SAHODAYA PRE BOARD

NAME OF THE EXAM: Sahodaya Pre - Board 2025 - 2026,
SUBJECT: MATHEMATICS (041) CLASS : XII

SET - 1

MARKING SCHEME

Q.No.	ANSWER KEY	MARKS
	SECTION - A	
1.	b) $y = sin^{-1}2x$	1
2.	c) $m \times n$	1
3.	c) $x = 8, y = 8$	1
4.	a) 12	1
5.	b)64	1
6.	a) -5	1
7.	b) f is everywhere continuous but not differentiable $at\ x = n\pi, n \in Z$	1
8.	b)1.5	1
9.	b) (0,2)	1
10.	b) 2 and 4	1
11.	d) $\frac{\mathrm{a+b}}{2}\int_{\mathrm{a}}^{\mathrm{b}} \mathrm{f(x)dx}$	1
12.	a) $\cot(xe^{-x}) + c$	1
13.	d) $\frac{5\vec{p}+3\vec{q}}{8}$	1
14.	a) [0,20]	1
15.	a)1	1
16.	d) every point on the line segment joining the points (0.6, 1.6) and (3, 0)	1
17.	a) $\mathrm{a - 3b + 2 = 0}$	1
18.	b) $\frac{2}{5}$	1
19.	(c) A is true but R is false.	1
20.	(d) A is false but R is true	1
	SECTION – B	
21	$-1 \le x^2 - 4 \le 1 \Rightarrow 3 \le x^2 \le 5$ $\Rightarrow x \in [-\sqrt{5}, -\sqrt{3}] \cup [\sqrt{3}, \sqrt{5}]$ OR $tan^2(sec^{-1}2) + cot^2(cosec^{-1}3) = sec^2(sec^{-1}2) - 1 + cosec^2(cosec^{-1}3) - 1$ $= 4 - 1 + 9 - 1 = 11$	1 1 1 1

22	$\lim\limits_{x\to 0}\frac{1-coskx}{xsinx}=\lim\limits_{x\to 0}\frac{2sin^2\frac{kx}{2}}{xsinx}=\lim\limits_{x\to 0}\frac{2sin^2\frac{kx}{2}}{\frac{k^2x^2}{4}\frac{sinx}{x}\times\frac{4}{x^2}}=\frac{k^2}{2}$ So $\frac{k^2}{2}=\frac{1}{2}\Rightarrow k=\pm 1$	1 1
23	$u=cos^{-1}(2x^2-1)=cos^{-1}(cos2\theta)=2cos^{-1}x\ (putting\ x=cos\theta)$ $v=cos^{-1}x$ $\frac{du}{dx}=-\frac{2}{\sqrt{1-x^2}}\qquad \frac{dv}{dx}=-\frac{1}{\sqrt{1-x^2}}$ $\Rightarrow\frac{du}{dv}=2$	1 1
24	$\int_0^{\frac{\pi}{6}}e^{2x}\left(\frac{1+sin2x}{1+cos2x}\right)dx=\int_0^{\frac{\pi}{6}}e^{2x}\left(\frac{1}{2}sec^2x+tanx\right)dx$ Put $t=2x\Rightarrow dt=2dx$ $\int_0^{\frac{\pi}{6}}e^{2x}\left(\frac{1+sin2x}{1+cos2x}\right)dx=\int_0^{\frac{\pi}{3}}e^t\left(\frac{1}{2}sec^2\frac{t}{2}+tan\frac{t}{2}\right)\frac{dt}{2}$ $=\frac{1}{2}\left\|e^t tan\frac{t}{2}\right\|_0^{\frac{\pi}{3}}=\frac{1}{2\sqrt{3}}e^{\frac{\pi}{3}}$ **OR** let x=t^2 $\Rightarrow$ dx=2tdt $I=\int\frac{2tdt}{t(t+1)(t+2)}$ $=2\int\left(\frac{1}{t+1}-\frac{1}{t+2}\right)dt$ $=\log\left\|\frac{\sqrt{x}+1}{\sqrt{x}+2}\right\|^2+c$	1 1 ½ ½ ½ ½
25	$(\vec{a}+\vec{b})$ and $(\vec{a}-\vec{b})$,where $\vec{a}=(4\hat{\imath}+3\hat{\jmath}+\hat{k})$ and $\vec{b}=(2\hat{\imath}-\hat{\jmath}+2\hat{k})$ $(\vec{a}+\vec{b})=(6\hat{\imath}+2\hat{\jmath}+3\hat{k})$ $(\vec{a}-\vec{b})=(2\hat{\imath}+4\hat{\jmath}-\hat{k})$ $(\vec{a}+\vec{b})\times(\vec{a}-\vec{b})=\begin{vmatrix}\hat{\imath}&\hat{\jmath}&\hat{k}\\6&2&3\\2&4&-1\end{vmatrix}=-14\hat{\imath}+12\hat{\jmath}+20\hat{k}=\vec{c}$ (say) $\hat{c}=\frac{\vec{c}}{\|\vec{c}\|}=\frac{1}{\sqrt{740}}(-14\hat{\imath}+12\hat{\jmath}+20\hat{k})$	½ ½ ½ ½

