MATHEMATICS · GRADES 10-12

Finding angles using inverse trigonometric functions

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out an angle from the sides you can measure. The slope of a wheelchair ramp, the angle of a ladder against a wall, or the pitch of a roof can all be found from two sides you can reach with a tape measure. The inverse functions turn those side lengths back into an angle. It is how you measure an angle you cannot put a protractor on.



Rule

Inverse trigonometric functions: when you know two sides and need the angle, write the ratio first, then use the inverse function to undo it.

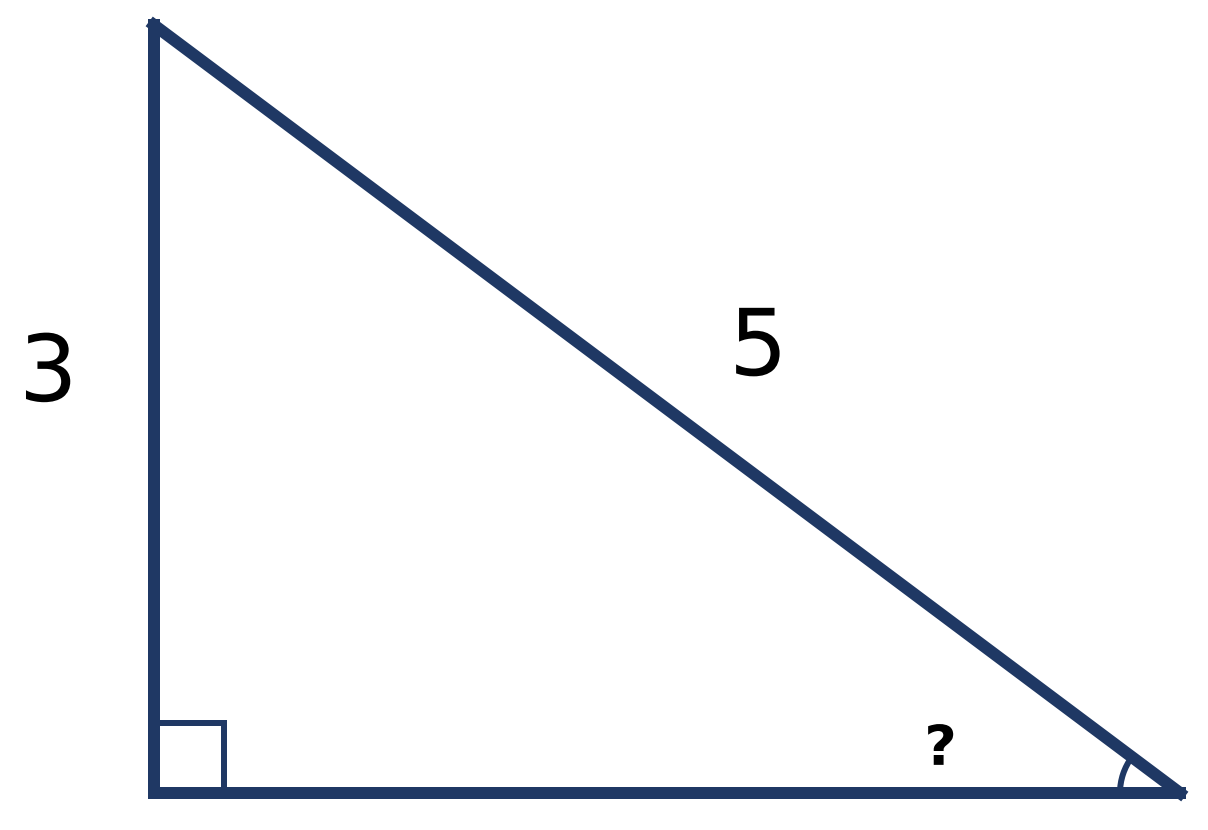
Opposite and hypotenuse call for $\sin^{-1}$, adjacent and hypotenuse call for $\cos^{-1}$, and opposite and adjacent call for $\tan^{-1}$.

