ $\therefore u = \frac{B^2}{2\mu_0} \alpha \frac{1}{r^2}$

32. Consider a ring of radius x and thickness dx.

Equivalent current in this ring

$= \frac{\omega}{2\pi} \times$ charge on ring $= \frac{\omega}{2\pi} \times (2\pi \times dx) \frac{Q}{\pi R^2}$



dB (due to this ring) $= \frac{\mu_0}{2x}\left(\frac{\omega}{2\pi}\frac{2xQ}{R^2}dx\right)$

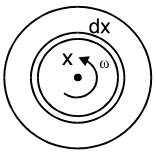
$\therefore B = \int_0^R \frac{\mu_0\omega}{2\pi}\frac{Q}{R^2}dx.$

$= \frac{\mu_0\omega\theta}{2\pi R^2}.R = \frac{\mu_0\omega\theta}{2\pi R}.$

त्रिज्या x व मोटाई dx की एक वलय पर विचार करें।

इस वलय में तुल्य धारा $= \frac{\omega}{2\pi} \times$ वलय पर आवेश

$= \frac{\omega}{2\pi} \times (2\pi \times dx) \frac{Q}{\pi R^2}$

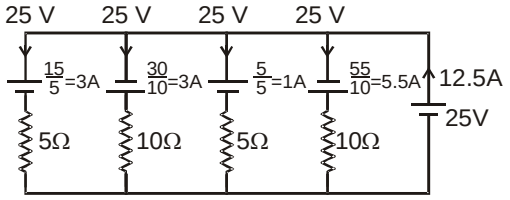


dB (इस वलय के कारण) $= \frac{\mu_0}{2x}\left(\frac{\omega}{2\pi}\frac{2xQ}{R^2}dx\right)$

$\therefore B = \int_0^R \frac{\mu_0\omega}{2\pi}\frac{Q}{R^2}dx.$

$= \frac{\mu_0\omega\theta}{2\pi R^2}.R = \frac{\mu_0\omega\theta}{2\pi R}.$

33.



34. Applying Bernoulli is equation from section–(1) and (2)

खण्ड–(1) से खण्ड–(2) में बरनॉली समीकरण लगाने पर

$P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$

$P_1 + \frac{1}{2}\rho V^2 + 0 = P_2 + \frac{1}{2}\rho(2v)^2 + \rho g h$

and तथा

$P_1 - P_2 = \rho g(2h)$

Solving we get,

हल करने पर प्राप्त होगा

$V = \sqrt{\frac{2gh}{3}}$

(C) Work done by gravitation force per unit value W_{gr} = decrease in gravitational PT_{value} $= \rho g h_1 - \rho g h_2$

गुरूत्वीय बल द्वारा प्रति इकाई आयतन किया गया कार्य W_{gr} = गुरूत्वीय स्थितिज ऊर्जा में कमी $PT_{value} = \rho g h_1 - \rho g h_2$

$W_{gr} = 0 - \rho g h$

(D) Work done by elastic force volume, प्रत्यास्थ बलों द्वारा प्रति इकाई आयतन पर किया गया कार्य

W_e = decrease in elastic

$P.E._{vol}$ = decrease in pressure

W_e = प्रत्यास्थ स्थितिज ऊर्जा में कमी

$P.E._{vol}$ = दाब में कमी

$= P_1 - P_2 = \rho g(2h).$

35 Zero magnetic field will be recorded at Q when particle is at A and B such that AQ and BQ are tangent to circle.

$\therefore$ zero magnetic field will be recorded at Q at time $\frac{T}{6}, T-\frac{T}{6}, T+\frac{T}{6}, 2T-\frac{T}{6}$.....

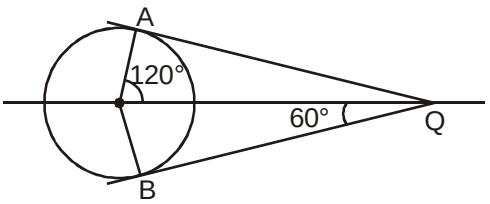
where $T = \frac{2\pi}{\omega}$

Q पर चुम्बकीय क्षेत्र शून्य होगा। जब कण A तथा B पर होंगे तब AQ तथा BQ वृत्त पर स्पर्श रेखा होगी।

$\therefore$ Q पर चुम्बकीय क्षेत्र निम्न समयों पर शून्य होगा $\frac{T}{6}, T-\frac{T}{6}, T+\frac{T}{6}, 2T-\frac{T}{6}$..... जहाँ

$T = \frac{2\pi}{\omega}$

$\therefore$ $t = \frac{\pi}{3\omega}, \frac{5\pi}{3\omega}, \frac{7\pi}{3\omega}, \frac{11\pi}{3\omega}$,.....