	SECTION - C	
26	∵ $y = \log\left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)^2$ ⇒ $y = 2\log\left(\sqrt{x}+\frac{1}{\sqrt{x}}\right) = 2\log\left(\frac{x+1}{\sqrt{x}}\right)$ $y = 2\log(x+1) - 2\log\sqrt{x}$ ⇒ $y = 2\log(x+1) - \log x$ ⇒ $y_1 = \frac{2}{x+1} - \frac{1}{x} = \frac{2x-x-1}{x(x+1)}$ ⇒ $y_1 = \frac{x-1}{x(x+1)}$	1
	⇒ $y_2 = \frac{x(x+1)-(x-1)(2x+1)}{x^2(x+1)^2}$ ⇒ $y_2 = \frac{x^2+x-2x^2-x+2x+1}{x^2(x+1)^2}$ ⇒ $y_2 = \frac{-x^2+2x+1}{x^2(x+1)^2}$	1
	Now, $x(x+1)^2y_2+(x+1)^2y_1 = x(x+1)^2.\frac{-x^2+2x+1}{x^2(x+1)^2}+(x+1)^2.\frac{(x-1)}{x(x+1)}$ $= \frac{-x^2+2x+1}{x}+\frac{(x+1)(x-1)}{x}$ $= \frac{-x^2+2x+1+x^2-1}{x} = \frac{2x}{x} = 2$ Hence proved.	1
	OR	
	Since, f is differentiable at 1. ⇒ f is also continuous at 1. Now $\lim_{x\to 1^+} f(x) = \lim_{h\to 0} f(1+h)$ [Here h is +ve and very small quantity] $= \lim_{h\to 0} 2(1+h)+1 = 2+1 = 3$ $\lim_{x\to 1^-} f(x) = \lim_{h\to 0} f(1-h) = \lim_{h\to 0}\{a(1-h)^2+b\} = a+b$ Since $f(x)$ is continuous at $x = 1$. ⇒ $a+b = 3$	1
	...(i) Again, since f is differentiable. ⇒ LHD (at $x = 1$) = RHD (at $x = 1$) ⇒ $\lim_{h\to 0}\frac{f(1-h)-f(1)}{-h} = \lim_{h\to 0}\frac{f(1+h)-f(1)}{h}$ ⇒ $\lim_{h\to 0}\frac{a(1-h)^2+b-3}{-h} = \lim_{h\to 0}\frac{2(1+h)+1-3}{h}$ ⇒ $\lim_{h\to 0}\frac{a-2ah+ah^2+b-3}{-h} = \lim_{h\to 0}\frac{2+2h+1-3}{h}$	1
	⇒ $\lim_{h\to 0}\frac{-2ah+ah^2+(a+b)-3}{-h} = \lim_{h\to 0}\frac{2h}{h}$ ⇒ $\lim_{h\to 0}\frac{-2ah+ah^2+3-3}{-h} = 2$ [From (i)] ⇒ $\lim_{h\to 0}\frac{ah(2-h)}{h} = 2$ ⇒ $2a = 2$ ⇒ $a = 1$ ⇒ $b = 2$	1/2+1/2
27	**Sol.** Here, objective function is $Z = 5x + 2y$ ...(i) Subject to the constraints : $x - 2y \le 2$ ...(ii) $3x + 2y \le 12$ ...(iii) $-3x + 2y \le 3$ ...(iv)	1

