CH. CHHABIL DASS PUBLIC SCHOOL

QUESTION BANK (2026–27)

CLASS XII MATHEMATICS

CHAPTER 1: RELATIONS AND FUNCTIONS		
	SECTION-A This section comprises of 15 very short answer type questions of 1 marks each.	
Q.No.	**Questions**	**Marks**
1.	A function $f: R \to R$ defined as $f(x) = x^2 - 4x + 5$ is (a) injective but not surjective (b) surjective but not injective (c) both injective and surjective (d) neither injective nor surjective	1
2.	A function $f: R_+ \to [-9,\ \infty)$ defined as $f(x) = 5x^2 + 6x - 9$ is (a) injective but not surjective (b) surjective but not injective (c) both injective and surjective (d) neither injective nor surjective	1
3.	The total number of symmetric and reflexive relations on a set $A = \{1,\ 2,\ 3\}$ are (a) 3 (b) 8 (c) 9 (d) 64	1
4.	The maximum number of equivalence relations on the set $A = \{1,\ 2,\ 3\}$ are (a) 1 (b) 2 (c) 3 (d) 5	1
5.	The relation R in the set of real numbers defined as $R = \{(a, b) \in R \times R : 1 + ab > 0\}$ is (a) reflexive and transitive (b) symmetric and transitive (c) reflexive and symmetric (d) equivalence relation	1
6.	Let set $X = \{1, 2, 3\}$ and a relation R is defined in X as : $R = \{(1, 3), (2, 2), (3, 2)\}$, then minimum ordered pairs which should be added in relation R to make it reflexive and symmetric are (a) {(1, 1), (2, 3), (1, 2)} (b) {(1, 1), (3, 3), (3, 1), (2, 3)} (c) {(3, 3), (3, 1), (1, 2)} (d) {(1, 1), (3, 3), (3, 1), (1, 2)}	1
7.	Let the function 'f' be defined by $f(x) = 5x^2 + 2, \forall x \in R$. Then '$f$' is (a) onto function (c) one-one, onto function (b) one-one, into function (d) many-one, into function	1
8.	Let $X = \{x^2 : x \in N\}$ and the function $f : N \to X$ is defined by $f(x) = x^2$, $x \in N$. Then this function is (a) injective only (c) not bijective (b) surjective only (d) bijective	1
9.	If R = {(x, y) : x + 2y = 8} is a relation on N, then range of R is (a) {3} (b) {1, 2, 3} (c) {1, 2, 3, ... 8} (d) {1, 2}	1
10.	Let $A = \{a, b, c\}$, then the total number of distinct relations in set A are (a) 64 (b) 32 (c) 256 (d) 512	1
	ASSERTION-REASON BASED QUESTIONS (Question 11 to 15 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the	

	options (a), (b), (c) and (d) as given below. (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.	
11.	**A: A function $f: R - \{0\} \rightarrow R - \{0\}$ defined by $f(x) = \frac{1}{x}$ is an one-one and onto function.** **R: A function $f: N \rightarrow R - \{0\}$ defined by $f(x) = \frac{1}{x}$ is one-one and onto.**	**1**
12.	**$f: X \rightarrow X$ is a function on the finite set X.** **A: If f is onto, then f is one-one and if f is one-one, then f is onto.** **R: Every one-one function is always onto and every onto function is always one-one.**	**1**
13.	**A: In set $A = \{1, 2, 3\}$ a relation R defined as $R = \{(1,1), (2,2)\}$ is reflexive.** **R: A relation R is reflexive in set A if $(a, a) \in R \ \forall \ a \in A$.**	**1**
14.	**A: In set $A = \{a, b, c\}$ relation R in set A, given as $R = \{(a, c)\}$ is transitive.** **R: A singleton relation is transitive.**	**1**
15.	**A: The relation R on set $A = \{1, 2, 3, 4, 5\}$ given by $R = \{(a, b): \lvert a - b \rvert \text{ is multiple of } 4\}$ is an equivalence relation.** **R: The relation R on set $\{1, 2, 3, 4, 5\}$ is said to be equivalence if it is reflexive, symmetric and transitive.**	**1**
	<u>SECTION-B</u> **This section comprises of 4 very short answer type questions of 2 marks each.**	
16.	**Show that the relation R in the set $\{1, 2, 3\}$ given by $R = \{(1,1), (2,2), (3,3), (1,2), (2,3)\}$ is reflexive but neither symmetric nor transitive.**	**2**
17.	**Let R be the equivalence relation in the set $A = \{0, 1, 2, 3, 4, 5\}$ given by $R = \{(a, b): 2 \text{ divides } (a - b)\}$. Write equivalence class $[0]$.**	**2**
18.	**Let $A = \{1, 2, 3\}$, $B = \{4, 5, 6, 7\}$ and let $f = \{(1,4), (2,5), (3,6)\}$ be a function from A to B. Show that f is one-one.**	**2**
19.	**Prove that the Greatest Integer Function $f : R \rightarrow R$, given by $f(x) = [x]$ is neither one-one nor onto, where $[x]$ denotes the greatest integer less than or equal to x.**	**2**
	<u>SECTION-C</u> **This section comprises of 4 short answer type questions of 3 marks each.**	
20.	**Let T be the set of all triangles in a plane with R a relation in T given by $R = \{(T_1, T_2) : T_1 \cong T_2\}$. Show that R is an equivalence relation.**	**3**
21.	**Show that the relation S in the set R of real numbers, defined as $S = \{(a, b) : a, b \in R \text{ and } a \leq b^3\}$ is neither reflexive, nor symmetric, nor transitive.**	**3**
22.	**Show that the function $f : R \rightarrow R$ defined by $f(x) = \frac{x}{x^2+1}, \forall x \in R$ is neither one-one nor onto.**	**3**
23.	**Let $f: R - \left\{\frac{-4}{3}\right\} \rightarrow R$ be a function defined as $f(x) = \frac{4x}{3x+4}$. Show that f is an one-one function.** **Also, check whether f is an onto function or not.**	**3**
	<u>SECTION-D</u> **This section comprises of 4 long answer type question of 5 marks.**	

24.	**Let N be the set of all natural numbers and R be a relation on $N \times N$ defined by $(a, b)R(c, d) \Leftrightarrow ad = bc\ \forall\ (a, b), (c, d) \in N \times N$. Show that R is an equivalence relation on $N \times N$.** **Also, find the equivalence class of $(2, 6)$ i.e. $[(2, 6)]$.**	**5**
25.	**Let N denote the set of all natural numbers and R be the relation on $N \times N$ defined by $(a, b)\ R\ (c, d)$ if $ad\,(b + c) = bc\,(a + d)$. Show that R is an equivalence relation.**	**5**
26.	**A function $f: [-4, 4] \to [0, 4]$ is given by $f(x) = \sqrt{16 - x^2}$. Show that f is an onto function but not a one-one function. Further, find all possible values of a for which $f(a) = \sqrt{7}$.**	**5**
27.	**Prove that function $f: R_+ \to [-5, \infty)$ defined as $f(x) = 4x^2 + 4x - 5$ is both one-one and onto.**	**5**
	<u>SECTION-E</u> **This section comprises 3 case-study/passage-based question of 4 marks (1+1+2) each with subparts.**	
28.	**Students of a school are taken to a railway museum to learn about railways heritage and its history.**  **An exhibit in the museum depicted many rail lines on the track near the railway station. Let L be the set of all rail lines on the railway track and R be the relation on L defined by:** $R = \{(l_1, l_2): l_1\ is\ parallel\ to\ l_2\}$ **On the basis of the above information, answer the following questions:** **(i)** **Find whether the relation R is symmetric or not.** **(ii)** **Find whether the relation R is transitive or not.** **(iii)** **If one of the rail lines on the railway track is represented by the equation $y = 3x + 2$, then find the set of rail lines in R related to it.** **(iv)** **Let S be the relation defined by:** $S = \{(l_1, l_2): l_1\ is\ perpendicular\ to\ l_2\}$. **Check whether the relation S is symmetric and transitive.**	**4**
29.	**A city's traffic management department is planning to optimize traffic flow by analyzing the connectivity between various traffic signals. The city has five major spots labelled A, B, C, D and E.**	**4**

The department has collected the following data regarding one-way traffic flow between spots:

1. Traffic flows from A to B, A to C, and A to D.
2. Traffic flows from B to C and B to E.
3. Traffic flows from C to E.
4. Traffic flows from D to E and D to C.

