CODE:2801- AG-21-23-24 पजियन क्रमांक **REG.NO:-TMC -D/79/89/36**

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.
7. All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks has been provided. An internal choice has been provided in the 2marks questions of Section E

EXAMINATION 2023 -24

Time : 3 Hours | Maximum Marks : 80

CLASS – XII | **CBSE** | **MATHEMATICS**

Sr. No.	**SECTION – A** **This section comprises of very short answer type-questions (VSA) of 2 marks each**	Marks
Q.1	If $X_{m\times 4}Y_{p\times 4}=Z_{5\times b}$, for three matrices X,Y,Z, find the values of m, p and b. (A) $m=4, p=5, b=4$ (B) $m=4, p=4, b=5$ (C) $m=5, p=4, b=4$ (D) NONE	1
Q.2	The value of a , b , c when the matrix $\begin{bmatrix} o & 1 & b \\ a & o & c \\ -2 & -1 & 3 \end{bmatrix}$ is skew symmetric matrix (A) 1,-2, -1(B)-1 , 2, 1 (C) -1,2,-1(D) NONE OF THESE	1

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Q.3	The matrix $\begin{bmatrix} 2 & \lambda & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ is non singular, if (a) $\lambda \neq -2$ (b) $\lambda \neq 2$ (c) $\lambda \neq 3$ (d) $\lambda \neq -3$	1
Q.4	For what value of λ the function defined by $f(x) = \begin{cases} \lambda(x^2+2), & \text{if } x \leq 0 \\ 4x+6, & \text{if } x > 0 \end{cases}$ is continuous at x = 0 (a)-2 (b) 3 (c) -3 (d) 2	1
Q.5	If $\lvert \mathbf{a} \rvert = 3, \lvert \mathbf{b} \rvert = 4$ then a value of λ for which $\mathbf{a} + \lambda\mathbf{b}$ is perpendicular to $\mathbf{a} - \lambda\mathbf{b}$ is (a) $\frac{9}{16}$ (b) $\frac{3}{4}$ (c) $\frac{3}{2}$ (d) $\frac{4}{3}$	1
Q.6	The solution of $(x\sqrt{1+y^2})dx + (y\sqrt{1+x^2})dy = 0$ is (a) $\sqrt{1+x^2} + \sqrt{1+y^2} = c$ (b) $\sqrt{1+x^2} - \sqrt{1+y^2} = c$ (c) $(1+x^2)^{3/2} + (1+y^2)^{3/2} = c$ (d)None of these	1
Q.7	A shopkeeper wants to purchase two articles A and B of cost price Rs. 4 and Rs. 3 respectively. He thought that he may earn 30 paise by selling article A and 10 paise by selling article B He has not to purchase total articles of more than Rs. 24. If he purchases the number of articles of A and B, x and y respectively, then linear constraints are (a) x ≥ 0, y ≥ 0,4 x + 3y ≤ 24 (b) x ≥ 0, y ≥ 0,30 x + 10y ≤ 24 (c) x ≥ 0, y ≥ 0,4 x + 3y ≥ 24 (d) x ≥ 0, y ≥ 0,30 x + 40y ≥ 24	1
Q.8	Direction ratios of the line represented by the equation $x = ay + b,\ z = cy + d$ are (a) $(a, 1, c)$ (b) $(a, b-d, c)$ (c) $(c, 1, a)$ (d) (b, ac, d)	1
Q.9	If $\int_0^k \frac{dx}{2+8x^2} = \frac{\pi}{16}$, then k = (a) 1 (b) $\frac{1}{2}$ (c) $\frac{1}{4}$ (d)None of these	1
Q.10	If $\Delta = \begin{vmatrix} a & b & c \\ x & y & z \\ p & q & r \end{vmatrix}$, then $\begin{vmatrix} ka & kb & kc \\ kx & ky & kz \\ kp & kq & kr \end{vmatrix} =$ (a) Δ (b) $k\Delta$ (c) $3k\Delta$ (d) $k^3\Delta$	1
Q.11	The minimum value of the objective function Z = 2x + 10y for linear constraints x − y ≥ 0, x − 5y ≤ −5 and x, y ≥ 0 is (a) 10 (b) 15 (c) 12 (d) 8	1
Q.12	If $\lvert \mathbf{a} \rvert = 2, \lvert \mathbf{b} \rvert = 5$ and $\lvert \vec{\mathbf{a}} \times \vec{b} \rvert = 8$, then $\vec{\mathbf{a}} . \vec{b}$ is equal to (a) o (b) 2 (c) 4 (d) 6	1