$x \geq 0, y \geq 0$ ...(v)

Graph for $x - 2y \leq 2$

We draw graph of $x - 2y = 2$ as 1

x	0	2
y	–1	0

$0 - 2 \times 0 \leq 2$ [By putting $x = y = 0$ in the equation]

i.e., (0, 0) satisfy (*ii*) $\Rightarrow$ feasible region lie origin side of line $x - 2y = 2$.

Graph for $3x + 2y \leq 12$

We draw the graph of $3x + 2y = 12$.

x	0	4
y	6	0

$3 \times 0 + 2 \times 0 \leq 12$ [By putting $x = y = 0$ in the given equation]

i.e., (0, 0) satisfy (*iii*) $\Rightarrow$ feasible region lie origin side of line $3x + 2y = 12$.

Graph for $-3x + 2y \leq 3$

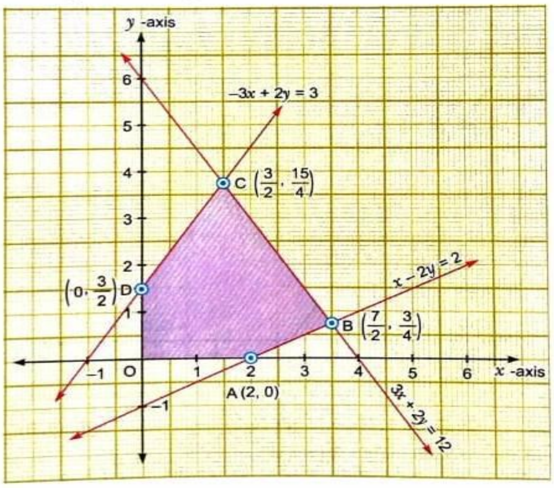
We draw the graph of $-3x + 2y = 3$

x	–1	0
y	0	1.5

$-3 \times 0 + 2 \times 0 \leq 3$ [By putting $x = y = 0$]

i.e., (0, 0) satisfy (*iv*) $\Rightarrow$ feasible region lie origin side of line $-3x + 2y = 3$.

$x \geq 0, y \geq 0 \Rightarrow$ feasible region is in Ist quadrant.



1

Now, we get shaded region having corner points O, A, B, C and D as feasible region.

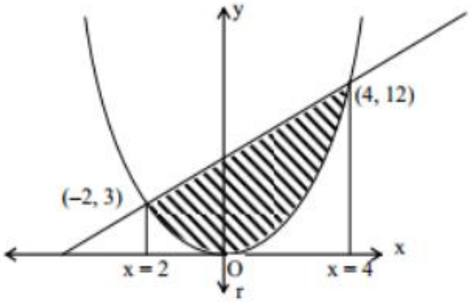
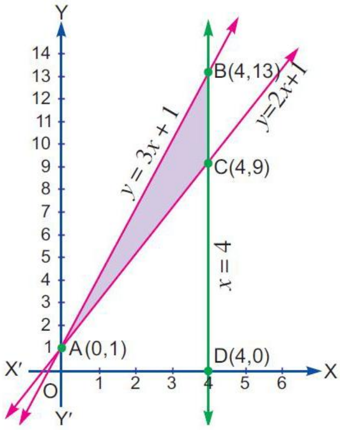
The co-ordinates of O, A, B, C and D are $O(0, 0)$, $A(2, 0)$, $B\left(\frac{7}{2}, \frac{3}{4}\right)$, $C\left(\frac{3}{2}, \frac{15}{4}\right)$ and $D\left(0, \frac{3}{2}\right)$ respectively. Now, we evaluate Z at the corner points.