The department wants to represent and analyze this data using relations and functions. Use the given data to answer the following questions.

(I) Is the traffic flow reflexive? Justify.

(II) Is the traffic flow transitive? Justify.

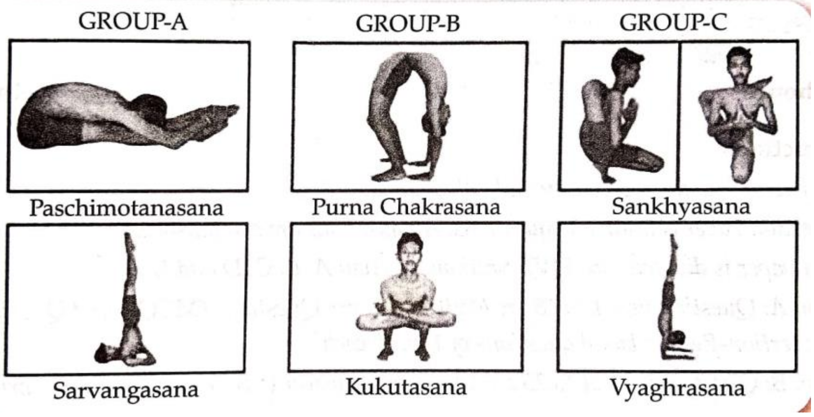
(III) Represent the relation describing the traffic flow as a set of ordered pairs. Also state the domain and range of the relation.

(IV) Does the traffic flow represent a function? Justify your answer.

30. Prathibha Karanji is an innovative program by the Government of Karnataka, India, where cultural and literacy competitions are held between schools at cluster, block, district and state levels. **4**

One of those competitions-Yogasana, is conducted under two categories –Middle school and High school. From a certain district, three students from middle school and two students from high school were selected for the state level.

National Schools Yogasana Competition



Let $M = \{m_1, m_2, m_3\}$, $H = \{h_1, h_2\}$, represent the set of students from middle school and high school, respectively who got selected for the state level from that district.

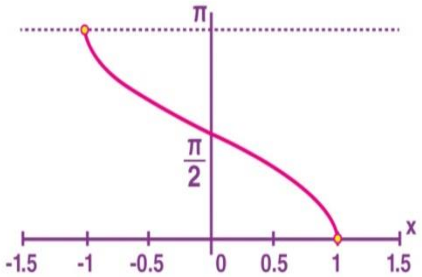
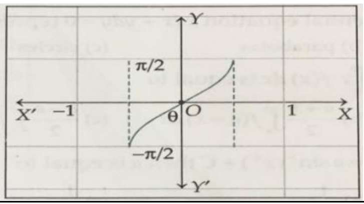
(I) A relation $R : M \to M$ is defined by:
$R = \{(x, y): x \text{ and } y \text{ are students from the same category}\}$.
Show that R is an equivalence relation.

(II) A function $f: M \to H$ is defined by $f = \{(m_1, h_1), (m_2, h_2), (m_3, h_2)\}$.
Show that f is onto but not one-one.

CH. CHHABIL DASS PUBLIC SCHOOL

QUESTION BANK (2026–27)

CLASS XII MATHEMATICS

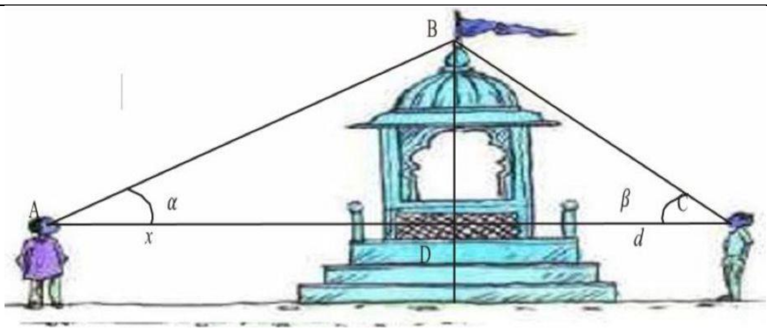
CHAPTER 2: INVERSE TRIGONOMETRIC FUNCTIONS		
	SECTION-A **This section comprises of 15 very short answer type questions of 1 marks each.**	
Q.No.	**Questions**	**Marks**
1.	 **The graph drawn below depicts the function:** **(a)** $\sin^{-1} x$ **(b)** $\cos^{-1} x$ **(c)** $\text{cosec}^{-1} x$ **(d)** $\cot^{-1} x$	**1**
2.	**The graph drawn below depicts the function:**  **(a)** $\sin^{-1} x$ **(b)** $\sin^{-1} 2x$ **(c)** $\text{cosec}^{-1} x$ **(d)** $2\sin^{-1} x$	**1**
3.	**The principal value of** $\sin^{-1}\left(\cos\frac{43\pi}{5}\right)$ **is equal to** **(a)** $-\frac{7\pi}{5}$ **(b)** $-\frac{\pi}{10}$ **(c)** $\frac{\pi}{10}$ **(d)** $\frac{3\pi}{5}$	**1**
4.	**The domain of** $\cos^{-1}(x^2-4)$ **is** **(a)** $[-1,\ 1]$ **(c)** $[-2,\ 2]$ **(b)** $[-\sqrt{5},-\sqrt{3}] \cup [\sqrt{3},\sqrt{5}]$ **(d)** $[0,\ \pi]$	**1**
5.	**The principal value of** $\sin^{-1}\left(\cos\frac{33\pi}{5}\right)$ **is equal to** **(a)** $-\frac{7\pi}{5}$ **(b)** $-\frac{\pi}{10}$ **(c)** $\frac{\pi}{10}$ **(d)** $\frac{3\pi}{5}$	**1**
6.	**If** $\cos\left(\sin^{-1}\frac{3}{5}+\cos^{-1}x\right)=\frac{1}{\sqrt{2}}$, **then x is equal to** **(a)** $\frac{1}{5}$ **(b)** $\frac{7}{5\sqrt{2}}$ **(c) 0** **(d) 1**	**1**
7.	**Find the value of x if** $\sin^{-1}x+\sin^{-1}(1-x)=\cos^{-1}x$ **(a)** $\frac{1}{2}$ **(b) 0** **(c) 0,** $\frac{1}{2}$ **(d)** $\frac{1}{4}, \frac{1}{2}$	**1**
8.	**If** $\cos^{-1}\frac{x}{a}+\cos^{-1}\frac{y}{b}=\alpha$ **, then find the value of** $\frac{x^2}{a^2}-2\frac{xy}{ab}\cos\alpha+\frac{y^2}{b^2}$ **(a)** $\sin^2\alpha$ **(b)** $\cos^2\alpha$ **(c)** $-\sin^2\alpha$ **(d) 0**	**1**
9.	**The value of** $tan^2(\sec^{-1}2)+cot^2(\text{cosec}^{-1}3)$ **is** **(a) 5** **(b) 11** **(c) 13** **(d) 15**	**1**
10.	**If** $\alpha \le 2\sin^{-1}x+\cos^{-1}x \le \beta$, **then** **(a)** $\alpha=\frac{-\pi}{2}, \beta=\frac{\pi}{2}$ **(c)** $\alpha=\frac{-\pi}{2}, \beta=\frac{3\pi}{2}$ **(b)** $\alpha=0, \beta=\pi$ **(d)** $\alpha=0, \beta=2\pi$	**1**
	ASSERTION-REASON BASED QUESTIONS **(Question 11 to 15 are Assertion-Reason based questions carrying 1**	

	mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below. (e) Both (A) and (R) are true and (R) is the correct explanation of (A). (f) Both (A) and (R) are true but (R) is not the correct explanation of (A). (g) (A) is true but (R) is false. (h) (A) is false but (R) is true.	
11.	**A: Maximum value of** $\left(\cos^{-1} x\right)^2$ **is** π^2. **R: Range of the principal value branch of** $\cos^{-1} x$ **is** $\left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$.	**1**
12.	**A: If** $\tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \frac{\pi}{2}$, **then** $xy + yz + zx = 1$. **R: If** $\tan^{-1} x + \tan^{-1} y + \tan^{-1} z = \pi$, **then** $x + y + z = xyz$.	**1**
13.	**A:** $\sin^{-1}\left(\sin\frac{7\pi}{4}\right) = -\frac{\pi}{4}$ **R:** $\sin^{-1}(\sin x) = x$ **for all** $x \in \mathbb{R}$	**1**
14.	**A: The domain of the function** $\sec^{-1} 2x$ **is** $\left(-\infty, -\frac{1}{2}\right) \cup \left[\frac{1}{2}, \infty\right)$. **R:** $\sec^{-1}(-2) = -\frac{\pi}{4}$.	**1**
15.	**A:** $\sin(\tan^{-1} x), \lvert x\rvert < 1$ **is equal to** $\frac{x}{\sqrt{1+x^2}}$. **R: Domain of** $\tan^{-1} x$ **is** $(0, \pi)$.	**1**
	SECTION-B **This section comprises of 4 very short answer type questions of 2 marks each.**	
16.	**Find the value of k if** $\sin^{-1}\left[k\tan\left(2\cos^{-1}\frac{\sqrt{3}}{2}\right)\right] = \frac{\pi}{3}$ **OR** **Evaluate** $\tan^{-1}\left[2\cos\left(2\sin^{-1}\frac{1}{2}\right)\right] + \tan^{-1} 1$	**2**
17.	**If** $\cos^{-1}\alpha + \cos^{-1}\beta + \cos^{-1}\gamma = 3\pi$, **then find the value of** $\alpha(\beta+\gamma) - \beta(\gamma+\alpha) + \gamma(\alpha+\beta)$	**2**
18.	**Draw the graph of** $f(x) = \sin^{-1} x$, **where** $x \in \left[-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$. **Also write range of** $f(x)$.	**2**
19.	**Find the value of** $\sin^{-1}\left(\cos\left(\frac{33\pi}{5}\right)\right) + \sin^{-1}\left(\sin\left(\frac{3\pi}{4}\right)\right)$.	**2**
	SECTION-C **This section comprises of 4 short answer type questions of 3 marks each.**	
20.	**Find the value of** $\sin\left(2\tan^{-1}\frac{1}{4}\right) + \cos\left(\tan^{-1} 2\sqrt{2}\right)$.	**3**
21.	**Prove that** $\sin^{-1}\left(\frac{2^{x+1}}{1+(4)^x}\right) = 2\tan^{-1}(2^x)$, **where** $x \le 0$	**3**
22.	**Prove that:** $\cos^{-1}(x) + \cos^{-1}\left(\frac{x}{2} + \frac{\sqrt{3-3x^2}}{2}\right) = \frac{\pi}{3}$	**3**
23.	**Express** $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right)$, $\frac{-3\pi}{2} < x < \frac{\pi}{2}$, **in the simplest form.**	**3**
	SECTION-D **This section comprises of 4 long answer type question of 5 marks.**	

24.	**Show that:** $\tan^{-1}\left(\frac{6x-8x^3}{1-12x^2}\right)-\tan^{-1}\left(\frac{4x}{1-4x^2}\right)=\tan^{-1}(2x), \lvert 2x\rvert<\frac{1}{\sqrt{3}}.$	**5**
25.	**Prove that** $\tan^{-1}\left[\frac{\sqrt{1+x^2}+\sqrt{1-x^2}}{\sqrt{1+x^2}-\sqrt{1-x^2}}\right]=\frac{\pi}{4}+\frac{1}{2}\cos^{-1}x^2;\ -1<x<1$	**5**
26.	**Solve the following:** $$3\sin^{-1}\left(\frac{2x}{1+x^2}\right)-4\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)+2\tan^{-1}\left(\frac{2x}{1-x^2}\right)=\frac{\pi}{3}$$	**5**
27.	**If** $\cos^{-1}\frac{x}{a}+\cos^{-1}\frac{y}{b}=\theta$ **, then show that** $\frac{x^2}{a^2}-2\frac{xy}{ab}\cos\theta+\frac{y^2}{b^2}=\sin^2\theta$	**5**

SECTION-E

This section comprises 1 case-study/passage-based question of 4 marks (1+1+2) each with subparts.

28.	 **Two men on either side of a temple of 30 meters high observe its top at the angles of elevation α and β respectively. (as shown in the figure above). The distance between the two men is $40\sqrt{3}$ meters and the distance between the first person A and the temple is $30\sqrt{3}$ meters.** **Based on the above information answer the following:** **(I) Find the value of $\angle CAB=\alpha$?** **(II) Find the value of $\angle BCA=\beta$?** **(III) Find the value of $\angle ABC$?** **(IV) Find the domain and range of $\cos^{-1}x$.**	**4**

CH. CHHABIL DASS PUBLIC SCHOOL

QUESTION BANK (2026–27)

CLASS XII MATHEMATICS

CHAPTER 3: MATRICES

SECTION-A

This section comprises of 15 very short answer type questions of 1 marks each.

Q.No.	Questions	Marks
1.	If $A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$, then which of the following statements is not correct? (a) $A^3 - I = A(A - I)$ (c) $A^3 + I = A(A^3 - I)$ (b) $A^4 - I = (A^2 + I)$ (d) $A^2 + I = A(A^2 - I)$	1
2.	If for three matrices $A = [a_{ij}]_{m\times4}$, $B = [b_{ij}]_{n\times3}$ and $C = [c_{ij}]_{p\times q}$ products AB and AC both are defined and are square matrices of same order then value of m, n, p and q are: (a) $m = q = 3$, $p = n = 4$ (c) $m = 2$, $q = 3$ and $p = n = 4$ (b) $m = q = 4$, $p = n = 3$ (d) $m = 4$, $p = 2$ and $q = n = 3$	1
3.	Assume X, Y, Z, W and P are matrices of order $2 \times n$, $3 \times k$, $2 \times p$, $n \times 3$, and $p \times k$, respectively. Then the restriction on n, k and p so that $PY + WY$ will be defined are: (a) $k = 3$, $p = n$ (c) p is arbitrary, $k = 3$ (b) k is arbitrary, $p = 2$ (d) $k = 2$, $p = 3$	1
4.	If the matrix $A = \begin{bmatrix} 0 & r & -2 \\ 3 & p & t \\ q & -4 & 0 \end{bmatrix}$ is skew-symmetric then the value of $\frac{q+t}{p+r}$ is (a) −2 (b) 0 (c) 1 (d) 2	1
5.	If A is a 3×3 non-singular matrix such that $AA^T = A^TA$ and $B = A^{-1}A^T$, then BB^T equals to: (a) $I + B$ (b) I (c) B^{-1} (d) $(B^{-1})^T$	1
6.	If a matrix $A = \begin{bmatrix} a & c & 0 \\ b & d & 0 \\ 0 & 0 & 5 \end{bmatrix}$ is a scalar matrix, then the value of $a + 2b + 3c + 4d$ is (a) 25 (b) 0 (c) 5 (d) 10	1
7.	Which of the following properties is/are true for two matrices of suitable orders? (I) $(A + B)' = A' + B'$ (II) $(A - B)' = B' - A'$ (III) $(AB)' = A'B'$ (IV) $(kAB)' = kB'A'$ (k is scalar) (a) (I) only (c) (I) and (II) (b) (I), (II) and (III) (d) (I) and (IV)	1
8.	A matrix $A = [a_{ij}]_{3\times3}$ is defined by $a_{ij} = \begin{cases} 2i + 3j, & i < j \\ 5, & i = j \\ 3i - 2j, & i > j \end{cases}$ The number of elements in A which are more than 5, is (a) 3 (b) 4 (c) 5 (d) 6	1

