BUDHA DAL PUBLIC SCHOOL PATIALA
FIRST TERM EXAMINATION (20 September 2025)
Class - XII
Paper- Mathematics (Set-A)

M.M. 80

Time: 3hrs.

General Instructions:

1. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer type questions of 2 marks each.
4. Section C has 6 Short Answer type questions of 3 marks each.
5. Section D has 4 Long Answer type questions of 5 marks each.
6. Section E has 3 case based studies of 4 marks each.

Section - A

1. A relation R on set $A = \{1, 2, 3\}$ given by $R = \{(1,1), (2,2), (2,3)\}$ is/are

   a) reflexive b) symmetric c) transitive d) all the three

2. Set A has 3 elements and the set B has 4 elements. Then the number of injective functions that can be defined from set A to set B is

   a) 144 b) 12 c) 24 d) 64

3. What is the domain of the function $cos^{-1}(2x - 3)$?

   a) $[-1, 1]$ b) $(1, 2)$ c) $(-1, 1)$ d) $[1, 2]$

4. The Principal value of $sin^{-1}\left(-\frac{1}{2}\right)$ is

   a) $\frac{\pi}{3}$ b) $-\frac{\pi}{3}$ c) $\frac{5\pi}{6}$ d) $-\frac{\pi}{6}$

5. The Principal value of $sin^{-1}\left(sin\frac{6\pi}{7}\right)$ is

   a) $\frac{\pi}{4}$ b) $\frac{\pi}{3}$ c) $\frac{2\pi}{7}$ d) $\frac{\pi}{7}$

6. If a matrix has 6 elements, then number of possible orders of the matrix can be

   a) 2 b) 4 c) 3 d) 6

7. If $A = diag\,(3, -1)$, then matrix A is

   a) $\begin{bmatrix} 0 & 3 \\ 0 & -1 \end{bmatrix}$ b) $\begin{bmatrix} -1 & 0 \\ 3 & 0 \end{bmatrix}$ c) $\begin{bmatrix} 3 & 0 \\ 0 & -1 \end{bmatrix}$ d) $\begin{bmatrix} 3 & -1 \\ 0 & 0 \end{bmatrix}$

8. If $\begin{vmatrix} 2x & -1 \\ 4 & 2 \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ 2 & 1 \end{vmatrix}$ then x is

   a) 3 b) $\frac{2}{3}$ c) $\frac{3}{2}$ d) $-\frac{1}{4}$

9. If $A = \begin{bmatrix} a & 2 \\ 2 & a \end{bmatrix}$ and $|A|^3 = 125$, then a is

   a) ± 3 b) 5 c) ± 2 d) 4

10. If A is a square matrix of order 3×3, such that $A.(Adj\ A) = 10I$, then $|Adj.\ A|$ is

    a) 1 b) 10 c) 100 d) 1000

11. The number of point(s) where $f(x) = |x + 2| + |x - 3|$ is not differentiable is/are

a) 2 b) 3 c) 0 d) 1

12. If $y = Ae^{5x} + Be^{-5x}$, then $\frac{d^2y}{dx^2}$, is equal to

a) $25y$ b) $5y$ c) $-25y$ d) $15y$

13. $\frac{d}{dx}(x^x)$ is equal to

a) x^{x-1} b) $x \log x$ c) $x^x(1 + \log x)$ d) xx^{x-1}

14. If $x^2 + y^2 = 5$ then $\frac{dy}{dx}$ is

a) $-x^2$ b) $-2x$ c) $\frac{x^2}{y^2}$ d) $-\frac{x}{y}$

15. The total revenue in Rs. received from the sale of x units of an article is given by $R(x) = 3x^2 + 36x + 5$. The marginal revenue when $x = 15$ is (in Rs.)