Corner Points	$Z = 5x + 2y$
$O\ (0, 0)$	0 ← Minimum
$A\ (2, 0)$	10
$B\left(\frac{7}{2}, \frac{3}{4}\right)$	19 ← Maximum
$C\left(\frac{3}{2}, \frac{15}{4}\right)$	15
$D\left(0, \frac{3}{2}\right)$	3

Hence, Z is minimum at $x = 0$, $y = 0$ and minimum value = 0

also Z is maximum at $x = \frac{7}{2}$, $y = \frac{3}{4}$ and maximum value = 19.

28	$\vec{a}_2 - \vec{a}_1 = \hat{j} - 4\hat{k}$ $\vec{b}_1 \times \vec{b}_2 = 2\hat{i} - 4\hat{j} - 3\hat{k}$ $(\vec{a}_2 - \vec{a}_1).(\vec{b}_1 \times \vec{b}_2) = 8$ $\lvert \vec{b}_1 \times \vec{b}_2 \rvert = \sqrt{29}$ correct formula $SD = \frac{8}{\sqrt{29}}$ **OR** Any point on the line 1 is (3n-1,5n-3,nk-5) Any point on line 2 is (m+2,3m+4,5m+6) For point of intersection 3n-1=m+2,5n-3=3m+4,nk-5=5m+6 Solving first two equations n=1/2,m=-3/2 Putting the value of n and m in third equation k=7	½ ½ ½ ½ 1 ½ ½ 1 ½ ½
29	E_1=Missing card is a heart card. E_2=Missing card is a spade card. E_3=Missing card is a club card. E_4=Missing card is a diamond card. $p(E_1) = p(E_2) = p(E_3) = p(E_4) = \frac{1}{4}$ $p(A/E_1) = \frac{^{12}c_2}{^{51}c_2}, p(A/E_2) = \frac{^{13}c_2}{^{51}c_2}, p(A/E_3) = \frac{^{13}c_2}{^{51}c_2}$ $p(A/E_4) = \frac{^{13}c_2}{^{51}c_2}$ Using Baye's theorem $p(E_1/A) = \frac{11}{50}$	**1** **1** **1**

30	 Required area= $\int_{-2}^{4}\left(\frac{3x+12}{2}-\frac{3x^2}{4}\right)=27 sq\ units$ **OR** The given lines are $y=2x+1\,......(i)$ $y=3x+1\,........(ii)$ $x=4\,.....(iii)$ For intersection point of (i) and (iii)  Shaded region is required triangular region: Required area = area of trapezium, OABD – area of trapezium OACD $=\int_0^4(3x+1)dx-\int_0^4(2x+1)dx=\left[\frac{3x^2}{2}+x\right]_0^4-\left[\frac{2x^2}{2}+x\right]_0^4$ = 8 sq units.	**1** **1+1** **1 ½** **1 ½**
31	Let v be the velocity of the car at t sec. Now $x=t^2\left(2-\frac{t}{3}\right)$ $\Rightarrow v=\frac{dx}{dt}=t(4-t)$ V=0 gives t=0 or t=4 Now v=0 at P as well as at Q,t=4. Thus the car will reach the point Q after 4 sec. Also the distance travelled in 4 sec is given by $\frac{32}{3}m$.	½ 1 ½ 1