9.	If $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 6 \\ 3 \\ 2 \end{bmatrix}$, then the value of $2x + y - z$ is (a) 1 (b) 2 (c) 3 (d) 5	1
10.	If $A = \frac{1}{\pi}\begin{bmatrix} \sin^{-1}\pi x & \tan^{-1}\frac{x}{\pi} \\ \sin^{-1}\frac{x}{\pi} & \cot^{-1}\pi x \end{bmatrix}$, $B = \frac{1}{\pi}\begin{bmatrix} -\cos^{-1}\pi x & \tan^{-1}\frac{x}{\pi} \\ \sin^{-1}\frac{x}{\pi} & -\tan^{-1}\pi x \end{bmatrix}$, then $A - B =$ (a) I (b) O (c) $2I$ (d) $\frac{1}{2}I$	1
	ASSERTION-REASON BASED QUESTIONS **(Question 11 to 15 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below.** (i) Both (A) and (R) are true and (R) is the correct explanation of (A). (j) Both (A) and (R) are true but (R) is not the correct explanation of (A). (k) (A) is true but (R) is false. (l) (A) is false but (R) is true.	
11.	A: Let M be a 2×2 symmetric matrix with integer entries. Then M is invertible if the product of entries in the main diagonal of M is not the square of an integer. R: If a matrix is invertible, determinant must not be equal to zero.	1
12.	A: All odd positive integral powers of a skew−symmetric matrix are skew−symmetric. R: Let A be a symmetric matrix and $n \in N$, then $(A^n)^T = (A)^n$.	1
13.	A: Let $A = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 4 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 4 & 3 & 6 \\ 7 & 8 & 9 \\ 5 & 1 & 2 \end{bmatrix}$, then the product of the matrices A and B is not defined. R: The number of rows in B is not equal to number of columns in A.	1
14.	A: The matrix $A = \begin{bmatrix} 0 & -1 & -2 \\ 1 & 0 & -3 \\ 2 & 3 & 0 \end{bmatrix}$ is a skew symmetric matrix. R: For the given matrix A we have $A' = A$.	1
15.	A: $A = diag[3 \quad 5 \quad 2]$ is a scalar matrix of order 3×3. R: If a diagonal matrix has all non-zero elements equal, it is known as a scalar matrix.	1
	SECTION-B **This section comprises of 4 very short answer type questions of 2 marks each.**	
16.	Find the value of a, b, c and d from the equation: $\begin{bmatrix} a-b & 2a+c \\ 2a-b & 3c+d \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$	2
17.	Find the matrix A such that : $A\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} = \begin{bmatrix} -7 & -8 & -9 \\ 2 & 4 & 6 \end{bmatrix}$	2
18.	If $A = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$, then find α satisfying $0 < \alpha < \frac{\pi}{2}$ when $A + A^T = \sqrt{2}\, I_2$, where A^T is transpose of A.	2
19.	Find X and Y, if $X + Y = \begin{bmatrix} 5 & 2 \\ 0 & 9 \end{bmatrix}$ and $X - Y = \begin{bmatrix} 3 & 6 \\ 0 & -1 \end{bmatrix}$.	2

SECTION-C **This section comprises of 4 short answer type questions of 3 marks each.**		
20.	**Express** $\begin{bmatrix} 3 & -2 & -4 \\ 3 & -2 & -5 \\ -1 & 1 & 2 \end{bmatrix}$ **matrix as a sum of a symmetric and skew−symmetric matrix.**	**3**
21.	**Let** $A = \begin{bmatrix} 2 & 3 \\ -1 & 2 \end{bmatrix}$, **then show that** $A^2 - 4A + 7I = O$. **Using this result, calculate** A^5 **also.**	**3**
22.	**If** $A = \begin{bmatrix} 0 & -\tan\frac{\alpha}{2} \\ \tan\frac{\alpha}{2} & 0 \end{bmatrix}$ **and** I **is the identity matrix of order 2,** **show that** $I + A = (I - A)\begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix}$	**3**
23.	**If** $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$, **prove that** $A^3 - 6A^2 + 7A + 2I = 0$	**3**
SECTION-D **This section comprises 3 case-study/passage-based question of 4 marks (1+1+2) each with subparts.**		
24.	**Two farmers** $Dev\ Chaudhary$ & $Naitik\ Nagar$ **cultivate only three varieties of rice namely** X, Y **and** Z. **The sale (in ₹) of these varieties of rice by both the farmers in the month of September and October are given by the following matrices** A **and** B. **September sales (in ₹)** $A = \begin{array}{c} \begin{array}{ccc} X & Y & Z \end{array} \\ \begin{bmatrix} 10000 & 20000 & 30000 \\ 50000 & 30000 & 10000 \end{bmatrix} \end{array} \begin{array}{l} Dev\ Chaudhary \\ Naitik\ Nagar \end{array}$ **October sales (in ₹)** $B = \begin{array}{c} \begin{array}{ccc} X & Y & Z \end{array} \\ \begin{bmatrix} 5000 & 10000 & 6000 \\ 20000 & 10000 & 10000 \end{bmatrix} \end{array} \begin{array}{l} Dev\ Chaudhary \\ Naitik\ Nagar \end{array}$ **Answer the following questions.** **(I)** **What were the combined sales in September and October for each farmer in each variety.** **(II)** **What was the change in sales from September to October?** **(III)** **(a) If** $Naitik\ Nagar$ **receive 3% profit on gross sales, compute the profit of** $Naitik\ Nagar$ **for each variety sold in October.** **OR** **(b) If** $Dev\ Chaudhary$ **receives 2% profit on gross sales, Compute the profit of** $Dev\ Chaudhary$ **for each variety sold in October.**	**4**
25.	**Three schools DPS, CCDPS & KVS decided to organize a fair for collecting money for helping the flood victims. They sold handmade fans, mats and plates from recycled material at a cost of ₹25, ₹100 and ₹50 each respectively. The numbers of articles sold are given as**	**4**

SCHOOL/ARTICLE	DPS	CCDPS	KVS
Handmade fans	40	25	35
Mats	50	40	50
Plates	20	30	40

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

(I) What is the total amount of money collected by all three schools DPS, CCDPS & KVS?

(II) How many articles (in total) are sold by three schools?

(III) If the number of handmade fans and plates are interchanged for all the schools, then what is the total money collected by all schools?

(IV) If the number of mats and plates are interchanged for all schools, then what is the total money collected by all schools?

26. **A company wanted to outsource the creation of its video and picture content for social media. They were approached by two firms offering the following rates per post (in ₹).** **4**

$$\begin{array}{cc} \begin{array}{cc} Video & Picture \end{array} & \\ \begin{bmatrix} 30 & 10 \\ 25 & 15 \end{bmatrix} & \begin{array}{c} Firm\,1 \\ Firm\,2 \end{array} \end{array}$$

They gave the contract to both the firms for an equal number of posts. After 3 months, each firm created the following number of posts.

$$\begin{bmatrix} 70 \\ 100 \end{bmatrix} \begin{array}{c} Video \\ Picture \end{array}$$

Each firm's posts created the following number of sales for the company.

$$\begin{array}{cc} \begin{array}{cc} Video & Picture \end{array} & \\ \begin{bmatrix} 500 & 200 \\ 400 & 300 \end{bmatrix} & \begin{array}{c} Firm\,1 \\ Firm\,2 \end{array} \end{array}$$

Based on the above information, answer the following questions.

(I) Which firm cost more to the company?

(II) If each sale as worth ₹ 300, which firm was more profitable for the company? Show your work.

