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CHAPTER NOTES

Inverse Trigonometric Functions

Class 12 Notes — CBSE Maths

Chapter 2

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Inverse Trigonometric Functions Class 12 Notes — CBSE Maths Chapter 2

Chapter 2 — **Inverse Trigonometric Functions** — covers domains, ranges, properties, and simplification of inverse trig expressions. Carries **6-8 marks**. Master the principal value branches and key properties.

Key Concepts

Principal Value Branches

Function	Domain	Range (Principal Value)
$\sin^{-1}x$	$[-1, 1]$	$[-\pi/2, \pi/2]$
$\cos^{-1}x$	$[-1, 1]$	$[0, \pi]$
$\tan^{-1}x$	$\mathbb{R}$ (all reals)	$(-\pi/2, \pi/2)$
$\cot^{-1}x$	$\mathbb{R}$	$(0, \pi)$
$\sec^{-1}x$	$\mathbb{R} - (-1, 1)$	$[0, \pi] - \{\pi/2\}$
$\operatorname{cosec}^{-1}x$	$\mathbb{R} - (-1, 1)$	$[-\pi/2, \pi/2] - \{0\}$

Important Properties

Complementary:

$\sin^{-1}x + \cos^{-1}x = \pi/2$

$\tan^{-1}x + \cot^{-1}x = \pi/2$

$\sec^{-1}x + \operatorname{cosec}^{-1}x = \pi/2$

Negative arguments:

$\sin^{-1}(-x) = -\sin^{-1}x$

$\cos^{-1}(-x) = \pi - \cos^{-1}x$

$\tan^{-1}(-x) = -\tan^{-1}x$

Reciprocal:

$$\sin^{-1}(1/x) = \operatorname{cosec}^{-1}x$$

$$\cos^{-1}(1/x) = \sec^{-1}x$$

$$\tan^{-1}(1/x) = \cot^{-1}x \text{ (for } x > 0\text{)}$$

Sum formulas:

$$\tan^{-1}x + \tan^{-1}y = \tan^{-1}((x+y)/(1-xy)), \text{ if } xy < 1$$

$$\tan^{-1}x - \tan^{-1}y = \tan^{-1}((x-y)/(1+xy))$$

Double angle:

$$2\tan^{-1}x = \sin^{-1}(2x/(1+x^2)) = \cos^{-1}((1-x^2)/(1+x^2)) = \tan^{-1}(2x/(1-x^2))$$

Solved Examples

Example 1

Q: Find the principal value of $\sin^{-1}(-1/2)$.

Solution: $\sin^{-1}(-1/2) = -\sin^{-1}(1/2) = -\pi/6$

(Range of $\sin^{-1}$ is $[-\pi/2, \pi/2]$, and $\sin(\pi/6) = 1/2$)

Example 2

Q: Prove that $\tan^{-1}(1/2) + \tan^{-1}(1/3) = \pi/4$

Solution: Using $\tan^{-1}x + \tan^{-1}y = \tan^{-1}((x+y)/(1-xy))$

$$= \tan^{-1}((1/2 + 1/3)/(1 - 1/6)) = \tan^{-1}((5/6)/(5/6)) = \tan^{-1}(1) = \pi/4 \checkmark$$

Example 3

Q: Simplify: $\cos^{-1}(1/2) + 2\sin^{-1}(1/2)$

Solution: $\cos^{-1}(1/2) = \pi/3$; $\sin^{-1}(1/2) = \pi/6$

$$= \pi/3 + 2(\pi/6) = \pi/3 + \pi/3 = 2\pi/3$$

Quick Revision Points

- $\sin^{-1}x \in [-\pi/2, \pi/2]$; $\cos^{-1}x \in [0, \pi]$; $\tan^{-1}x \in (-\pi/2, \pi/2)$
- $\sin^{-1}x + \cos^{-1}x = \pi/2$ (always!)
- $\sin^{-1}(-x) = -\sin^{-1}x$; $\cos^{-1}(-x) = \pi - \cos^{-1}x$
- $\tan^{-1}x + \tan^{-1}y = \tan^{-1}((x+y)/(1-xy))$ when $xy < 1$
- $2\tan^{-1}x = \sin^{-1}(2x/(1+x^2))$ for $|x| \leq 1$
- Always check if answer falls within principal value range!

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