Q.13	If A is a square matrix of order 3, then the value of $\lvert 3A \rvert$ (a) $3\lvert A \rvert$ (b) $\lvert A \rvert$ (c) $9\lvert A \rvert$ (d) $27\lvert A \rvert$	1
Q.14	Two cards are drawn successively with replacement from a well shuffled deck of 52 cards then the mean of the number of aces is (a) 1/13 (b)3/13(c)2/13(d)None of these	1
Q.15	The order and degree of the differential equation $x\left(\frac{dy}{dx}\right)^3 + 2\left(\frac{d^2y}{dx^2}\right)^2 + 3y + x = 0$ are respectively (a) 3, 2 (b)2, 1(c) 2, 2 (d) 2, 3	1
Q.16	$\lvert \vec{\mathbf{a}}\times\mathbf{i} \rvert^2 + \lvert \vec{\mathbf{a}}\times\mathbf{j} \rvert^2 + \lvert \vec{\mathbf{a}}\times\mathbf{k} \rvert^2 =$ (a) $\lvert \vec{\mathbf{a}} \rvert^2$ (b) $2\lvert \vec{\mathbf{a}} \rvert^2$ (c) $3\lvert \vec{\mathbf{a}} \rvert^2$ (d) $4\lvert \vec{\mathbf{a}} \rvert^2$	1
Q.17	$f(x)=\begin{cases} 1-x & x<1 \\ (1-x)(2-x) & 1\le x\le 2 \\ 3-x & x>2 \end{cases}$ at x = 1 & x = 2 . Which of these is true? **(a)**f(x) is continuous at x = 1 and discontinuous at x = 2 **(b)** f(x) is differentiable at x = 1 but f(x) is not differentiable at x = 2 **(c)** f(x) is continuous at x = 1 and f(x) is differentiable at x = 1 (d) **all three**	1
Q.18	If the co-ordinates of the points A, B, C, D be (1, 2, 3), (4, 5, 7), (–4, 3, –6) and (2, 9, 2) respectively, then the angle between the lines AB and CD is (a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) None of these	1
	ASSERTION-REASON BASED QUESTIONS In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices. (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.	
Q.19	Assertion (A): The function f(x) tanx – x always increases . Reason (R): The value(s) of x for which $f'(x) > 0$, $f(x)$ is increasing; and the value(s) of x for which $f'(x) < 0$, $f(x)$ is decreasing.	1
Q.20	**Assertion (A) :** For real function of x , range of the function $y=\frac{1}{2-\sin 3x}$ *is* $\frac{1}{3}\le y\le 1$. **Reason (R):** range of sin x [-1,1] .	1