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QUESTION BANK (2026–27)

CLASS XII MATHEMATICS

CHAPTER 4: DETERMINANTS		
SECTION-A **This section comprises of 15 very short answer type questions of 1 marks each.**		
Q.No.	**Questions**	**Marks**
1.	**For a square matrix A,** $A.(adj\ A) = \begin{bmatrix} 2026 & 0 & 0 \\ 0 & 2026 & 0 \\ 0 & 0 & 2026 \end{bmatrix}$, **then the value of** $\lvert A\rvert \times \lvert adj\ A\rvert$ **is equal to** **(a)** 1 **(c)** $2026 + 1$ **(b)** $(2026)^3$ **(d)** $2026 + (2026)^2$	**1**
2.	**For a matrix** $A = \begin{bmatrix} 2 & -1 & 1 \\ \lambda & 2 & 0 \\ 1 & -2 & 3 \end{bmatrix}$ **to be invertible, the value of** λ **is** **(a)** 0 **(b)** 10 **(c)** $\mathbb{R} - \{10\}$ **(d)** $\mathbb{R} - \{-10\}$	**1**
3.	**Value of the determinant** $\begin{vmatrix} \cos 67^\circ & \sin 67^\circ \\ \sin 23^\circ & \cos 23^\circ \end{vmatrix}$ **is** **(a)** 0 **(b)** $\frac{1}{2}$ **(c)** $\frac{\sqrt{3}}{2}$ **(d)** 1	**1**
4.	**If the matrix** $A = \begin{bmatrix} 2 & -3 \\ -4 & 1 \end{bmatrix}$, **then** $adj\ (3A^2 + 12A)$ **is equal to:** **(a)** $\begin{bmatrix} 48 & 27 \\ 36 & 39 \end{bmatrix}$ **(b)** $\begin{bmatrix} 72 & -63 \\ -84 & 51 \end{bmatrix}$ **(c)** $\begin{bmatrix} 51 & 63 \\ 84 & 72 \end{bmatrix}$ **(d)** $\begin{bmatrix} 72 & -27 \\ -36 & 51 \end{bmatrix}$	**1**
5.	**If** $(a,\ b)$, $(c,\ d)$ **and** $(e,\ f)$ **are the vertices of** ΔABC **and** Δ **denotes the area of** ΔABC, **then** $\begin{vmatrix} a & c & e \\ b & d & f \\ 1 & 1 & 1 \end{vmatrix}^2$ **is equal to:** **(a)** $2\Delta^2$ **(b)** $4\Delta^2$ **(c)** 2Δ **(d)** 4Δ	**1**
6.	**If** A **and** B **are two square matrices of order 2 and** $\lvert A\rvert = 2$ **and** $\lvert B\rvert = 5$, **then** $\lvert -3AB\rvert$ **is** **(a)** −90 **(b)** −30 **(c)** 30 **(d)** 90	**1**
7.	**Let** P **be a skew-symmetric matrix of order 3. If** $det(P) = \alpha$, **then** $(2026)^\alpha$ **is** **(a)** 0 **(b)** 1 **(c)** 2026 **(d)** $(2026)^3$	**1**
8.	**If** $\lvert A\rvert = 2$, **where** A **is a** 2×2 **matrix, then** $\lvert 4A^{-1}\rvert$ **equal to** **(a)** 4 **(b)** 2 **(c)** 8 **(d)** $\frac{1}{32}$	**1**
9.	**If** $A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 3 & 1 \\ 3 & a & 1 \end{bmatrix}$ **is non-singular matrix and** $a \in A$, **then the set** A **is** **(a)** $\mathbb{R}$ **(b)** $\{0\}$ **(c)** $\{4\}$ **(d)** $\mathbb{R} - \{4\}$	**1**
10.	**If** A **is a square matrix of order 3 such that the value of** $\lvert adj\ A\rvert = 8$, **then the value of** $\lvert A^T\rvert$ **is** **(a)** $\sqrt{2}$ **(b)** $-\sqrt{2}$ **(c)** 8 **(d)** $2\sqrt{2}$	**1**
	ASSERTION-REASON BASED QUESTIONS **(Question 11 to 15 are Assertion-Reason based questions carrying 1**	

	mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below. (m) Both (A) and (R) are true and (R) is the correct explanation of (A). (n) Both (A) and (R) are true but (R) is not the correct explanation of (A). (o) (A) is true but (R) is false. (p) (A) is false but (R) is true.	
11.	**A: Let** $A = \begin{bmatrix} p & 0 & 0 \\ 0 & q & 0 \\ 0 & 0 & r \end{bmatrix}$**, then** $A^{-1} = \begin{bmatrix} p^{-1} & 0 & 0 \\ 0 & q^{-1} & 0 \\ 0 & 0 & r^{-1} \end{bmatrix}$. **R: Inverse of a invertible diagonal matrix is always a diagonal matrix.**	**1**
12.	**A: Minor of an element of a determinant of order** n $(n \geq 2)$ **is a determinant of order** $(n-1)$. **R: Minor of an element** 9 **of** $\begin{bmatrix} -2 & 0 & 1 \\ 9 & 2 & -3 \\ 6 & 1 & -2 \end{bmatrix}$ **is 1.**	**1**
13.	**A: The value of determinant of a matrix and the value of determinant of its transpose are equal.** **R: The value of determinant remains unchanged if its rows and columns are interchanged.**	**1**
14.	**A: The matrix** $A = \begin{bmatrix} 2 & 3 & -0.5 \\ 7 & 3 & 2 \\ 3 & 1 & 1 \end{bmatrix}$ **is singular.** **R: The value of determinant of matrix A is zero.**	**1**
15.	**A:** $adj(adj\ A) = \lvert A\rvert^{n-2} \cdot A$. **R:** $\lvert adj\ A\rvert = \lvert A\rvert^{n-1}$.	**1**
	SECTION-B **This section comprises of 4 very short answer type questions of 2 marks each.**	
16.	**Show that the points** $(a+5,\ a-4), (a-2,\ a+3)$ **and** $(a,\ a)$ **do not lie on a straight line for any value of a.**	**2**
17.	**If** $(A+B+C) = \pi$**, then find the value of** $\begin{vmatrix} \sin(A+B+C) & \sin B & \cos C \\ -\sin B & 0 & \tan A \\ \cos(A+B) & -\tan A & 0 \end{vmatrix}$.	**2**
18.	**Find the maximum value of** $\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+\sin\theta & 1 \\ 1 & 1 & 1+\cos\theta \end{vmatrix}$	**2**
19.	**If the area of a triangle with vertices** $(k, 0), (1, 1)$ **and** $(0, 3)$ **is** $5\ sq\ units$**. Find the value(s) of** k**.**	**2**
	SECTION-C **This section comprises of 4 short answer type questions of 3 marks each.**	
20.	**For what value of x where** $x \in \left[0, \frac{\pi}{2}\right]$**, the matrix** $A = \begin{vmatrix} 3 & -1 & \sin 3x \\ -7 & 4 & \cos 2x \\ -11 & 7 & 2 \end{vmatrix}$ **is singular?**	**3**
21.	**If** $A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$**, then show that** $A^T A^{-1} = \begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$.	**3**
22.	**Show that** $A = \begin{bmatrix} 2 & -3 \\ 3 & 4 \end{bmatrix}$ **satisfies the equation** $x^2 - 6x + 17 = O$. **Hence find** A^{-1}.	**3**
23.	**If** $A = \begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix}$ **and** $B = \begin{bmatrix} 4 & 6 \\ 3 & 2 \end{bmatrix}$**, verify that** $(AB)^{-1} = B^{-1}A^{-1}$.	**3**
	SECTION-D	

