B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

PRE BOARD-2 EXAMINATION- 2025-26
MATHEMATICS (041)

Class: XII A **Marking Scheme** **Time: 3 hr**
Date: **Max Marks: 80**
Admission no: **Roll no:**

Q.no.	SECTION A	Marks
1	(c) b/a cosecθ	1
2	(a) 2	1
3	(a) 8	1
4	(d) i $\neq$ j	1
5	(c) 0	1
6	(b) Unbounded	1
7	(c) $\left(\pm\frac{1}{\sqrt{3}},\pm\frac{1}{\sqrt{3}},\pm\frac{1}{\sqrt{3}}\right)$	1
8	(a) $\sqrt{3}$	1
9	(b) 1 and 4	1
10	(a) 512	1
11	(c) -2	1
12	(b) x^2	1
13	(c) parabola	1
14	(c) ± 6	1
15	(b)1-P (A)	1
16	(b) $\pm\frac{1}{\sqrt{3}}(-\hat{\imath}+\hat{\jmath}+\hat{k})$	1
17	(b) -24	1
18	(b) $\frac{\pi}{4}$	1
19	(c) Assertion is correct, reason is incorrect	1
20	(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.	1
	SECTION B	
21	$-1\leq 2x^2-4\leq 1$ $3\leq 2x^2\leq 5$ $x\in\left[\frac{\sqrt{3}}{2},\frac{\sqrt{5}}{2}\right]$ **OR**	 1 1

	$\tan^{-1}(\tan\ \pi + \frac{\pi}{6})$ $\frac{\pi}{6} \in \left(-\frac{\pi}{2}, \quad \frac{\pi}{2}\right)$	1 1
22	$\frac{x^2+x+1}{(x+2)(x^2+1)} = \frac{A}{x+2} + \frac{Bx+c}{x^2+1}$ A=3/5 , B= 2/5 and C = 1/5 $\frac{x^2+x+1}{(x+2)(x^2+1)} = \frac{3}{5(x+2)} + \frac{\frac{2}{5}x+\frac{1}{5}}{x^2+1}$ $\int \frac{x^2+x+1}{(x+2)(x^2+1)}dx$ $= \frac{3}{5}\log\|x+2\| + \frac{1}{5}log\|x^2+1\| + \frac{1}{5}\tan^{-1}x \ + C$	½ 1/2 1
23	$\lim_{x\to3^+} f(x) = \lim_{x\to3^-} f(x) = f(3)$ f(3) = 4 $\lim_{x\to3^+} f(x) = \lim_{x\to3^+} 3x - 5 = 4$ $\lim_{x\to0^-} f(x) = \lim_{x\to3^-} x + k = 3 + k$ 3+k = 4 , k = 1	½ ½ ½ 1/2
24	the volume of a cube with radius "x" is given by V = x^3 ans surface area = $6x^2$ Hence, the rate of change of volume "V' with respect to the time "t" is given by: $\frac{dV}{dt} = 9$ cm^3/s $9 = \frac{dV}{dt} = \frac{d}{dt}x^3 = 3x^2.\frac{dx}{dt}$, By using the chain rule $\frac{dx}{dt} = \frac{3}{x^2}$ $\frac{ds}{dt} = \frac{d(6x^2)}{dt} = 12\frac{dx}{dt} = 12 \times \frac{3}{x^2} = \frac{36}{x}$ At x= 10 , $\frac{ds}{dt} = 3.6$ cm^2/s **OR** p(x) = 41-72x-18x^2 P'(x) = -72 -36 P'' = -36 For maximum or minina or critical points p'(x) =0 -72 -36x =0 , x=-2 x=-2, p'' (-2) = -36 <0	½ 1/2 1/2 ½ ½ ½ ½

