CODE:1002- AG-7-FC-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 — **MATHEMATICS**

Sr. No.	SECTION – A **This section comprises of very short answer type-questions (VSA) of 2 marks each**	Marks
Q.1	If $A=\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}$, I is the unit matrix of order 2 and a, b are arbitrary constants, then $(aI+bA)^2$ is equal to (a) a^2I+abA (b) $a^2I+2abA$ (c) a^2I+b^2A (d) None of these	1
Q.2	If $A=\begin{bmatrix}4 & 3 & 3\\ -1 & 0 & -1\\ -4 & -4 & -3\end{bmatrix}$ .Then the matrix A (A) Nilpotent matrix (B) Involutory matrix (C) Idempotent (D)Orthogonal	1

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Q.3	Let $A=\begin{pmatrix}1 & -1 & 1\\ 2 & 1 & -3\\ 1 & 1 & 1\end{pmatrix}$ and $(10)B=\begin{pmatrix}4 & 2 & 2\\ -5 & 0 & \alpha\\ 1 & -2 & 3\end{pmatrix}$. If B is the inverse of matrix A, then α is (a) 5 (b) -1 (c) 2 (d) -2	1
Q.4	Which one is the correct statement about the function $f(x) = \sin 2x$ (a) $f(x)$ is increasing in $\left(0,\frac{\pi}{2}\right)$ and decreasing in $\left(\frac{\pi}{2},\pi\right)$ (b) $f(x)$ is decreasing in $\left(0,\frac{\pi}{2}\right)$ and increasing in $\left(\frac{\pi}{2},\pi\right)$ (c) $f(x)$ is increasing in $\left(0,\frac{\pi}{4}\right)$ and decreasing in $\left(\frac{\pi}{4},\frac{\pi}{2}\right)$ (d) The statements (a), (b) and (c) are all correct	1
Q.5	If $ABCDEF$ is a regular hexagon and $\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}=\lambda\overrightarrow{AD}$, then $\lambda =$ (a) 2 (b) 3 (c) 4 (d) 6	1
Q.6	An integrating factor for the differential equation $(1+y^2)dx-(\tan^{-1}y-x)dy=0$ (a) $\tan^{-1}y$ (b) $e^{\tan^{-1}y}$ (c) $\frac{1}{1+y^2}$ (d) $\frac{1}{x(1+y^2)}$	1
Q.7	We have to purchase two articles A and B of cost Rs. 45 and Rs. 25 respectively. I can purchase total article maximum of Rs. 1000. After selling the articles A and B, the profit per unit is Rs. 5 and 3 respectively. If I purchase x and y numbers of articles A and B respectively, then the mathematical formulation of problem is (a) $x \ge 0, y \ge 0, 45x + 25y \ge 1000, 5x + 3y = c$ (b) $x \ge 0, y \ge 0, 45x + 25y \le 1000, 5x + 3y = c$ (c) $x \ge 0, y \ge 0, 45x + 25y \le 1000, 3x + 5y = c$ (d) None of these	1
Q.8	Given $\vec{\mathbf{a}}=\mathbf{i}+\mathbf{j}-\mathbf{k}, \vec{b}=-\mathbf{i}+2\mathbf{j}+\mathbf{k}$ and $\vec{c}=-\mathbf{i}+2\mathbf{j}-\mathbf{k}$ A unit vector perpendicular to both $\mathbf{a}+\mathbf{b}$ and $\mathbf{b}+\mathbf{c}$ is (a) i(b)j (c) k (d) $\vec{c}=\frac{\mathbf{i}+\mathbf{j}+\mathbf{k}}{\sqrt{3}}$	1
Q.9	$\int_0^{\pi/2} \lvert \sin x-\cos x\rvert\, dx =$ (a) 0 (b) $2(\sqrt{2}-1)$ (c) $\sqrt{2}-1$ (d) $2(\sqrt{2}+1)$	1
Q.10	If $\Delta=\begin{vmatrix}a_1 & b_1 & c_1\\ a_2 & b_2 & c_2\\ a_3 & b_3 & c_3\end{vmatrix}$ and A_1,B_1,C_1 denote the co-factors of a_1,b_1,c_1 respectively, then	1