This section comprises of 4 long answer type question of 5 marks.		
24.	**Using the matrix method, solve the following system of linear equations where $x, y, z \neq 0$:** $$\frac{2}{x}+\frac{3}{y}+\frac{10}{z}=4, \quad \frac{4}{x}-\frac{6}{y}+\frac{5}{z}=1, \quad \frac{6}{x}+\frac{9}{y}-\frac{20}{z}=2$$	**5**
25.	**Use product** $\begin{bmatrix}1 & -1 & 2\\ 0 & 2 & -3\\ 3 & -2 & 4\end{bmatrix}\begin{bmatrix}-2 & 0 & 1\\ 9 & 2 & -3\\ 6 & 1 & -2\end{bmatrix}$ **to solve the system of linear equations** $x+3z=9, \ -x+2y-2z=4, \ 2x-3y+4z=-3$.	**5**
26.	**A school wants to allocate students into three clubs: Sports, Music and Drama, under following conditions:** • **The number of students in Sports club should be equal to the sum of the number of students in Music and Drama club.** • **The number of students in Music club should be 20 more than half the number of students in Sports club.** • **The total number of students to be allocated in all three clubs are 180.** **Find the number of students allocated to different clubs, using matrix method.**	**5**
27.	**If** $A=\begin{bmatrix}2 & -3 & 5\\ 3 & 2 & -4\\ 1 & 1 & -2\end{bmatrix}$ **, find** A^{-1} **and hence solve the system of linear equations:** $2x-3y+5z=11;\ 3x+2y-4z=-5;\ x+y-2z=-3$.	**5**

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QUESTION BANK (2026–27)

CLASS XII MATHEMATICS

CHAPTER 5: CONTINUITY AND DIFFERENTIABILITY		
	SECTION-A **This section comprises of 15 very short answer type questions of 1 marks each.**	
Q.No.	**Questions**	**Marks**
1.	**The set of all points where the function $f(x) = x + \|x\|$ is differentiable, is:** **(a)** $(0,\ \infty)$ **(c)** $(-\infty,\ 0)$ **(b)** $(-\infty,\ 0) \cup (0,\ \infty)$ **(d)** $(-\infty,\ \infty)$	**1**
2.	**If $f(x) = 2\|x\| + 3\|\sin x\| + 6$, then the right hand derivative of $f(x)$ at $x = 0$ is** **(a) 6 (b) 5 (c) 3 (d) 2**	**1**
3.	**The value of k for which the function $f(x) = \begin{cases} \frac{1-\cos 4x}{8x^2} & if\ x \neq 0 \\ k & if\ x = 0 \end{cases}$ is continuous at $x = 0$ is** **(a) 0 (b) −1 (c) 1 (d) 2**	**1**
4.	**The function $f(x) = [x]$, where $[x]$ denotes the greatest integer less than or equal to x, is continuous at:** **(a)** $x = 1$ **(b)** $x = 1.5$ **(c)** $x = -2$ **(d)** $x = 4$	**1**
5.	**If $\tan\left(\frac{x+y}{x-y}\right) = k$, then $\frac{dy}{dx}$ is equal to** **(a)** $\frac{-y}{x}$ **(b)** $\frac{y}{x}$ **(c)** $sec^2\left(\frac{y}{x}\right)$ **(d)** $-sec^2\left(\frac{y}{x}\right)$	**1**
6.	**If $xe^y = 1$, then the value of $\frac{dy}{dx}$ at $x = 1$ is:** **(a) 1 (b)** $-\frac{1}{e}$ **(c) −e (d) −1**	**1**
7.	**If $y = \log\sqrt{\sec\sqrt{x}}$, then $\frac{dy}{dx}$ at $x = \frac{\pi^2}{16}$ is equal to** **(a)** $\frac{1}{\pi}$ **(b)** π **(c)** $\frac{1}{2}$ **(d)** $\frac{1}{4}$	**1**
8.	**Derivative of $sin\,x$ with respect to $log\,x$, is** **(a)** $\frac{x}{\cos x}$ **(b)** $\frac{\cos x}{x}$ **(c)** $\mathrm{x}\cos x$ **(d)** $\mathrm{x}^2\cos x$	**1**
9.	**If $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$, then $(x^2 - 1)y_2 + xy_1$ is equal to** **(a)** $\pm m^2y$ **(b)** m^2y **(c)** $-m^2y$ **(d)** $-my$	**1**
10.	**A function f is said to be continuous for $x \in R$, if** **(a) it is continuous at $x = 0$** **(b) differentiable at $x = 0$** **(c) continuous at two points** **(d) differentiable for $x \in R$**	**1**
	ASSERTION-REASON BASED QUESTIONS **(Question 11 to 15 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and**	

	the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below. (q) Both (A) and (R) are true and (R) is the correct explanation of (A). (r) Both (A) and (R) are true but (R) is not the correct explanation of (A). (s) (A) is true but (R) is false. (t) (A) is false but (R) is true.	
11.	**A: The function $f(x) = \|x-3\| + \|x+1\|$ is continuous at $x = 3$, but not differentiable at $x = 3$.** **R: Every differentiable function is continuous, but every continuous function need not be differentiable.**	**1**
12.	**A: $f(x) = \|x - 3\|$ is continuous at $x = 0$.** **R: $f(x) = \|x - 3\|$ is differentiable at $x = 0$.**	**1**
13.	**A: Every differentiable function is continuous but converse is not true.** **R: Function $f(x) = \|x\|$ is continuous.**	**1**
14.	**A: If $e^{xy} + \log(xy) + \cos(xy) + 4 = 0$, then $\frac{dy}{dx} = -\frac{y}{x}$.** **R: $\frac{d}{dx}(xy) = 0 \Rightarrow \frac{dy}{dx} = -\frac{y}{x}$.**	**1**
15.	**A: If $f(x) = \sqrt{1 + \cos^2(x^2)}$, then $f'\left(\frac{\sqrt{\pi}}{2}\right)$ is $\frac{\pi}{3}$.** **R: If $f(x) = e^x$, $g(x) = \sin^{-1} x$ and $h(x) = f(g(x))$, then $\frac{h'(x)}{h(x)}$ is $\frac{1}{\sqrt{1-x^2}}$.**	**1**
	SECTION-B **This section comprises of 4 very short answer type questions of 2 marks each.**	
16.	**Find the value(s) of k so that the following function is continuous at $x = 0$.** $$f(x) = \begin{cases} \frac{1-\cos kx}{x \sin x} & if\ x \neq 0 \\ \frac{1}{2} & if\ x = 0 \end{cases}$$	**2**
17.	**Find the number of points of discontinuity of f defined by $f(x) = \|x\| - \|x+1\|$.**	**2**
18.	**Differentiate $2^{\cos^2 x}$ w.r.t. $\cos^2 x$.** **OR** **If $x^y = e^{x-y}$, then prove that $\frac{dy}{dx} = \frac{\log x}{(1+\log x)^2}$**	**2**
19.	**If $x = a(\theta + \sin\theta)$ and $y = a(1 - \cos\theta)$ then find $\frac{d^2y}{dx^2}$**	**2**
	SECTION-C **This section comprises of 4 short answer type questions of 3 marks each.**	
20.	**If $y = \tan x + \sec x$, then prove that $\frac{d^2y}{dx^2} = \frac{\cos x}{(1-\sin x)^2}$**	**3**
21.	**If $x = a(\cos t + t \sin t)$ and $y = a(\sin t - t\cos t)$, find $\frac{d^2y}{dx^2}$ at $t = \frac{\pi}{4}$**	**3**
22.	**If $f(x) = \begin{cases} ax + b, & 0 < x \leq 1 \\ 2x^2 - x, & 1 < x < 2 \end{cases}$ is a differentiable function in $(0, 2)$, then find the values of a and b.**	**3**

23.	**Differentiate** $\sin^{-1}\left(\frac{2^{x+1}.\ 3^x}{1+(36)^x}\right)$ **with respect to** x.	**3**

SECTION-D

This section comprises of 4 long answer type question of 5 marks.