	hence x= -2 is a point of local maxima, maximum profit = 113	½
25	f(x) = $-\frac{x}{2}$ +sinx, f'(x) = -1/2+cosx as, 1/2$< cosx < 1/2$ -1/2+cosx > 0, Since, f'(x) $>$0 therefore f(x) is increading on given interval.	½ 1/2 ½ 1/2
	SECTION C	
26	$y^x + x^y + x^x = a^b$ $\frac{d}{dx}(y^x + x^y + x^x) = \frac{d}{dx}a^b$ $\frac{d}{dx}(y^x + x^y + x^x) = 0$ $\frac{du}{dx} + \frac{dv}{dx} + \frac{dw}{dx} = 0$ Taking log one by one for u = y^x ,v= x^y, w= x^x $\frac{du}{dx} = y^x\left(\frac{x}{y}\frac{dy}{dx} + logy\right)$, $\frac{dv}{dx} = x^y\left(\frac{y}{x} + logx\frac{dy}{dx}\right)$, $\frac{dw}{dx} = x^x(1 + logx)$ $\frac{du}{dx} + \frac{dv}{dx} + \frac{dw}{dx}$ $= y^x\left(\frac{x}{y}\frac{dy}{dx} + logy\right) + x^y\left(\frac{y}{x} + logx\frac{dy}{dx}\right) + x^x(1 + logx)$ $= 0$ OR If x= a(cost +t sint) and y = a(sint-t cost), find $\frac{d^2y}{dx^2}$ $\frac{dx}{dt} = atcost \quad and \ \frac{dy}{dt} = at\ cost$ $\frac{dy}{dx} = tant$ $\frac{d^2y}{dx^2} = sec^2t\frac{dt}{dx}$	1/2 ½ ½ ½ 1/2 ½ 1+1 1/2 1/2

$$\frac{d^2y}{dx^2} = \frac{sec^2t}{at}$$

27

x_i	2	3	4	5	6	7	8	9	10	11	12
$P_i(x)$	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

2

1

E(X) = μ $= \sum_{i=1}^{n} x_i P_i = 7$

OR

½

Let E be the event that 'number 4 appears at least once' and F be the event that 'the sum of the numbers appearing is 6'. Then,

½

E = {(4,1), (4,2), (4,3), (4,4), (4,5), (4,6), (1,4), (2,4), (3,4), (5,4), (6,4)}

1/2

F = {(1,5), (2,4), (3,3), (4,2), (5,1)}

½

P(E) = 11/36 and P(F) = 5/36 ,

1/2

E∩F = {(2,4), (4,2)}, P(E∩F) = 2/36

1/2

P(E/F) = $\frac{P(E\cap F)}{P(F)} = \frac{2}{5}$

28

$$\frac{dy}{dx} + ycotx = 4x\ cosecx$$

P= cot x , Q = 4x cosec x ½

I.F = $e^{\int \cot x dx} = sinx$ ½

y I.F. = $\int Q.IF\ dx$ 1/2

y sinx = $\int$ 4x cosec x sinxdx =$\int$ 4x dx ½

y sinx = $2x^2$ +C, C = $-\frac{\pi^2}{2}$ ½

y sinx = $2x^2 - \frac{\pi^2}{2}$ ½

OR

Clearly given equation is homogeneous differential equation

Let x=vy ⟹ dy/dx = v+y (dv/dy) ½

$2e^v$dv = -1/y dy ½

Integrating both side

$2e^{x/y}$ – log|c/y|. 1

½

1/2

29	$$\int_1^4 [\lvert x-1\rvert + \lvert x-2\rvert + \lvert x-3\rvert]\, dx$$ $\int_1^4 \lvert x-1\rvert dx + \int_1^4 \lvert x-2\rvert dx + \int_1^4 \lvert x-3\rvert dx$ = $\int_1^4 (x-1)dx + \int_1^2 -(x-2)dx + \int_2^4 (x-2) + + \int_1^3 -(x-3) + \int_3^4 (x+3)$ For calculation $$\int_1^4 [\lvert x-1\rvert + \lvert x-2\rvert + \lvert x-3\rvert]\, dx = \frac{19}{2}$$	½ 1 1 1/2
30	$$\int \frac{x+3}{\sqrt{5-4x+x^2}} dx$$ X+3 = A $\frac{d}{dx}(5-4x+x^2) + B$ A=-1/2 and B = 1 $\int \frac{x+3}{\sqrt{5-4x+x^2}} dx$ $$= -\frac{1}{2}\int \frac{(-4-2x)}{\sqrt{5-4x+x^2}} dx + \int \frac{dx}{\sqrt{5-4x+x^2}}$$ For calculation $$\int \frac{x+3}{\sqrt{5-4x+x^2}} dx = -\sqrt{5-4x+x^2} + \sin^{-1}\frac{x+2}{3} + C$$	½ ½ ½ 1 1/2
31	Proper graph Corner points (2,72), (15,20) , (40,15) Max. of Z = 285, at (40, 15)	2 ½ ½
	SECTION D	
32	For labelled and correct diagram	2