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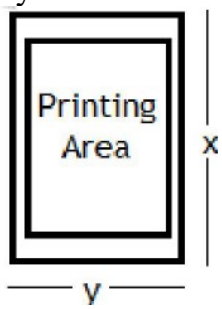
	SECTION – B **This section comprises of very short answer type-questions (VSA) of 2 marks each**	
Q.21	Find the intervals in which the function $f(x)=\sin\left(2x+\frac{\pi}{4}\right), 0\le x\le 2\pi$ is (a) increasing (b) decreasing.	2
Q.22	Prove : $\tan^{-1}\left(\frac{6x-8x^3}{1-12x^2}\right)-\tan^{-1}\left(\frac{4x}{1-4x^2}\right)=\tan^{-1}(2x)$. **OR** Prove the following : $\sin\left[\tan^{-1}\left(\frac{1-x^2}{2x}\right)+\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right]=1,\ 0<x<1$.	2
Q.23	Find λ when the scalar projection of $\vec{a}=\lambda\hat{i}+\hat{j}+4\hat{k}$ on $\vec{b}=2\hat{i}+6\hat{j}+3\hat{k}$ is 4 units .	2
Q.24	Find the interval in which the functions $f(x)=-3\log(1+x)+4\log(2+x)-\frac{4}{2+x}$ is strictly decreasing. **OR** Find the point when $f(x)=\sec x+\log(\cos^2 x),\ 0<x<2\pi$ is maximum or minimum also find maximum and minimumvalue .	2
Q.25	A stone is dropped into a quiet lake and waves move in circles at a speed of 4cm per second. At the instant, when the radius of the circular wave is 10 cm, how fast is the enclosed area increasing	2
	SECTION – C **(This section comprises of short answer type questions (SA) of 3 marks each)**	
Q.26	If $\vec{a},\vec{b}\ \vec{c}$ are mutually perpendicular vectors of equal magnitudes, show that the vector $\vec{a}+\vec{b}+\vec{c}$ is equally inclined to $\vec{a},\vec{b}$ and $\vec{c}$. Also, find the angle which $\vec{a}+\vec{b}+\vec{c}$ makes with $\vec{a}$ or $\vec{b}$ or $\vec{c}$.	3
Q.27	Evaluate: $\int \frac{dx}{x[(\log x)^2+4\log x-1]}$. **OR** Evaluate : $\int_{-2}^{2}\frac{x^2}{1+5^x}dx$	3
Q.28	A and B take turn in throwing two dices. The first to throw 9 being awarded. Show that if A has the first throw, their chances of winning are in the ratio 9:8. **OR** A speaks truth 3 out of four times, B speaks truth 4 out of five times and C speaks truth 5 out of six times of the cases. What is the probability that, of the three person	3

	A , B & C a majority speaks truth ?	
Q.29	Show that the solution of differential equation : $y = 2(x^2 - 1) + ce^{-x^2}$ is $\frac{dy}{dx} + 2xy - 4x^3 = 0$. OR The equation of the curve passing through the origin and satisfying the equation $(1 + x^2)\frac{dy}{dx} + 2xy = 4x^2$.	3
Q.30	If $\sin y = x\sin(a + y)$, prove that $\frac{dy}{dx} = \frac{\sin^2(a + y)}{\sin a}$.	3
Q.31	Maximize z = 6x + 3y subject to the constraints, $3x + 2y \le 150; x + 5y \ge 115; 4x + y \ge 80; x, y \ge 0$.	3
	SECTION – D **(This section comprises of long answer-type questions (LA) of 5 marks each)**	
Q.32	A line with direction numbers <2, 7, -5> is drawn to intersect the lines $\frac{x-5}{3} = \frac{y-7}{-1} = \frac{z+2}{1}$ and $\frac{x+3}{-3} = \frac{y-3}{2} = \frac{z-6}{4}$. Find the co –ordinates of the points of intersection and the length intercepted on it. **OR** Find the shortest between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$. Also find the equation of this line (S.D.).	5
Q.33	Using integration, find the area lying above x-axis and included between the circle $x^2 + y^2 = 8x$ and interior of the parabola $y^2 = 4x$.	5
Q.34	Let A = {1, 2, 3…… 9} and R be the relation in $A \times A$ defined by (a, b) R(c, d) if a + d = b + c for (a, b), (c, d) $\in A \times A$. . Prove that R is an equivalence relation and also obtain the equivalence class [(2, 5)] . **OR** Consider $f : R_+ \to [-9, \infty)$ given by $f(x) = 5x^2 + 6x - 9$. Show that f is invertible with $f^{-1}(y) = \left[\frac{\sqrt{5y + 54} - 3}{5}\right]$.	5
Q.35	Evaluate : $\int \sqrt{\left(\frac{1 - \sqrt{x}}{1 + \sqrt{x}}\right)}\, dx$.	5
	SECTION – E (This section comprises of 3 case study / passage – based questions of 4 marks each with two sub parts (i),(ii),(iii) of marks 1, 1, 2 respectively.The third case study question has two sub – parts of 2 marks each.)	
Q.36	**Case Study based-3**	

