

TERM I EXAMINATION 2024-2025

CLASS XII

MATHEMATICS

SET B

TIME: 3 hours

MM: 80

General Instructions:

1. This question paper contains five sections A, B, C, D, and E. Each section is compulsory.
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 subparts.

Section A

(Multiple Choice Questions)

Each question carries 1 mark

1. The derivative of  $x^{2x}$  with respect to  $x$  is  
 (a)  $x^{2x-1}$  (b)  $2x^{2x} \log x$  (c)  $2x^{2x} (1 - \log x)$  (d)  $2x^{2x} (1 + \log x)$
2. If a matrix is both symmetric and skew symmetric then A is a  
 (a) Scalar matrix (b) Diagonal matrix (c) Zero matrix (d) Square matrix
3. The function  $f(x) = [x]$ , where  $[x]$  denotes the greatest integer less than or equal to  $x$  is continuous at  
 (a)  $x = -2$  (b)  $x = 3.5$  (c)  $x = 1$  (d)  $x = 4$
4. What is the number of all possible matrices of order  $3 \times 3$  with each entry 1 or 2?  
 (a) 512 (b) 81 (c) 9 (d) 18
5.  $\frac{d}{dx} [\sin^{-1}(\cos x)]$  is equal to  
 (a) -1 (b)  $\frac{1}{2}$  (c)  $\cos^{-1}x$  (d)  $\frac{1}{\sin x}$
6. If  $x = A \cos 4t + B \sin 4t$ , then  $\frac{d^2x}{dt^2}$  is equal to  
 (a)  $x$  (b)  $-x$  (c)  $16x$  (d)  $-16x$
7. Let A be a square matrix of order  $3 \times 3$ . Write the value of  $|2A|$ , where  $|A| = 8$   
 (a) 16 (b) 32 (c) 8 (d) 64
8. If A, B are non-singular square matrices of the same order, then  $(A^{-1}B)^{-1} =$   
 (a)  $B^{-1}A$  (b)  $A^{-1}B^{-1}$  (c)  $BA^{-1}$  (d) AB
9. If A is a square matrix of order 3 and  $|A| = 5$ , then  $|\text{adj } A| =$   
 (a) 5 (b) 125 (c) 25 (d)  $\frac{1}{5}$

10. Find the value of  $k$  so that  $f(x) = \begin{cases} kx + 1 & \text{if } x \leq \pi \\ \cos x & \text{if } x > \pi \end{cases}$  is continuous at  $x = \pi$
- (a)  $-\frac{2}{\pi}$  (b)  $\frac{\pi}{2}$  (c)  $\frac{2}{\pi}$  (d)  $\frac{-\pi}{2}$
11. The principal value of  $\cos^{-1}\left(\frac{1}{2}\right) + \sin^{-1}\left(-\frac{1}{\sqrt{2}}\right)$  is
- (a)  $\pi$  (b)  $\frac{\pi}{3}$  (c)  $\frac{\pi}{6}$  (d)  $\frac{\pi}{12}$
12. If  $\begin{vmatrix} 2 & 4 \\ 5 & 1 \end{vmatrix} = \begin{vmatrix} 2x & 4 \\ 6 & x \end{vmatrix}$ , then the possible values of 'x' is/are
- (a) 3 (b)  $\sqrt{3}$  (c)  $-\sqrt{3}$  (d)  $\sqrt{3}, -\sqrt{3}$
13. Let  $R^*$  denote the set of all non negative real numbers. Then the function  $f: R^* \rightarrow R^*$  defined as  $f(x) = x^2 + 1$  is
- (a) One-one but not onto (b) onto but not one-one  
(c) both one-one and onto (d) Neither one-one nor onto
14. How many one-one functions are there from set  $A = \{1, 2, 3, 4\}$  to itself?
- (a) 16 (b) 24 (c) 8 (d) 42
15. If  $\begin{vmatrix} 1 & 3 & 1 \\ k & 0 & 1 \\ 0 & 0 & 1 \end{vmatrix} = \pm 6$ , then the value of  $k$  is
- (a)  $\pm 2$  (b) -3 (c) 2 (d)  $\pm 3$
16. The interval in which the function  $f(x) = 2x^3 + 9x^2 + 12x - 1$  is decreasing is
- (a)  $(-1, \infty)$  (b)  $(-2, -1)$  (c)  $(-\infty, -2)$  (d)  $[-1, 1]$
17. If  $A$  and  $B$  are two skew symmetric matrices, then  $(AB - BA)$  is
- (a) a skew symmetric matrix (b) a symmetric matrix  
(c) a null matrix (d) an identity matrix
18. For  $x, y \in Z$ , define a relation  $R$  by  $xRy$  if and only if  $x - y + \sqrt{2}$  is an irrational number. Then  $R$  is
- (a) Only symmetric (b) only transitive (c) An equivalence relation (d) None of these

### 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.

19. Assertion (A): The principal value of  $\cot^{-1}(\sqrt{3})$  is  $\frac{\pi}{6}$ .

Reason (R): Domain of  $\cot^{-1}x$  is  $R - [-1, 1]$

20. Assertion (A): If  $A$  is an invertible matrix of order 3 and  $|A| = 6$  then  $|\text{adj } A| = 36$ .

Reason (R): If  $A$  is a non-singular matrix of order  $n$ . Then,  $|\text{adj } A| = |A|^{n-1}$