36. (A) $\alpha = -3$

(B) $\beta = 4$

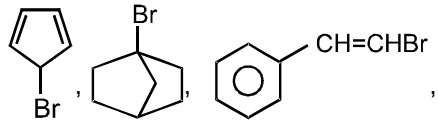
(D) $\gamma = -2$

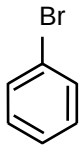
PART-III: CHEMISTRY

43. $NaHCO_3$, $KHCO_3$, NH_4HCO_3 and $CsHCO_3$ can exist in solid state

$NaHCO_3$, $KHCO_3$, NH_4HCO_3 तथा $CsHCO_3$ ठोस अवस्था में अस्तित्व रख सकते है।

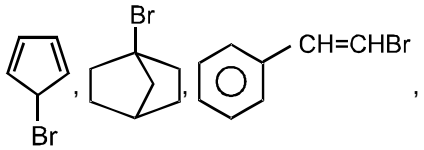
44.

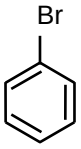




are inert towards nucleophilic substitution by H_2O in aqueous solution.

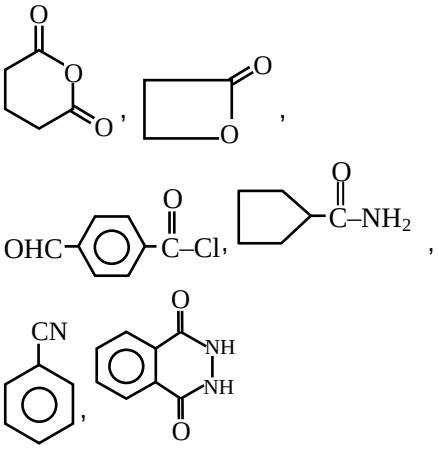
हल.





यौगिक जलीय विलयन में H_2O द्वारा नाभिकस्नेही प्रतिस्थापन के प्रति अक्रिय है।

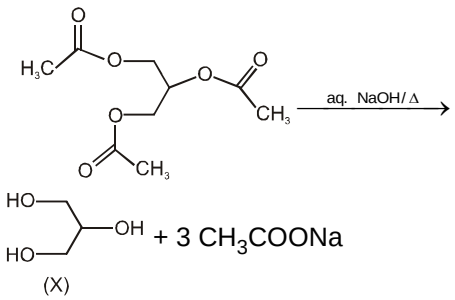
45.



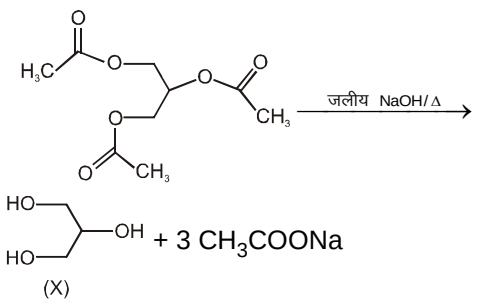
46. In free radical substitution reaction alkyl free radical formation is rate determining step.

हल. मुक्त मुलक प्रतिस्थापन अभिक्रिया में एल्किल मुक्त मूलक निर्माण दर निर्धारक पद होता है।

47. HCHO and HCOOH

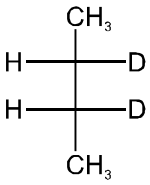


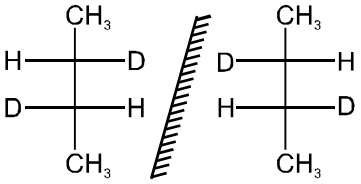
हल. HCHO तथा HCOOH

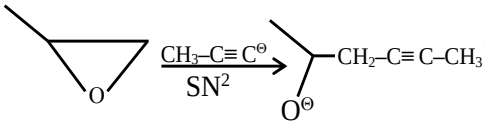


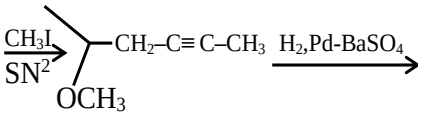
48. x = 1 (meso) (मीसो)

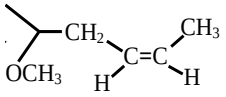
y = 2 (racemic mixture) (रेसेमिक मिश्रण)

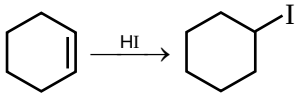
x is 

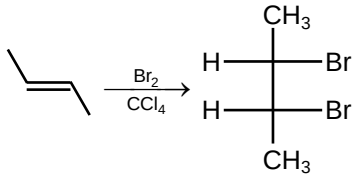
y is 

53. 