	Required area = $\int_{-2}^{4}\frac{3x+12}{2}dx - \int_{-2}^{4}\frac{3}{4}x^2dx$ For calculation = 27sq units	1/2 2 1/2
33	To prove reflexive To prove symmetric To prove transitive Proving T_1 related with T_3 $\frac{3}{6}=\frac{4}{8}=\frac{5}{10}$ OR Showing one one Taking cases, x_1,x_2 both are even , x_1,x_2 both are odd and x_1,x_2 one is odd another is even Showing onto by any method	1 1 2 1 3 2
34	(i) 2x +4y +3z = 29000 5x +2x +3x = 30500 x +y + z = 9500 (ii) matrix method AX=B $X=A^{-1}B$ IAI = -1 adj A=$\begin{bmatrix}-1 & -1 & 6\\ -2 & -1 & 9\\ 3 & 2 & -16\end{bmatrix}$ calculation X= 2500, y= 3000 and z =4000	1 ½ ½ 2 ½ ½
35	$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}\ \ and\ \ \frac{x-2}{3}=\frac{y-4}{4}=\frac{z-5}{5}$ $\overrightarrow{a_1}=\hat{\imath}+2\hat{\jmath}+3\hat{k}$,$\overrightarrow{a_2}=2\hat{\imath}+4\hat{\jmath}+5\hat{k}$ $\overrightarrow{b_1}=2\hat{\imath}+3\hat{\jmath}+4\hat{k}$,$\overrightarrow{b_2}=3\hat{\imath}+4\hat{\jmath}+5\hat{k}$ $\overrightarrow{a_2}-\overrightarrow{a_1} = \hat{\imath}+2\hat{\jmath}+2\hat{k}$ $\overrightarrow{b_1}\times\overrightarrow{b_2} = -\hat{\imath}+2\hat{\jmath}-\hat{k}$ $\left\|\overrightarrow{b_1}\times\overrightarrow{b_2}\right\| = \sqrt{6}$	1 ½ 1 ½

	$(\overrightarrow{b_1} \times \overrightarrow{b_2}).(\overrightarrow{a_2} - \overrightarrow{a_1}) = 1$ S.D. = d = $\left\lvert \frac{(\overrightarrow{b_1} \times \overrightarrow{b_2}).(\overrightarrow{a_2} - \overrightarrow{a_1})}{\lvert \overrightarrow{b_1} \times \overrightarrow{b_2} \rvert} \right\rvert$ Shortest distance d = $\frac{1}{\sqrt{6}}$ The lines do not intersect **OR** Eq. of line $\vec{r} = \vec{a} + \lambda\vec{b}$ Line passes through (1,2,-4) and let (a,b,c) be the D,Ratio of line then Eq of line is $\vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(a\hat{\imath} + b\hat{\jmath} + c\hat{k})$ Line is perpendicular to the lines $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$ $\vec{a} \times \vec{b}$ *is perpendicular to* $\vec{a}$ *and* $\vec{b}$ *both* $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 3 & -16 & 7 \\ 3 & 8 & -5 \end{vmatrix}$ = $24\hat{\imath} + 36\hat{\jmath} + 72\hat{k}$ Hence D' Ratio of line is (24,36,72) Eq. of line $\frac{x-1}{24} = \frac{y-2}{36} = \frac{z+4}{72}$ $\vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(24\hat{\imath} + 36\hat{\jmath} + 72\hat{k})$ $\vec{r} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + 6\hat{k})$	½ ½ ½ 1/2 ½ 1/2 $2\frac{1}{2}$ ½ ½ ½
	SECTION E	
36	Let A be the event that the doctor visit the patient late and let E_1, E_2, E_3, E_4 be the events that the doctor comes by cab, metro, bike and other means of transport respectively. P(E1)=0.3, P(E2)=0.2, P(E3)=0.1, P(E4)=0.4 P(A I E_1) = Probability that the doctor arriving late when he comes by cab = 0.25 Similarly, P (A I E_2) = 0.3, P (A I E_3) = 0.35 and P (A I E_4) = 0.1 P(A) = $P(E_1)P\left(\frac{A}{E_1}\right) + P(E_2)P\left(\frac{A}{E_2}\right) + P(E_3)P\left(\frac{A}{E_3}\right) +$ $P(E_4)P\left(\frac{A}{E_4}\right)$	