## SECTION B

This section comprises of very short answer type-questions (VSA) of 2 marks each

21. Find the value of  $\operatorname{cosec}^{-1} \left[ \operatorname{cosec} \left( \frac{13\pi}{4} \right) \right]$
22. If the matrix  $A = \begin{bmatrix} 0 & 2b & -2 \\ 3 & 1 & 3 \\ 3a & 3 & -1 \end{bmatrix}$  is a symmetric, find the values of a and b
23. Prove that the function  $f: N \rightarrow R_0$  defined as  $f(x) = \frac{1}{x}$  is injective. (Where  $R_0$  is the set of all non-zero real numbers). Is the function surjective? Justify your answer.
24. Find  $\frac{dy}{dx}$  at  $x = 1, y = \frac{\pi}{4}$  if  $\sin^2 y + \cos xy = k$
25. A ladder 13 m long is leaning against a vertical wall. The bottom of the ladder is dragged away from the wall along the ground at the rate of 2cm/s. How fast is the height on the wall decreasing when the foot of the ladder is 5m away from the wall?

## SECTION C

This section comprises of short answer type questions (SA) of 3 marks each

26. Differentiate the function  $(\sin x)^x + \sin^{-1}\sqrt{x}$  with respect to x.

27. Express the matrix  $\begin{bmatrix} 3 & 3 & -1 \\ -2 & -2 & 1 \\ -4 & -5 & 2 \end{bmatrix}$  as the sum of a symmetric and a skew symmetric matrices.

28. If the function f defined by  $f(x) = \begin{cases} 3ax + b, & \text{if } x > 1 \\ 11, & \text{if } x = 1 \\ 5ax - 2b, & \text{if } x < 1 \end{cases}$  is continuous at  $x=1$ , find the values of a and b.

29. For the matrix  $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}$ . Show that  $A^3 - 23A - 40I = 0$ .

30. If  $y = \tan x + \sec x$ , then prove that  $\frac{d^2y}{dx^2} = \frac{\cos x}{(1-\sin x)^2}$

31. Using determinants, find the value of  $\lambda$  so that the points  $(\lambda, 7)$ ,  $(1, -5)$  and  $(-4, 5)$  are collinear.

## SECTION D

(This section comprises of long answer-type questions (LA) of 5 marks each)

32. Find all points of discontinuity of f where f is defined by  $f(x) = \begin{cases} \frac{|x|}{x}, & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases}$

33. Show that the relation R in the set  $A = \{x : x \in W, 0 \leq x \leq 12\}$  given by  $R = \{(a, b) : |a - b| \text{ is a multiple of } 4\}$  is an equivalence relation.

34. Prove that every differentiable functions are continuous and every continuous function need not be differentiable.

35. If  $A = \begin{bmatrix} 2 & 3 & 1 \\ 1 & 2 & 2 \\ -3 & 1 & -1 \end{bmatrix}$  find  $A^{-1}$ . Use  $A^{-1}$  to solve the system of linear equations.

$$2x + y - 3z = 13,$$

$$3x + 2y + z = 4 \text{ and}$$

$$x + 2y - z = 8$$

### SECTION E

(This section comprises of 3 case-study/passage-based questions of 4 marks each.)

36. Gautam buys 5 pens, 3 bags 1 box and pays a sum of Rs. 160. From the same shop, Vikram buys 2 pens, 1 bag and 3 boxes and pays a sum of Rs. 190. Also, Ankur buys 1 pen, 2 bags and 4 boxes and pays a sum of Rs. 250.

On the basis of the above information, answer the following questions.

(i) Convert the situation into a matrix equation of the form  $AX=B$

(ii) Find  $|A|$

(iii) Find  $A^{-1}$

37. Let  $f(x) = \begin{cases} x + a\sqrt{2} \sin x, & 0 \leq x < \frac{\pi}{4} \\ 2x \cot x + b, & \frac{\pi}{4} \leq x \leq \frac{\pi}{2} \\ a \cos 2x - b \sin x, & \frac{\pi}{2} < x \leq \pi \end{cases}$

be a real valued function.

Based on the above information, answer the following questions:

(i) Find the value of  $\lim_{x \rightarrow \frac{\pi}{4}^-} f(x)$

(ii) Find the value of  $\lim_{x \rightarrow \frac{\pi}{2}^+} f(x)$

(iii) If  $f(x)$  is continuous at  $x = \frac{\pi}{2}$ , then find the relation between  $a$  and  $b$ .

38. The relation between the height of the plant ( $y$  in cm) with respect to exposure to sunlight is governed by the following equation  $y = 4x - \frac{1}{2}x^2$ , where  $x$  is the number of days exposed to sunlight.

Based on the above information, answer the following questions:

(i) Find the rate of growth of the plant with respect to sunlight.

(ii) What is the number of days it will take for the plant to grow to the maximum height?

(iii) If the height of the plant is  $\frac{7}{2}$  cm, find the number of days it has been exposed to the sunlight.