INDIAN SCHOOL AL WADI AL KABIR

Unit Test (2025 - 2026)

Class: XII | Sub: MATHEMATICS (041) | Max Marks: 30

Date: 20.05.2025 | Set-2 -MARKING SCHEME | Time: 1 hour

General Instructions:

1. This question paper is divided in to 4 sections- A, B, C and D.
2. Section A comprises of 7 questions of 1 mark each.
3. Section B comprises of 3 questions of 2 marks each.
4. Section C comprises of 3 questions of 3 marks each.
5. Section D comprises of 2 case study-based question.
6. Internal choice has been provided.

SECTION - A

1. The value of $\tan^{-1}(-1) + \sin^{-1}\left(\frac{1}{2}\right)$ corresponding to principal branches is: (1m)

   a) b) c) d) $-\frac{\pi}{12}$

2. If A $=\begin{pmatrix} 2 & 0 & 0 \\ 4 & 2 & 1 \\ 5 & 0 & 5 \end{pmatrix}$ $then$ |A|+ |adjA|: (1m)

   a) b) 420 c) d)

3. If $\begin{bmatrix} 7 & x+y \\ xy & x-y \end{bmatrix} = \begin{bmatrix} 7 & 5 \\ 6 & -1 \end{bmatrix}$: (1m)

   a) b) c) d) x =2, y = 3

4. The value of k if the points A (1, 1), B (-1, -3) and C (k, 5) are collinear: (1m)

   a) b) c) 3 d)

5. Find the value of $\cos^{-1}\left(\sin\left(\tan^{-1}\sqrt{3}\right)\right)$ (1m)

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

6. If R= {(x, y): x – y + $\sqrt{5}$ $is\ irrational, x, y \in R$}, then R is: (1m)

   a) c)

   b) a reflexive relation d)

7. In the following question a statement of assertion (A) is followed by a statement of reason (R). Choose the correct answer out of the following choices. (1m)

   A) Both A and R are true and R is the correct explanation of A.

Assertion **(A)**: If A = $\begin{bmatrix} 0 & -1 & -2 \\ c & a & -3 \\ 2 & b & 0 \end{bmatrix}$ is a skew symmetric matrix, then a+b+c = 4.

Reason (R): For a skew symmetric matrix A= $[a_{ij}]$, $\begin{cases} a_{i\,j} = 0, \ if \ \ i = j \\ a_{ij=-}a_{j\,i}, \ if \ \ i \neq j. \end{cases}$

SECTION – B

8. Check whether the relation R defined on the set A = {1, 2, 3, 4, 5, 6} as R = {(a, b): b is divisible by a} is reflexive or symmetric.

Prove: (a, a) ∈ R – Reflexive (1m)

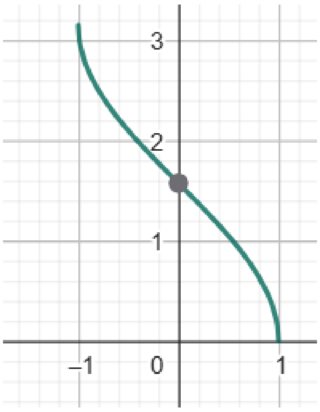
: (a, b)∈ $R, but\ (b, a) \notin R$ (1m)

9. a) Evaluate: $tan^{-1}\left(\frac{cosx+sinx}{cosx-sinx}\right), when\ x = \frac{\pi}{3}$.

$tan^{-1}\left(\frac{cosx+sinx}{cosx-sinx}\right) = tan^{-1}\left(\frac{1+tanx}{1-tanx}\right) = tan^{-1}\left(\tan\left(\frac{\pi}{4}+x\right)\right) = -\frac{\pi}{12}$ (1m+1m)

OR-

b) Sketch the graph of the function f(x)= $cos^{-1}x, f: [-1, 1] \to [0,\ \pi]$



10. Given A = $\begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and B = $\begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 5 \end{bmatrix}$, find AB= $\begin{pmatrix} 4 & 2 \\ 3 & 34 \\ -1 & 12 \end{pmatrix}$ (2m)

SECTION - C

11. Check whether the relation S in the set of all real numbers ($\mathbb{R}$) defined by $S = \{(a, b) : a \leq b^3\}$ is reflexive, symmetric or transitive.

Neither reflexive nor symmetric nor transitive

(Each case with appropriate example- 1 marks each)

–OR -

Show that the function *f*: R- {3} ⟶ R- {1} defined by *f*(x) = $\frac{x-2}{x-3}$ is a bijective function.

Prove: (One to one

$f(x_1)= f(x_2)$ proving $x_1 = x_2$--- 1.5 m)

Getting y= $\frac{3y-2}{y-1}, y \neq 1$ and verifying onto (1.5 marks)

12. Solve using matrices: $2x - y + z = 7, x + 2y - z = 3$, and $3x - y - 2z = 4$

$\begin{pmatrix} 2 & -1 & 1 \\ 1 & 2 & -1 \\ 3 & -1 & -2 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 7 \\ 3 \\ 4 \end{pmatrix}$ (1m)

AX = B and $A^{-1} = -\frac{1}{16}\begin{pmatrix} -5 & -3 & -1 \\ -1 & -7 & 3 \\ -7 & -1 & 5 \end{pmatrix}$ and getting x= 3, y= 2 and z=1 (1m+1m)

-OR-

Given a matrix of order 3 such that $A^2 = \begin{bmatrix} 3 & -4 & 4 \\ 0 & -1 & 0 \\ -2 & 2 & -3 \end{bmatrix}$, then show that $A^3 = A^{-1}$.

Prove: $A^2 . A^2 = I$ hence $A^3 A = I$. Therefor, $A^3 = A^{-1}$. (1m +1m+1m)

13. Express A= $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ as the sum of a symmetric and a skew symmetric matrix.

$\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix} = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ (1m+ 1m +1m- Reason)

SECTION - D (Case study-based questions)

14. Students of Grade 12, 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 planted 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.

Based on the above information, answer the following:

(i) Let R be a relation such that R= $\{(L1, L2): L1 \parallel L2, L1, L2 \in L\}$. Then show that R is an equivalence relation.
Proving reflexive, symmetric and transitive—(2m)

(ii) If $f(x) = x + 4$, f: N to N, then show that f one to one but not onto

Proving one to one (1m)

Proving not onto 1, 2, 3, 4 elements in the codomain do not have pre image. (1m)

15. 10 students were selected from a school on the basis of values for giving awards and were divided into three groups. The first group comprises hard workers, the second group has honest and law-abiding students, and the third group contains vigilant and obedient students. Double the number of students of the first group added to the number in the second group gives 13, while the combined strength of the first and the second group is four times that of the third group. Assume that x, y and z denote the number of students in first, second and third group respectively.

Based on the above information, answer the following questions:

(i) Write the system of linear equations that can be formulated from the above described situation. (1m)

$$x + y + z = 10, 2x + y = 13, x + y - 4z = 0$$

ii) Write the coefficient matrix, say A.

$$\begin{pmatrix} 1 & 1 & 1 \\ 2 & 1 & 0 \\ 1 & 1 & -4 \end{pmatrix}$$

(1m)

(ii) a) Write the matrix of cofactors of every element of matrix A. (2m)

$$\begin{pmatrix} -4 & 8 & 1 \\ 5 & -5 & 0 \\ -1 & 2 & -1 \end{pmatrix}$$

-OR-

b) Determine the number of students of each group.

x= 3, y = 5 and z= 2 (2m)

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