



B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

PRE MID TERM (2026-27) MATHEMATICS SET-B

Class: XII (041)

Duration: 1 Hr

Date: 24.07.26

Max. Marks: 25

Admission No: _____

Roll No.: _____

SECTION A | Multiple Choice Questions (1 mark each)

1. A relation R on set $A = \{1, 2, 3, 4\}$ is defined as $R = \{(1,1), (2,2), (3,3), (4,4), (1,2), (2,1)\}$.
Which of the following correctly classifies R ?
(a) Reflexive and symmetric but NOT transitive
(b) Reflexive, symmetric and transitive (equivalence relation)
(c) Symmetric and transitive but NOT reflexive
(d) Reflexive and transitive but NOT symmetric
1
2. Let $f : \{1, 2, 3, 4\} \rightarrow \{1, 4, 9, 16\}$ be defined by $f(x) = x^2$.
Which statement is CORRECT?
(a) f is onto but not one-one
(b) f is one-one but not onto
(c) f is a bijection
(d) f is neither one-one nor onto
1
3. The domain of the function $f(x) = \sin^{-1}(2x - 1)$ is:
(a) $[-1, 1]$ (b) $[0, 1]$ (c) $[-1/2, 1/2]$ (d) $[0, 2]$
1
4. The principal value of $\tan^{-1}\left(\tan\left(\frac{5\pi}{4}\right)\right)$ is:
(a) $5\pi/4$ (b) $\pi/4$ (c) $-\pi/4$ (d) $3\pi/4$
1
5. If $A = \begin{bmatrix} 2 & -1 \\ 3 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix}$, then the a_{12} entry of AB is:
(a) 4 (b) -1 (c) 1 (d) 5
1

Directions: Select the correct option.

- (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.

6. **Assertion (A):** For any matrix A, $(A^T)^T = A$ 1
Reason (R): Transposing a matrix twice returns the original matrix because transposing interchanges rows and columns, and doing it twice restores the original arrangement.

SECTION B | Short Answer (2 marks)

7. (i) Find the value of: $\sin^{-1}\left(\frac{1}{2}\right) + \cos^{-1}\left(\frac{1}{2}\right) + \tan^{-1}(-1)$ 2
(ii) Without a calculator, evaluate: $\tan^{-1}(\sqrt{3}) - \sec^{-1}(-2)$
Justify each step citing the principal value and range of the respective inverse function.
8. If $A = \begin{bmatrix} 3 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \end{bmatrix}$, find $2A - 3B$ and verify $(2A - 3B)^T = 2A^T - 3B^T$. 2
 $\begin{bmatrix} 2 & 4 \end{bmatrix} \quad \begin{bmatrix} -1 & 0 \end{bmatrix}$

SECTION C | Short Answer (3 marks)

9. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = x + 2$ and $g(x) = 3x - 1$. 3
(i) Find fog and gof and show they are not equal.
(ii) Is fog one-one? Is gof onto? Justify both answers.
10. I. Find the value of: 3
 $\sin^{-1}\left(\sin\left(\frac{3\pi}{4}\right)\right) + \cos^{-1}\left(\cos\left(\frac{5\pi}{3}\right)\right) + \tan^{-1}\left(\tan\left(\frac{7\pi}{6}\right)\right)$
II. Determine the domain and range of $f(x) = 2 \sin^{-1}(x - 1)$
State how the domain shifts compared to the standard $\sin^{-1} x$.

SECTION D | Long Answer (5 marks)

11. Let R be the relation on $\mathbb{N} \times \mathbb{N}$ (where $\mathbb{N}$ = natural numbers) defined by: 5
(a, b) R (c, d) if and only if $ad = bc$.
(i) Show R is reflexive.
(ii) Show R is symmetric.
(iii) Show R is transitive.
(iv) Hence conclude that R is an equivalence relation. Write the equivalence class of (2, 4).

SECTION E | Competency-Based Case Study (4 marks)

- 12 **CASE STUDY: DECODING INVERSE TRIGONOMETRIC EXPRESSIONS** 4

A mathematics teacher writes the following four expressions on the board and asks students to evaluate them step-by-step, citing the principal value branch used at each stage.

Expression 1: $\sin^{-1}\left(\sin\left(\frac{5\pi}{6}\right)\right)$

Expression 2: $\cos^{-1}\left(\cos\left(-\frac{\pi}{3}\right)\right)$

Expression 3: $\tan^{-1}\left(\tan\left(\frac{3\pi}{4}\right)\right)$

Expression 4: $\sin^{-1}\left(\cos\left(\frac{\pi}{3}\right)\right)$

Answer the following:

Q.12.(i) Evaluate Expression 1. State why the answer is NOT $5\pi/6$.

Q.12.(ii) Evaluate Expression 2. State the range of $\cos^{-1} x$ used.

Q.12.(iii) Evaluate Expression 3 and identify the equivalent angle in the principal branch.

Q.12.(iv) Evaluate Expression 4.