	SECTION - D	
32	System of equations: $15=4a+2b+c$ $25=16a+4b+c$ $15=196a+14b+c$ Express in AX=B form $\lvert A\rvert=-240$ $adj(A)=\begin{pmatrix}-10 & 12 & -2\\ 180 & -192 & 12\\ -560 & 336 & -16\end{pmatrix}$ $a=-\frac{1}{2},b=8,c=1$ Equation of path is $y=-\frac{1}{2}x^2+8x+1$	1 1 1 1 1
33	$I=\int_0^\pi \frac{xdx}{a^2cos^2x+b^2sin^2x}$ $=\int_0^\pi \frac{(\pi-x)dx}{a^2cos^2(\pi-x)+b^2sin^2(\pi-x)}$ $=\pi\int_0^\pi \frac{dx}{a^2cos^2x+b^2sin^2x}-I$ So, $2I=\pi\int_0^\pi \frac{dx}{a^2cos^2x+b^2sin^2x}$ $=2\pi\int_0^{\frac{\pi}{2}}\frac{\sec^2 x}{a^2+b^2\tan x}dx$ let $b\tan x=t$ $=\frac{2\pi}{b}\int_0^\infty\frac{dt}{a^2+t^2}$ $=\frac{2\pi}{ab}\left[\tan^{-1}\frac{t}{a}\right]_0^\infty$ $=\frac{2\pi}{ab}.\frac{\pi}{2}$ $=\frac{\pi^2}{ab}$ $\Rightarrow I=\frac{\pi^2}{2ab}$ **OR**	1 1 1 1 1

	$I=\int\frac{\sqrt{x^2+1}\left(\log(x^2+1)-2\log x\right)}{x^4}dx$ $=\int\sqrt{1+\frac{1}{x^2}}\log\left(1+\frac{1}{x^2}\right)\frac{dx}{x^3}$ Let $1+\frac{1}{x^2}=t^2$ $=-2\int t^2\log t dt$ $=-2\left[\frac{t^3}{3}\log t-\frac{t^3}{4}\right]+c$ where t = $\sqrt{1+\frac{1}{x^2}}$	1 1 1 1 1
34	$\frac{dy}{dx}+\frac{2xy}{x^2-1}=\frac{2}{\left(x^2-1\right)^2}$ $P=\frac{2x}{x^2-1},Q=\frac{2}{\left(x^2-1\right)^2}$ $IF=x^2-1$ $Solution: y\left(x^2-1\right)=\int\left(x^2-1\right)\frac{2}{\left(x^2-1\right)^2}dx$ $\Rightarrow y\left(x^2-1\right)=\log\left\|\frac{x-1}{x+1}\right\|+c$ **OR** $\frac{dy}{dx}=\frac{x^2y}{x^3+y^3}$ put y=vx $\Rightarrow$ v+x $\frac{dv}{dx}=\frac{v}{1+v^3}$ $\Rightarrow$ x $\frac{dv}{dx}=\frac{-v^4}{1+v^3}$ $\Rightarrow\int\frac{1+v^3}{v^4}dv=-\int\frac{dx}{x}$ $\Rightarrow\frac{-1}{3v^3}+\log\|v\|=-\log\|x\|+\log c$ $\Rightarrow\frac{x^3}{3y^3}=\log\left\|\frac{y}{c}\right\|$	1 1 1 2 1 1 1 1 1

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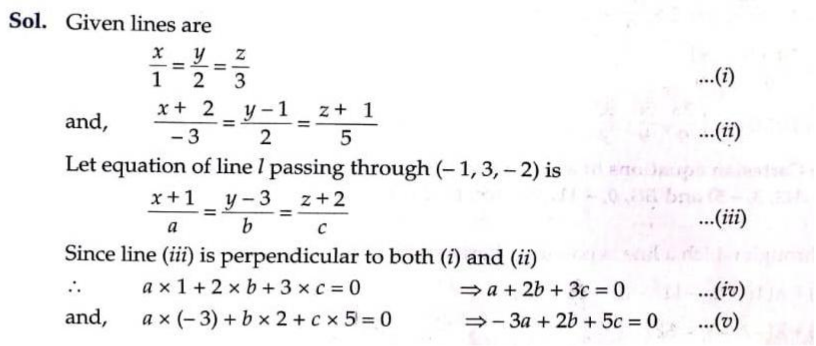