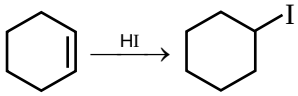


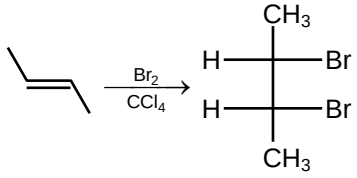


54. (A) 

(D) 

(trans gives meso product on anti addition)

हल. (A) 

(D) 

(विपक्ष समावयवी एन्टी योग पर मिसो उत्पाद देता है I)

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

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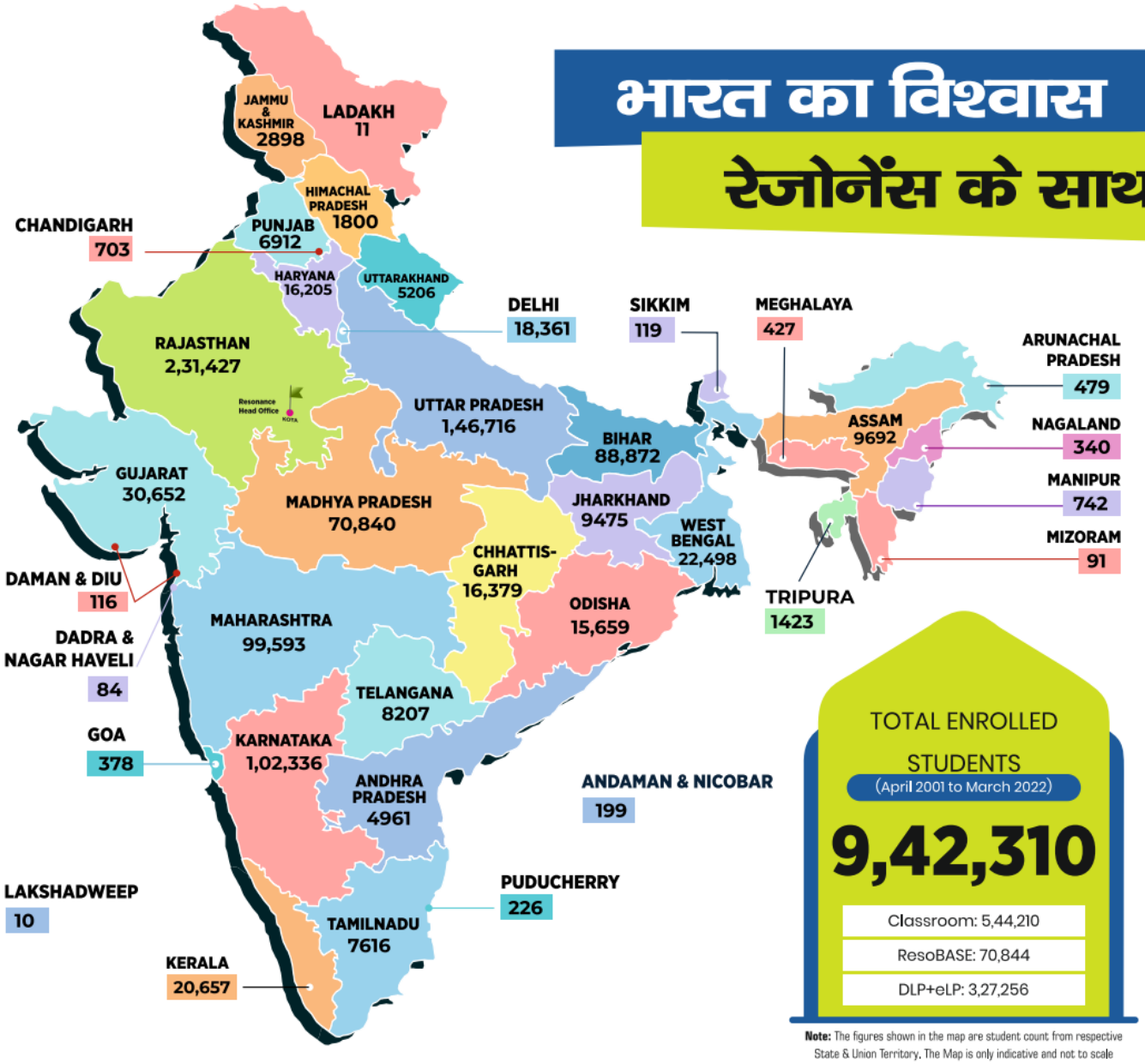
रेजोनेंस के साथ



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