	P(A) = 0.25x0.3 + 0.3x0.2 + 0.1x0.35 + 0.4x0.1 = 0.21 (i)P(E_4/A) = $\frac{P(E_4)P(A/E_4)}{P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P\left(\frac{A}{E_2}\right)+P(E_3)P\left(\frac{A}{E_3}\right)+P(E_4)P\left(\frac{A}{E_4}\right)} = \frac{4}{21}$ (i)P(E_2/A) = $\frac{P(E_2)P(A/E_2)}{P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P\left(\frac{A}{E_2}\right)+P(E_3)P\left(\frac{A}{E_3}\right)+P(E_4)P\left(\frac{A}{E_4}\right)} = \frac{2}{7}$ (iii) P(E_3/A) + P(E_4/A) = $\frac{P(E_3)P\left(\frac{A}{E_3}\right)+P(E_4)P(A/E_4)}{P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P\left(\frac{A}{E_2}\right)+P(E_3)P\left(\frac{A}{E_3}\right)+P(E_4)P\left(\frac{A}{E_4}\right)} = \frac{5}{14}$ **OR** P(E_1/A) + P(E_2/A) = $\frac{P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P(A/E_2)}{P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P\left(\frac{A}{E_2}\right)+P(E_3)P\left(\frac{A}{E_3}\right)+P(E_4)P\left(\frac{A}{E_4}\right)} = \frac{9}{14}$	1 1 2 2
37	(i)we have $\overrightarrow{OA} = 8\hat{\imath}\ km\ \overrightarrow{AB} = 6\hat{\jmath}$ vector distance from Gitika's house to school =$8\hat{\imath} + 6\hat{\jmath}$ (ii)vector distance from school to Aloke's house = 6cos$30^0\hat{\imath} + 6sin30^0\hat{\jmath}$ = $3\sqrt{3}\hat{\imath} + 3\hat{\jmath}$ (iii)vector distance from Gitika's house to Aloke's house= $8\hat{\imath} + 6\hat{\jmath} + 3\sqrt{3}\hat{\imath} + 3\hat{\jmath}$ =$(8 + 3\sqrt{3})$+9$\hat{\jmath}$ **OR** The total distance travel by Gitika from her house to Aloke's house= 8 + 6 + 6 = 20 km	1 1 2 2
38	Let the increase of ₹ x in annual subscription of ₹ 300 maximize the profit of the company. Due to this increase of ₹ x, x subscriber will discontinue. Therefore Number of subscriber = 500-x Annual subscription = ₹ (300+x) R be the total revenue =(500-x)(300-x) $\frac{dR}{dx} = 200 - 2x\ and\ \frac{d^2R}{dx^2} = -2$ For critical point $\frac{dR}{dx} = 200 - 2x = 0$, x= 100 $\frac{d^2R}{dx^2} < 0\ at$ x=100 So R is maximum at x=100 and maximum R = 400x400=160000	2 2 2

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