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	the value of the determinant $\begin{vmatrix} A_1 & B_1 & C_1 \\ A_2 & B_2 & C_2 \\ A_3 & B_3 & C_3 \end{vmatrix}$ is (a) Δ (b) Δ^2 (c) Δ^3 (d) 0 ANS (b)	
Q.11	Mohan wants to invest the total amount of Rs. 15,000 in saving certificates and national saving bonds. According to rules, he has to invest at least Rs. 2000 in saving certificates and Rs. 2500 in national saving bonds. The interest rate is 8% on saving certificate and 10% on national saving bonds per annum. He invests Rs. x in saving certificates and Rs. y in national saving bonds. Then the objective function for this problem is (a) $.08+.10y$ (b) $\frac{x}{2000}+\frac{y}{2500}$ (c) $2000x+2500y$ (d) $\frac{x}{8}+\frac{y}{10}$	1
Q.12	If $\vec{a}.\vec{b}=\vec{a}.\vec{c}$, $\vec{a}\times\vec{b}=\vec{a}\times\vec{c}$ and $\vec{a}\neq\mathbf{0}$, then (a) $\vec{b}=\mathbf{0}$ (b) $\vec{b}\neq\vec{c}$ (c) $\vec{b}=\vec{c}$ (d) None of these	1
Q.13	If $A=\begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 9 \\ 1 & 8 & 27 \end{bmatrix}$, then the value of $\lvert Coff\ A \rvert$ is (a) 36 (b)72(c) 144 (d) None of these	1
Q.14	The chance of India winning toss is 3/4. If it wins the toss, then its chance of victory is 4/5 otherwise it is only 1/2. Then chance of India's victory is (a) $\frac{1}{5}$ (b) $\frac{3}{5}$ (c) $\frac{3}{40}$ (d) $\frac{29}{40}$	1
Q.15	The equation of the curve which passes through the point (1, 1) and whose slope is given by $\frac{2y}{x}$, is (a) $y=x^2$ (b) $x^2-y^2=0$ (c) $2x^2+y^2=3$ (d)None of these	1
Q.16	The total number of bijective function from set A to A if A ={1, 2 ,3, 4} (a) 256 (b) 16 (c) 24 (d) 0	1
Q.17	If $y=(x^x)^x$, then $\frac{dy}{dx}=$ (a) $(x^x)^x(1+2\log x)$ (b) $(x^x)^x(1+\log x)$ (c) $x(x^x)^x(1+2\log x)$ (d) $x(x^x)^x(1+\log x)$	1
Q.18	If the angle between the lines whose direction ratios are 2,–1 , 2 and a, 3, 5 be $45°$, then a = (a) 1 (b) 2(c) 3 (d) 4	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 value of p for which the function $f(x)\begin{cases}\dfrac{1-\cos x}{x^2} & x\neq 0\\ p & x=0\end{cases}$ is continuous at x = 0 is 8 . Reason (R): A function $f(x)$ is continuous at a point $x = m$ if, $\lim\limits_{x\to m^-} f(x) = \lim\limits_{x\to m^+} f(x) = f(m)$, where $\lim\limits_{x\to m^-} f(x)$ is **Left Hand Limit** of $f(x)$ at $x = m$ and $\lim\limits_{x\to m^+} f(x)$ is **Right Hand Limit** of $f(x)$ at $x = m$. Also $f(m)$ is the value of function $f(x)$ at $x = m$.	1
Q.20	Assertion (A): The area of parallelogram with diagounal $\vec{a}\,\&\,\vec{b}$ is $\frac{1}{2}\left\|\vec{a}\times\vec{b}\right\|$. Reason (R): If $\vec{a}\,\&\,\vec{b}$ represent the adjacent sides of a triangle , then area of the triangle can bre obtained by evaluating $\left\|\vec{a}\times\vec{b}\right\|$.	1
	SECTION – B **This section comprises of very short answer type-questions (VSA) of 2 marks each**	
Q.21	Find the intervals for which $f(x)=\frac{3}{10}x^4-\frac{4}{5}x^3-3x^2+\frac{36}{5}x+11$ is increasing or decreasing.	2
Q.22	Solve the following equations: $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)+\tan^{-1}\left(\frac{2x}{1-x^2}\right)=\frac{2\pi}{3}, 0\leq x<1$. **OR** Solve : $\cos^{-1}\left[\sin\left(\cos^{-1}x\right)\right]=\frac{\pi}{3}$.	2
Q.23	Find λ , μ if $(2i+26j+27k)\times(i+\lambda j+\mu k)=0$.	2
Q.24	Sand is pouring from a pipe at the rate of 12 cm ^{3}/ sec . The falling sand forms a cone on the ground in such a way that the height of the cone is always one – sixth of the radius of the base. How fast is the height of the sand – cone increasing when the	2

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	height is 4 cm? **OR** Find all the local maximum values and local minimum values of the function $f(x) = \sin x - \cos x, 0 < x < 2\pi$.	
Q.25	**Find the intervals in which** $f(x) = \frac{3}{10}x^4 - \frac{4}{5}x^3 - 3x^2 + \frac{36}{5}x + 11$ **is (a) strictly increasing (b) strictly decreasing.**	2
	SECTION – C **(This section comprises of short answer type questions (SA) of 3 marks each)**	
Q.26	Evaluate: $\int \frac{dx}{\sin(x-a)\sin(x-b)}$.	3
Q.27	Evaluate : $\int\left(\sqrt{\tan x} + \sqrt{\cot x}\right)dx$ **OR** Evaluate: $\int_0^{\pi} \frac{x\,dx}{1+\sin x}$.	3
Q.28	Consider the experiment of tossing a coin. If the coin shows head, toss it again but if it shows tail, then throw a die. Find the conditional probability of the event that 'the die shows a number greater than 4' given that 'there is at least one tail'. OR A die is thrown three times. Events A and B are defined as below: A : 4 on the third throw B : 6 on the first and 5 on the second throw .Find the probability of (i) A given that B has already occurred (ii) B given that A has already occurred.	3
Q.29	Solve the following differential equation: $\sqrt{1+x^2+y^2+x^2y^2} + xy\frac{dy}{dx} = 0$ **OR** Solve the following differential equation: $(x+\log y)dy + y\,dx = 0$.	3
Q.30	If $y = a^{x^{a^{x^{\cdots\cdots\infty}}}}$ then $\frac{dy}{dx} = \frac{y^2 \log y}{x(1 - y\log x \log y)}$.	3
Q.31	Minimise and Maximise Z = 5x + 10y ; subject to x + 2y ≤ 120, x + y ≥ 60, x – 2y ≥ 0, x ≥ 0, and y ≥ 0 .	3
	SECTION – D **(This section comprises of long answer-type questions (LA) of 5 marks each)**	
Q.32	Find the point on the line : (x + 2)/3 = (y + 1)/2 = (z – 3)/2 at a distance $3\sqrt{2}$ from the point (1, 2, 3). **OR** Find the perpendicular distance of the point (1, 0, 0) from the line $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8}$. Also find the co – ordinates of the foot of the perpendicular.	5