a) 126 b) 116 c) 96 d) 90

16. The function $f(x) = \tan x - x, x \in R$ is

a) always increasing b) always decreasing

c) neither increasing nor decreasing d) none of these

17. The absolute maximum value of $y = x^3 - 3x + 2$ in $0 \leq x \leq 2$ is

a) 4 b) 6 c) 2 d) 0

18. The objective function for a given linear programming problem is $Z = ax + by - 5$. If Z attains same value at (1, 2) and (3, 1) then

a) $a + 2b = 0$ b) $a + b = 0$ c) $a = b$ d) $2a - b = 0$

Assertion & Reasoning Questions

The following questions consists of two statements - Assertion (A) and Reason (R). Answer the question selecting appropriate option given below:

a) Both A and R are true and R is correct explanation for A.
b) Both A and R are true but R is not correct explanation for A.
c) A is true but R is false.
d) A is false but R is true.

19. Assertion (A) : In set $A = \{1, 2, 3\}$ a relation R defined as $R = \{(1, 1), (2, 2)\}$ is reflexive.
Reason (R) : A relation R is reflexive in set A if $(a, a) \in R$

20. Assertion (A) : If matrix $A = \begin{bmatrix} 1 & 2 \\ 4 & -1 \end{bmatrix}$ then it is a singular matrix.

Reason (R) : If matrix A is singular, then $|A| = 0$.

Section - B

21. Show that the Signum Function $f: R \to R$, given by $f(x) = \begin{cases} 1, if\ x > 0 \\ 0, if\ x = 0 \\ -1, if\ x < 0 \end{cases}$ is neither one-one nor onto

A-2

22. Find the value of $\sin\left[\frac{\pi}{3} - sin^{-1}\left(-\frac{1}{2}\right)\right]$

23. For what value of x, is the matrix $A = \begin{bmatrix} 0 & 1 & -2 \\ -1 & 0 & 3 \\ x & -3 & 0 \end{bmatrix}$ a skew symmetric matrix ?

24. Find the value of x, such that the points $(0, 2)$, $(1, x)$ and $(3, 1)$ are collinear.

25. Is the function $f(x) = \begin{cases} \frac{e^{1/x}-1}{e^{1/x}+1}, & if\ x \neq 0 \\ 0, & if\ x = 0 \end{cases}$ continuous at $x = 0$?

Section - C

26. If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, show that $A^2 - 5A + 7I = O$. Hence find A^{-1}

27. Find $\frac{dy}{dx}$ at $x = 1, y = \frac{\pi}{4}$ if $sin^2 y + \cos xy = K$

28. Find $\frac{dy}{dx}$ at $t = \frac{2\pi}{3}$ when $x = 10\ (t - \sin t) and\ y = 12\ (1 - \cos t)$

29. The volume of a sphere is increasing at the rate of 3 cubic centimeter per second. Find the rate of increase of its surface area, when the radius is 2 cm.

30. Find the intervals in which the function f given by $f(x) = \frac{3}{10}x^4 - \frac{4}{5}x^3 - 3x^2 + \frac{36}{5}x + 11$ is
(i) strictly increasing (ii) strictly decreasing

31. Solve the following LPP graphically.

Minimise $Z = 5x + 10y$,

subject to constraints

$$x + 2y \leq 120$$
$$x + y \geq 60 \quad \text{and } x, y \geq 0$$
$$x - 2y \geq 0$$

Section - D

32. If $y = \left(\log\left(x + \sqrt{x^2 + 1}\right)\right)^2$, show that $(1 + x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - 2 = 0$

33. Show that the rectangle of maximum area that can be inscribed in a circle of radius r is a square of side $\sqrt{2}r$.