24.	**If** $(x-a)^2+(y-b)^2=c^2$, **for some** $c>0$, **then prove that** $\dfrac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$ **is a constant independent of** a **and** b.	**5**
25.	**If** $x=\cos t+\log\left(\tan\frac{t}{2}\right)$ **and** $y=\sin t$, **then find the values of** $\frac{d^2y}{dt^2}$ **and** $\frac{d^2y}{dx^2}$ **at** $t=\frac{\pi}{4}$.	**5**
26.	**If** $y=\log\left(\sqrt{x}+\frac{1}{\sqrt{x}}\right)^2$, **then prove that** $x(x+1)^2y_2+(x+1)^2y_1=2$.	**5**
27.	**Find the value of a for which the function f is defined as** $$f(x)=\begin{cases} a\sin\frac{\pi}{2}(x+1), & if\ x\le 0 \\ \frac{\tan x-\sin x}{x^3}, & if\ x>0 \end{cases}$$ **is continuous at** $x=0$.	**5**

SECTION-E

This section comprises 2 case-study/passage-based question of 4 marks (1+1+2) each with subparts.

28.	**STOCK MARKET CIRCUIT BREAKER** **SEBI (Securities & Exchange Board of India) is designing a new "circuit breaker algorithm" for the NSE (National Stock Exchange of India). The price volatility index** $V(t)$ **of a stock** t **minutes before/after a major news release at** $t=0$ **is modeled to prevent panic trading.** **For smooth operation, the volatility function must be continuous at** $t=0$, **else trading will halt abruptly.** $$V(t)=\begin{cases} \frac{\sin(a+1)t+\sin t}{t}, & if\ t<0\ [\text{Pre}-\text{News Rumor Phase}] \\ c, & if\ t=0\ [\text{News Release Instant}] \\ \frac{\sqrt{t+bt^2}-\sqrt{t}}{b\sqrt{t^3}}, & if\ t>0\ [\text{Post}-\text{News Reaction Phase}] \end{cases}$$ **where** a, b, c **are control parameters set by SEBI's risk team.** **Based on the above model, answer the following questions:** **(IV)** **Calculate** $\lim_{t\to 0^-}V(t)$, **the volatility index just before the news breaks, in terms of** a. **(V)** **Calculate** $\lim_{t\to 0^+}V(t)$, **the volatility index just after the news breaks, in terms of** b. **(VI)** **If SEBI wants zero market disruption, the function must be continuous at** $t=0$. **(a) Find the values of** a, b **and** c **that ensure this.** **(b) What does the value of** c **represent in this stock market context?**	**4**
29.	**DRONE ALTITUDE CONTROL**	**4**

	A tech start-up is programming a drone's autopilot. The drone's altitude $h(t)$ in meters at time t seconds is modeled by a piecewise function to ensure smooth transition at the critical time $t = \frac{\pi}{2}$ sec when it switches from "Ascent Mode" to "Stabilize Mode". $$h(t) = \begin{cases} \dfrac{1-\sin^3 t}{3\cos^2 t}, & if\ 0 \le t < \dfrac{\pi}{2} \quad [\text{Ascent Mode}] \\ k, & if\ t = \dfrac{\pi}{2} \quad [\text{Transition Mode}] \\ \dfrac{m(1-\sin t)}{(\pi - 2t)^2}, & if\ \dfrac{\pi}{2} < t \le \pi\ [\text{Stabilize Mode}] \end{cases}$$ **For passenger safety, the altitude function must be continuous at $t = \frac{\pi}{2}$. Otherwise the drone will jerk and crash.** **Based on the above information, answer the following questions:** **(VII) Find $\lim_{t \to \frac{\pi}{2}^-} h(t)$, the altitude just before transition.** **(VIII) Find $\lim_{t \to \frac{\pi}{2}^+} h(t)$ in terms of m, the altitude just after transition.** **(IX) Using the condition of continuity, find the values of k and m that the programmers must set to ensure a smooth flight. Interpret what k represents physically.**	

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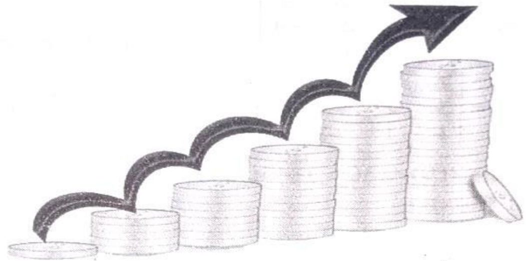
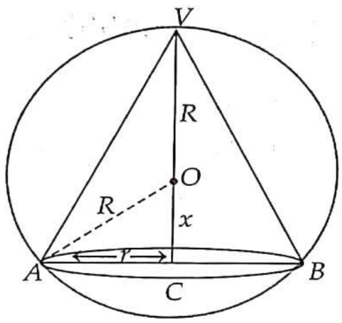
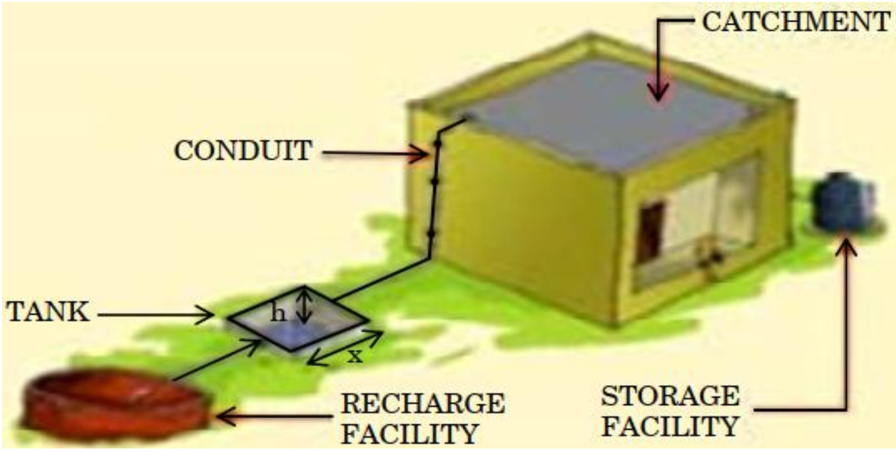
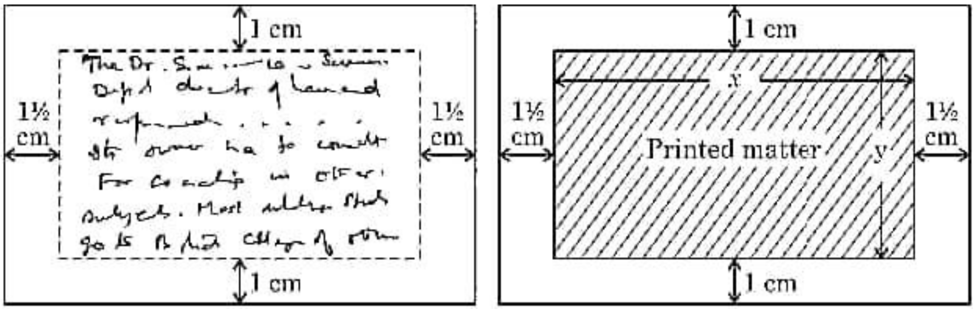
QUESTION BANK (2026–27)