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	Also find coordinate of image of point A . $(3,-4,-2)$. $(5,-8,-4)$.	
Q.33	Find the area of the region enclosed by the parabola $x^2 = y$ the line y = x + 2 .	5
Q.34	Determine whether the relation R defined on the set R of all real number as $R = \{(a,b); a,b \in R$ and $a-b+\sqrt{3} \in S$, where S is the set of all irrational numbers}, is reflexive, symmetric and transitive. **OR** Prove that g is Bijection function $g(x)=\dfrac{4x+3}{3x+4}$. & $g:R-\left\{-\dfrac{4}{3}\right\}\to R-\left\{\dfrac{4}{3}\right\}$.Find the inverse of g hence find $g^{-1}(0)$ and x such that $g^{-1}(x)=2$.	5
Q.35	Suppose a girl throws a die . If she gets a 1 or 2 , she tosses a coin three times and note the number of heads . If she gets a 3 , 4, 5 or 6 , she tosses a coin once and notes whether a heads or tail is obtained . If she obtained exactly one head ;what is the probability that she threw 3 , 4 , 5 or 6 with the die .	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	Area of triangle $A(x_1, y_1)$, $B(x_2, y_2)$and $C(x_3, y_3)$ is given by the determinant $\Delta=\dfrac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$ Since, area is a positive quantity, so we always take the absolute value of the determinant Δ. Also, the area of the triangle formed by three collinear points is zero. Based on the above information, answer the following questions.	
i.	Find the area of the triangle whose vertices are $(-2,6)$, $(3,-6)$ and $(1,5)$. (a) 30 sq. units (b) 35 sq. units (c) 40 sq. units (d) 15.5 sq. units	1
ii.	If the points $(2,-3)$, $(k,-1)$ and $(0,4)$ are collinear, then find the value of $4k$. (a) 4 (b) $\dfrac{7}{140}$ (c) 47 (d) $\dfrac{40}{7}$	1
iii.	If the area of a triangle *ABC*, with vertices $A(1, 3)$, $B(0, 0)$ and $C(k, 0)$ is 3 sq. units, then value of k is? (a) 2 (b) 3 (c) 4 (d) 5 **OR** Using determinants, find the equation of the line joining the points A(1, 2) and B(3, 6).	2

	(a) $y=2x$ (b) $x=3y$ (c) $y=x$ (d) $4x-y=5$	
Q.37	**CASE STUDY- 2** A magazine company in a town has 5000 subscriber on its list and collects fix charges of Rs 3000 per year from each subscriber. The company proposes to increase the annual charges and it is believed that for every increase of Rs 1, one subscriber will discontinue service.  Based on the above information, answer the following questions.	
i.	If x denote the amount of increase in annual charges, then revenue R, as a function of x can be represented as (a) $R(x)=3000\times5000\times x$ (b) $R(x)=(3000-2x)(5000+2x)$ (c) $R(x)=(5000+x)(3000-x)$ (d) $R(x)=(3000+x)(5000-x)$	1
ii.	If magazine company increases Rs 500 as annual charges, then R is equal to (a) $Rs15750000$ (b) $Rs16750000$ (c) $Rs17500000$ (d) $Rs15000000$	1
iii.	If revenue collected by the magazine company is Rs 15640000, then value of amount increased as annual charges for each subscriber, is (a) 400 (b) 1600 (c) Both (a) and (b) (d) None of these **OR** Maximum revenue is equal to (a) $Rs15000000$ (b) $Rs16000000$ (c) $Rs20500000$ (d) $Rs25000000$	2
Q.38	**Case Study based-3** Lines $\frac{x-5}{4}=\frac{y-7}{4}=\frac{z+3}{-5}$ & $\frac{x-8}{7}=\frac{y-4}{1}=\frac{z-K}{3}$	
i.	Find K for lines are intersect .	2
ii.	Find point of intersection .	2
	"शिक्षा कभी भी व्यर्थ नहीं होती भले ही वो किसी भी तरह की ग्रहण की गई हो।"	