34. Find $\frac{dy}{dx}$, if $y = (\cos x)^x + (\sin x)^{\frac{1}{x}}$

35. 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 equation
$x + 3z = 90, -x + 2y - 2z = 4,\ 2x - 3y + 4z = -3$

A-3

Section - E

Case Study Questions

36. Suppose f is a real function on a subset of the real numbers and let c be a point in the domain of f. Then f is continuous at c if $\lim_{x\to c} f(x) = f(c)$. The function f is given by

$$f(x) = \begin{cases} ax + 5, if\ x < 5 \\ 10, \quad if\ x = 5 \\ bx + 20, if\ x > 5 \end{cases}$$

The given function is continuous at $x = 5$

Based on above information, answer these following questions:

1. Find the relation between a *and* b (1)
2. Find the value of a (1)
3. Find the value of function $f(3)$ (2)

37. **Read the following passage and answer the following questions.**

On the occasion of children's day, class teacher of class XII Shri Singh, decided to donate some money to students of class XII.

If there were 8 students less, everyone would have got Rs. 10 more. However, if there were 16 students more, everyone would have got Rs. 10 less.

1. (a) If number of students in class be x and Shri Singh has decided to donate Rs. y to each student, express the information provided in problem in system of linear equation. (2)
   (b) Express system of linear equation obtained in (a) in matrix equation.
2. Find the number of students in class XII and the amount distributed by Shri Singh. (2)

38. Student of Grade XII, planned to plant saplings along straight lines, parallel to each other to one side of the playground ensuring that they had enough play area. Let us assume that they planned one of the rows of the saplings along the line $y = x - 4$. Let L be the set of all lines which are parallel on the ground and R be a relation on L.

Answer the following questions using the above information:

1. Let relation R be defined by $R = \{(L_1, L_2): L_1 \parallel L_2\ where\ L_1, L_2 \in L\}$. What is the type of relation R? (1)
2. Let $R = \{(L_1, L_2): L_1 \perp L_2\ where\ L_1, L_2 \in L\}$, then, show that R is symmetric but neither reflexive nor transitive. (1)
3. Prove that the $f: R \to R$ be defined by $f(x) = x - 4$ is bijective. (2)

BUDHA DAL PUBLIC SCHOOL PATIALA

FIRST TERM EXAMINATION (20 September 2025)

Class – XII

Paper- Mathematics (Set-B)

Time: 3hrs. **M.M. 80**

General Instructions:

1. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer type questions of 2 marks each.
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6. Section E has 3 case based studies of 4 marks each.

Section - A

1. Given triangles with sides $T_1: 3, 4, 5$; $T_2: 5, 12, 13$; $T_3: 6, 8, 10$; $T_4: 4, 7, 9$ and a relation R in set of triangles defined as $R = \{\Delta_1, \Delta_2): \Delta_1 \text{ is similar to } \Delta_2\}$. Which triangles belong to the same equivalence class?

   a) T_1 and T_2 b) T_2 and T_3 c) T_1 and T_3 d) T_1 and T_4

2. Consider the set A containing n elements, then the total number of injective functions from set A onto itself is/are

   a) n b) n^n c) $\frac{n}{2}$ d) $n!$

3. $tan^{-1}\left\{\sin\left(-\frac{\pi}{2}\right)\right\}$ is equal to

   a) -1 b) 1 c) $\frac{\pi}{2}$ d) $-\frac{\pi}{4}$

4. Principal branch of $tan^{-1}x$ is

   a) $\left[0, \frac{\pi}{2}\right]$ b) $\left(0, \frac{\pi}{2}\right)$ c) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ d) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