Sol. Given lines are

$$\frac{x}{1}=\frac{y}{2}=\frac{z}{3} \quad ...(i)$$

and, $$\frac{x+\ 2}{-3}=\frac{y-1}{2}=\frac{z+\ 1}{5} \quad ...(ii)$$

Let equation of line *l* passing through (– 1, 3, – 2) is

$$\frac{x+1}{a}=\frac{y-3}{b}=\frac{z+2}{c} \quad ...(iii)$$

Since line (*iii*) is perpendicular to both (*i*) and (*ii*)

$\therefore \quad a\times 1+2\times b+3\times c=0 \qquad \Rightarrow a+2b+3c=0 \quad ...(iv)$

and, $\quad a\times(-3)+b\times 2+c\times 5=0 \qquad \Rightarrow -3a+2b+5c=0 \quad ...(v)$

$$\frac{a}{10-6}=\frac{b}{-9-5}=\frac{c}{2+6}$$

$$\Rightarrow \frac{a}{2}=\frac{b}{-7}=\frac{c}{4}=\lambda$$

Required equation is $\frac{x+1}{2}=\frac{y-3}{-7}=\frac{z+2}{4}$

i.e. $\vec{\mathrm{r}}=\left(-\hat{i}+3\hat{j}-2\hat{k}\right)+\lambda\left(2\hat{i}-7\hat{j}+4\hat{k}\right)$

and $\vec{\mathrm{r}}=\left(-3\hat{j}+4\hat{k}\right)+\mu\left(2\hat{i}-7\hat{j}+4\hat{k}\right)$

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SECTION - E

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(i) $L=40-2x, b=25-2x, h=x$

(ii) $V=(25-2x)(40-2x)x=4x^3-130x^2+1000x$

(iii) $\frac{dV}{dx}=12x^2-260x+1000=0, x=5\ or\ \frac{50}{3}$ are critical points.

X=50/3 not possible as breadth will be negative

$$\frac{d^2V}{dx^2}=24x-260$$

At x=5 ,$\frac{d^2V}{dx^2}<0$

So, Volume is maximum for $x=5$

Max Volume =2250

OR

$$\frac{dV}{dx}=12x^2-260x+1000=0 \Rightarrow x=5\ or\ \frac{50}{3}$$

<table>
<tr><td>Interval</td><td>Sign of $\frac{dV}{dx}=4(3x-50)(x-5)$</td><td>Nature</td></tr>
<tr><td>$(-\infty,5)$</td><td>+ ve</td><td>St Increasing</td></tr>
<tr><td>$\left(5,\frac{50}{3}\right)$</td><td>-ve</td><td>St decreasing</td></tr>
<tr><td>$\left(\frac{50}{3},\infty\right)$</td><td>+ ve</td><td>St Increasing</td></tr>
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So, V(x) is strictly increasing in

$(-\infty,5)\cup\left(\frac{50}{3},\infty\right)$

And strictly decreasing in

$\left(5,\frac{50}{3}\right)$

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37	**(i)** $2^{20}-2^{12}$ **(ii)** ${}^5p_4=5!$ **(iii)** 2^{20} OR 4^5	1 1 2 2
38	Let E_1 be the event that one parrot and one owl flew from cage I Let E_2 be the event that two parrots flew from cage II Let A be the event that the owl is still in cage I $i)P(A)=\frac{\left({}^5c_1\times{}^1c_1\right)\left({}^7c_1\times{}^1c_1\right)+{}^5c_2\times{}^8c_2}{\left({}^5c_1\times{}^1c_1\right)\left({}^7c_1\times{}^1c_1\right)+\left({}^5c_1\times{}^1c_1\right){}^7c_2+{}^5c_2\times{}^8c_2}$ $=\frac{315}{420}=\frac{3}{4}$ $ii)P\left(\frac{E_1}{A}\right)=\frac{\frac{35}{420}}{\frac{315}{420}}=\frac{1}{9}$	2 2 2

-----x-----