There is a local printing press, whose owner is given a bulk order for printing of a magazine by a school of the same locality. He shows variety of pages to school administration. Following is the pictorial description for a particular page, selected by school administration.



The total area of the page is 150 cm^2 . The combined width of the margin at the top and bottom is 3 cm and the side 2 cm. Using the information given above, answer the following

i. The relation between x and y is given by
(a) (x - 3)y =150 (b) xy =150 (c) x(y - 2) =150 (d) (x - 2)(y - 3) = 150 — 1

ii. For what value of 'x', the printable area of the page is maximum?
(a) 15 cm (b) 10 cm (c) 12 cm (d) 15 units — 1

iii. The area of the printable region of the page, in terms of x, is — 2

(a) $156 + 2x + \frac{450}{x}$ (b) $156 - 2x + 3\left(\frac{150}{x}\right)$ (c) $156 - 2x - 15\left(\frac{3}{x}\right)$ (d) $156 - 2x + -3\left(\frac{150}{x}\right)$

OR

What should be dimension of the page so that it has maximum area to be printed?
(a) Length = 1 cm, width =15 cm (b) Length =15 cm, width =10 cm
(c) Length =15 cm, width =12 cm (d) Length 150 cm, width 1 cm

Q.37

Case Study based-2

For the schools of Delhi state, the Department of Education (DOE) issues a notice to help flood victims in some states of India. Authorities of three private schools namely A, B and C decided to organize a fair for collecting money for helping the flood victims. These schools encouraged their students to make handmade fans, mats and plates from recycled materials. The students sold these handmade fans, mats and plates at a cost of Rs 25, Rs 100 and Rs.50 each respectively.



The number of articles sold are given as

School / Article	A	B	C
Handmade fans	40	25	35
Mats	50	40	50
Plates	20	30	40

Based on the information given above, answer the following questions :

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i.	What is the total money collected by the school A? (a) Rs.700 (b) Rs.7000 (c) Rs.6125 (d) Rs.7875	1
ii.	What is the total amount of money (in Rs.) collected by schools B and C? (a) Rs 14000 (b) Rs 15725 (c) Rs 21000 (d) Rs 13125	1
iii.	What is the total amount of money (in Rs.) collected by all the three schools A, B and C? (a) Rs 15775 (b) Rs 14000 (c) Rs 21000 (d) Rs 17125 **OR** Number of handmade fans made by the students of schools A, B and C are 20, 30 and 40 respectively; and the no. of plates made by the students of schools A, B and C are 40, 25 and 35 respectively. Moreover the no. of mats made by the students of respective schools remains unchanged. Then what is the total money collected by all schools? (a) Rs.21250 (b) Rs.6750 (c) Rs.21000 (d) Rs.7000	2
Q.38	**Case Study based-2** An insurance company insured 3000 cyclists, 4000 scooter drivers and 5000 car drivers. The probability of an accident involving a cyclists , scooter driver and a car driver are 0.02, 0.03 and 0.04 respectively. One of the insured persons meets with an accident.	
i.	What is the probability that he is a cyclists driver .	2
ii.	What is the probability that he is a car driver .	2
	"शिक्षा कभी भी व्यर्थ नहीं होती भले ही वो किसी भी तरह की ग्रहण की गई हो।"	