5. The Principal value of $cos^{-1}\left(\frac{1}{2}\right) + sin^{-1}\left(-\frac{1}{\sqrt{2}}\right)$ is

   a) $\frac{\pi}{12}$ b) π c) $\frac{\pi}{3}$ d) $\frac{\pi}{6}$

6. If $A = [a_{ij}]$ is a 2×3 matrix, such that $a_{ij} = \frac{(-i+2j)^2}{5}$, then a_{23} is

   a) $\frac{1}{5}$ b) $\frac{2}{5}$ c) $\frac{9}{5}$ d) $\frac{16}{5}$

7. Total number of possible matrices of order 2×3 with each entry 1 or 0 is

   a) 6 b) 36 c) 32 d) 64

8. If $\begin{vmatrix} 2x+5 & 3 \\ 5x+2 & 9 \end{vmatrix} = 0$, then x is

   a) 13 b) 9 c) -9 d) -13

9. A is invertible matrix of order 3×3 and $|A| = 9$, then value of $|A^{-1}|$ is

   a) 9 b) -9 c) $\frac{1}{9}$ d) $-\frac{1}{9}$

10. If A is a square matrix of order 3, $|A'| = -3$, then $|AA'| =$

    a) 9 b) -9 c) 3 d) -3

11. A function which is continuous at $x = 1$, but not differentiable at $x = 1$ is

a) $|x|$ b) $[x]$ c) $sgn\,(x)$ d) $|x - 1|$

12. If $y = \log x$, then $\frac{d^2y}{dx^2}$, is

a) $-\frac{1}{x^2}$ b) $\frac{1}{x}$ c) 1 d) x

13. If $x = at^2, y = 2at$, then $\frac{d^2y}{dx^2}$ is

a) $\frac{1}{t}$ b) $-\frac{1}{t^2}$ c) at^2 d) $\frac{-1}{2at^3}$

14. Find $\frac{d^2y}{dx^2}$, if $y = e^{-3x}$

a) $-3y$ b) $9y$ c) $-9y$ d) $3y$

15. Rate of change of volume of a sphere of diameter r, with respect to r is

a) $4\pi r^2$ b) $\frac{4}{3}\pi r^2$ c) $\frac{1}{2}\pi r^2$ d) πr^2

16. The function $f(x) = 4 - 3x + 3x^2 - x^3,\ \ x \in R$ is

a) decreasing function b) increasing function

c) strictly increasing on R d) neither increasing nor decreasing on R

17. Least value of $f(x) = e^x + e^{-x}$ is

a) -2 b) 0 c) 2 d) 3

18. The objective function of LPP is

a) a constraint b) a function to be optimized

c) a relation between the variables d) none of these

Assertion & Reasoning Questions

The following questions consists of two statements – Assertion (A) and Reason (R). Answer the question selecting appropriate option given below:

a) Both A and R are true and R is correct explanation for A.
b) Both A and R are true but R is not correct explanation for A.
c) A is true but R is false.
d) A is false but R is true.

19. Assertion (A) : Let $A = \{1, 2, 3\}$ then define a relation on A as $R = \{(1, 2), (2, 1)\}$, R is not transitive relation.

Reason (R) : A relation R defined on a non-empty set A is said to be transitive relation if $(a, b), (b, c) \in R \Rightarrow (a, c) \in R$.

20. Assertion (A) : Adjoint of matrix $A = \begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$ *is* $\begin{bmatrix} 2 & 1 \\ -3 & 2 \end{bmatrix}$

Reason (R) : Adjoint of matrix is the transpose of a matrix formed by cofactors of each element of a determinant correspond to a given matrix.

Section - B

21. Show that the function $f: R - \{0\} \to R - \{0\}$ defined by $f(x) = \frac{1}{x}$ is one-one and onto.

22. Find the principle value of $\tan^{-1}\sqrt{3} - sec^{-1}(-2)$

23. If A and B are symmetric matrices, show that AB + BA is symmetric and AB - BA is skew symmetric.

24. If area of a triangle with vertices $(3,2), (-1,4) and\ (6,k)$ is 7sq units, then find the possible values of k ?

25. Prove that the function $f(x) = \begin{cases} \frac{x}{|x|+2x^2}, & if\ x \neq 0 \\ k, & if\ x = 0 \end{cases}$ remain discontinuous at $x = 0$, regardless the value of k

Section - C

26. Show that $A = \begin{bmatrix} 2 & -3 \\ 3 & 4 \end{bmatrix}$ satisfies the equation $A^2 - 6A + 17I = 0$. Hence find A^{-1}