CLASS XII MATHEMATICS

CHAPTER 6: APPLICATION OF DERIVATIVES		
SECTION-A **This section comprises of 15 very short answer type questions of 1 marks each.**		
Q.No.	**Questions**	**Marks**
1.	**The interval in which the function $f(x) = 2x^3 + 9x^2 + 12x - 1$ is decreasing is:** **(a)** $(-1,\ \infty)$ **(c)** $(-2, -1)$ **(b)** $(-\infty, -2)$ **(d)** $(-1,\ 1)$	**1**
2.	**In the interval $(1, 2)$, the function $f(x) = 2\|x-1\| + 3\|x-2\|$ is:** **(a) strictly increasing.** **(b) strictly decreasing.** **(c) neither increasing nor decreasing.** **(d) remains constant.**	**1**
3.	**The smallest value of polynomial $x^3 - 18x^2 + 96x$ in $[0, 9]$ is** **(a) 126 (b) 0 (c) 135 (d) 160**	**1**
4.	**The real function $f(x) = 2x^3 - 3x^2 - 36x + 7$ is:** **(a) strictly increasing in $(-\infty, -2)$ and strictly decreasing in $(-2,\ \infty)$** **(b) strictly decreasing in $(-2,\ 3)$** **(c) strictly decreasing in $(-\infty,\ 3)$ and strictly increasing in $(3,\ \infty)$** **(d) strictly decreasing in $(-\infty, -2) \cup (3,\ \infty)$**	**1**
5.	**The maximum value of $\left(\frac{1}{x}\right)^x$ is** **(a)** e **(b)** e^e **(c)** $e^{1/e}$ **(d)** $\left(\frac{1}{e}\right)^{1/e}$	**1**
6.	**The value of x for which $(x - x^2)$ is maximum, is:** **(a) 3/4 (b) 1/2 (c) 1/3 (d) 1/4**	**1**
7.	**If $f(x) = a(x - \cos x)$ is strictly decreasing in R, then 'a' belongs to** **(a)** $\{0\}$ **(b)** $(0, \infty)$ **(c)** $(-\infty, 0)$ **(d)** $(-\infty, \infty)$	**1**
8.	**The value of b for which the function $f(x) = x + \cos x + b$ is strictly decreasing over R is** **(a)** $b < 1$ **(b)** $b \geq 1$ **(c)** $b \leq 1$ **(d) No value of b exists**	**1**
9.	**A ladder, $5\,m$ long, standing on a horizontal floor, leans against a vertical wall. If the top of the ladder slides downwards at the rate of $10\,cm/s$, then the rate at which the angle between the floor and the ladder is decreasing when lower end of ladder is $2\,m$ from the wall is** **(a) 1/10 radian/sec** **(b) 1/20 radian/sec** **(c) 20 radian/sec** **(d) 10 radian/sec**	**1**
10.	**A wire of length $20\,cm$ is bent in the form of a sector of a circle. The maximum area that can be enclosed by the wire is:** **(a)** $20\,sq\,cm$ **(b)** $25\,sq\,cm$ **(c)** $10\,sq\,cm$ **(d)** $30\,sq\,cm$	**1**
	ASSERTION-REASON BASED QUESTIONS **(Question 11 to 15 are Assertion-Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (a), (b), (c) and (d) as given below.**	

	(u) Both (A) and (R) are true and (R) is the correct explanation of (A). (v) Both (A) and (R) are true but (R) is not the correct explanation of (A). (w) (A) is true but (R) is false. (x) (A) is false but (R) is true.	
11.	**A: The minimum value of $f(x) = x^2 - 8x + 17$ is 1.** **R: If $f'(c) = 0$ and $f''(c) > 0$ then f has a local minimum.**	**1**
12.	**A: The rate of change of area of a circle with respect to its radius r when $r = 6\ cm$ is $12\pi\ cm^2/cm$.** **R: Rate of change of area of a circle with respect to its radius r is $\frac{dA}{dx}$, where A is the area of the circle.**	**1**
13.	**A: $f(x) = x^4$ is decreasing in the interval $(0, \infty)$.** **R: Any function $y = f(x)$ is decreasing if $\frac{dy}{dx} < 0$.**	**1**
14.	**A: The absolute maximum value of the function $f = (x-1)^2 + 3\ in\ [-3, 1]$ is 19.** **R: The absolute value of function exists only on critical point of a function in I.**	**1**
15.	**An open-top box is to be constructed by removing equal squares from each corner of a $3\ m$ by $8\ m$ rectangular sheet and folding up the sides.** **A: Maximum volume of the box is $\frac{200}{27}$ cubic meters.** **R: Volume is largest when the square of side $\frac{2}{3}$ is removed from each corner.**	**1**
SECTION-B **This section comprises of 4 very short answer type questions of 2 marks each.**		
16.	**A ladder is 5 m long is leaning against the wall. The bottom of the ladder is pulled along the ground, away from the wall, at the rate of $2\ cm/s$. How fast is its height on the wall decreasing when the foot of the ladder is 4 m away from the wall?**	**2**
17.	**Show that the function f defined by $f(x) = (x-1)e^x + 1$ is an increasing function for all $x > 0$.**	**2**
18.	**Find all the points of local maxima and minima of the function $f(x) = x^3 - 6x^2 + 9x - 8$.**	**2**
19.	**The amount of pollution content added in air in a city due to x - diesel vehicles is given by $P(x) = 0.005x^3 + 0.02x^2 + 30x$. Find the marginal increase in pollution content when 3 diesel vehicles are added.**	**2**
SECTION-C **This section comprises of 4 short answer type questions of 3 marks each.**		
20.	**Find the absolute maximum and absolute minimum values of the function f given by $f(x) = \sin^2 x - \cos x,\ x \in [0, \pi]$.**	**3**
21.	**The volume of a cube is increasing at the rate of $9\ cm^3/s$. How fast is its surface area increasing when the length of an edge is $10\ cm$?**	**3**
22.	**Find the interval/intervals in which the function $f(x) = \sin 3x - \cos 3x$, $0 < x < \frac{\pi}{2}$ is strictly increasing.**	**3**
23.	**An Apache helicopter of enemy is flying along the curve given by $y = x^2 + 7$. A soldier placed at $(3, 7)$ wants to shoot down the helicopter, when it is nearest to him. Find the nearest distance.**	**3**
SECTION-D **This section comprises of 4 long answer type question of 5 marks.**		

24.	**If the length of three sides of a trapezium other than the base are each equal to $10\,cm$, then find the area of the trapezium, when it is maximum.**	**5**
25.	**Show that the height of the cylinder of maximum volume that can be inscribed in a sphere of radius R is $\frac{2R}{\sqrt{3}}$. Also, find the maximum volume.**	**5**
26.	**A wire of length $25\,m$ is to be cut into two pieces. One of the pieces is to be made into a square and the other into a circle. What could be the lengths of the two pieces so that the combined area of the square and circle is minimum?**	**5**
27.	**A window is in the form of rectangle surmounted by a semi-circular opening. If the perimeter of window is $10\,m$, find the dimensions of the window so as to admit maximum possible light through the whole opening.**	**5**
	SECTION-E **This section comprises 4 case-study/passage-based question of 4 marks (1+1+2) each with subparts.**	
28.	**$P(x) = -6x^2 + 120x + 25000$ (in ₹) is the total profit function of a company, where x denotes the production of the company.**  **Based on the above information, answer the following questions.** **(I) Find the profit of the company, when the production is 3 units.** **(II) Find $P'(5)$.** **(III) (a) Find the interval in which the profit is strictly increasing.** **(b) Find the production, when the profit is maximum.**	**4**
29.	**Let a cone be inscribed in a sphere of radius R. The height and radius of cone are h and r, respectively.**  **On the basis of above information, answer the following questions.** **(I) Write the relation between r and R in terms of x.** **(II) Write the volume V of the cone in terms of R and x.** **(III) (a) Show the volume V of the cone is maximum, when $x = \frac{R}{3}$.** **(b) If volume V of the cone is maximum at $x = \frac{R}{3}$, then find the maximum value of V and find the ratio of volume of cone and volume of sphere, when volume of cone is maximum.**	**4**
30.	**In order to set up a rainwater harvesting system, a tank to collect**	**4**

	rainwater is to be dug. The tank should have a square base and a capacity of $250\,m^3$. The cost of land is ₹ 5000 per m^2 and cost of digging increases with depth and for the whole tank, it is $40000\,h^2$, where h is the depth of the tank in metres. x is the side of the square base of the tank in metres.  Based on the above information, answer the following questions. (I) Find the total cost C of digging the tank in terms of x. (II) Find $\frac{dC}{dx}$. (III) (a) Find the value of x for which cost C is minimum. OR (b) Check whether the cost function $C(x)$ expressed in terms of x is increasing or not, where $x > 0$.	
31.	A rectangular visiting card is to contain $24\,cm^2$ of printed matter. The margins at the top and bottom of the card are to be $1\,cm$ and the margins on the left and right are to be $1\frac{1}{2}\,cm$ as shown below.  On the basis of the above information, answer the following questions. (I) Write the expression for the area of the visiting card in terms of x. (II) Obtain the dimensions of the card of minimum area.	4