27. Find $\frac{dy}{dx}$ at $x = 1, y = \frac{\pi}{2}$ if $sin^2 y + \cos xy = K$

28. If $x = \sqrt{a^{sin^{-1}t}}, y = \sqrt{a^{cos^{-1}t}}$, show that $\frac{dy}{dx} = \frac{-y}{x}$

29. The radius r of the base of a right circular cone is decreasing at the rate of 2 cm/min and its height h is increasing at the rate of 3 cm/min. When $r = 3.5\ cm\ and\ h = 6\ cm$, find the rate of change of the volume of the cone. $\left[Use\ \pi = \frac{22}{7}\right]$

30. Find the intervals in which the function $f(x) = \frac{x^4}{4} - x^3 - 5x^2 + 24x + 12$ is

    (i) strictly increasing (ii) strictly decreasing

31. Solve the following LPP graphically.

    Minimise $Z = 8x + 9y$

    subject to constraints : $2x + 3y \leq 6;\ 3x - 2y \leq 6;\ y \leq 1;\ x, y \geq 0$

Section - D

32. If $y = e^{a\cos^{-1}x}, -1 \leq x \leq 1$, prove that $(1 - x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} - a^2y = 0$

33. A window is in the form of a rectangle surmounted by a semicircular opening. The total perimeter of the window is 10 m. Find the dimensions of the window to admit maximum light through the whole opening.

34. If $y = x^{\cos x} + (\cos x)^{\sin x}$, find $\frac{dy}{dx}$.

35. If $A = \begin{bmatrix} 2 & 3 & 10 \\ 4 & -6 & 5 \\ 6 & 9 & -20 \end{bmatrix}$, find A^{-1}. Using A^{-1} solve the system of equation $\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 2,\ \frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 5,\ \frac{6}{x} + \frac{9}{y} - \frac{20}{z} = -4$

Section - E

Case Study Questions

36. Student of Grade XII, planned to plant saplings along straight lines, parallel to each other to one side of the playground ensuring that they had enough play area. Let us assume that they planned one of the rows of the saplings along the line $y = x - 3$. Let L be the set of all lines which are parallel on the ground and R be a relation on L.

Answer the following questions using the above information:

1. Let relation R be defined by $R = \{(L_1, L_2): L_1 \parallel L_2 \text{ where } L_1, L_2 \in L\}$. What is the type of relation R? (1)
2. Let $R = \{(L_1, L_2): L_1 \perp L_2 \text{ where } L_1, L_2 \in L\}$, then, show that R is symmetric but neither reflexive nor transitive. (1)
3. Prove that the $f: R \to R$ be defined by $f(x) = x - 3$ is bijective. (2)

37. **Read the following passage and answer the following questions:**
The monthly incomes of two sister Reshma and Ritam are in the ratio 3 : 4 and their monthly expenditures are in the ratio 5 : 7. Each sister saves Rs. 15,000 per month. (1)

a) If monthly income of Reshma and Ritam are Rs. $3x$ and Rs. $4x$ and their monthly expenditure are Rs. $5y$ and Rs. $7y$ respectively, then express information provided in problem in system of linear equations. (1)
b) Express the system of linear equations (i) in matrix from AX = B. (2)
c) Find $C = A^2 - 2I$

38. Suppose f is a real function on a subset of the real numbers and let c be a point in the domain of f. Then f is continuous at c if $\lim_{x \to c} f(x) = f(c)$. The function f is given by

$$f(x) = \begin{cases} ax + 5, if\ x < 5 \\ 10, \ \ if\ x = 5 \\ bx + 20, if\ x > 5 \end{cases}$$

The given function is continuous at $x = 5$

Based on above information, answer these following questions:

1. Find the relation between a and b (1)
2. Find the value of b (1)
3. Find the value of function $f(10)$ (2)