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Worked examples

EXAMPLE 1

Q Opposite 3, hypotenuse 5. Find the angle.



SOLUTION

Opposite and hypotenuse point to sine, so sin of the angle = $\frac{3}{5}$ = 0.6

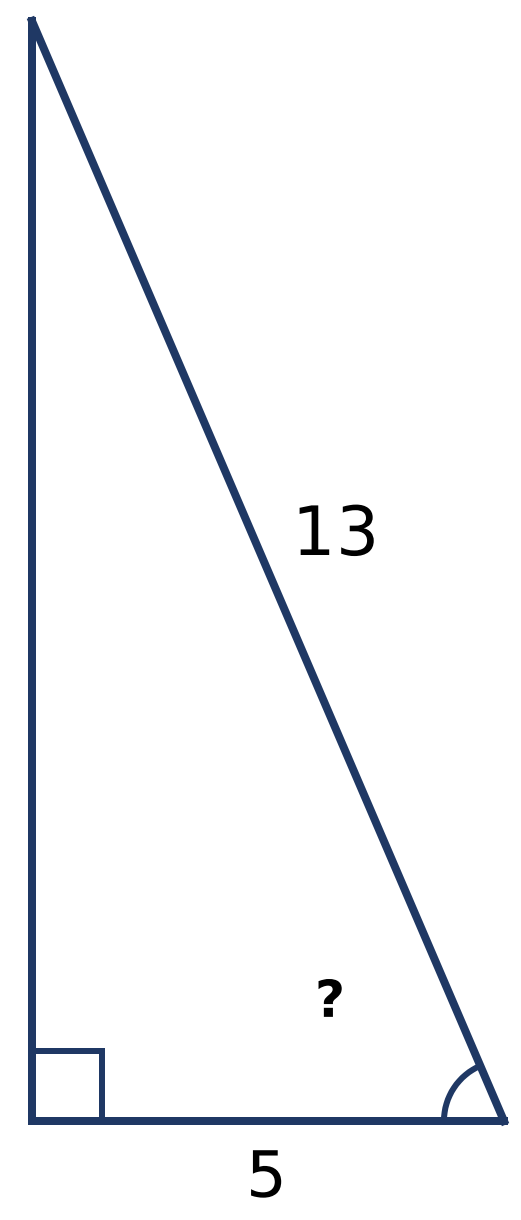
angle = $\sin^{-1}(0.6)$

The angle is about 36.87 degrees.

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EXAMPLE 2

Q Adjacent 5, hypotenuse 13. Find the angle.



SOLUTION

Adjacent and hypotenuse point to cosine, so cos of the angle = $\frac{5}{13}$, about 0.385.

angle = $\cos^{-1}(0.385)$

The angle is about 67.38 degrees.

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Practice questions

1 **Opposite 1, hypotenuse 2: find the angle.**

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2 **Adjacent 1, hypotenuse 2: find the angle.**

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3 **Opposite 1, adjacent 1: find the angle.**

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4 A ladder 5 m long leans against a wall and reaches 4 m up the wall. What angle does the ladder make with the ground, to two decimal places?

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5 A ramp is 5 m long and its horizontal run is 3 m. What angle does the ramp make with the ground, to two decimal places?

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6 A roof rises 3 m over a horizontal run of 4 m. What is the pitch angle, to two decimal places?

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7

Which inverse function undoes sine?

A Inverse sine

B Inverse cosine

C Inverse tangent

D Inverse secant

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8

Opposite and adjacent are known. Which inverse function finds the angle?

A Inverse sine

B Inverse cosine

C Inverse tangent

D Inverse secant

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9 Opposite 6, hypotenuse 10: which ratio equals sin of the angle?

- **A** $\frac{6}{10}$
- **B** $\frac{10}{6}$
- **C** $\frac{8}{10}$
- **D** $\frac{6}{8}$

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10 An angle is 22.62 degrees and the hypotenuse is 13. What is the length of the adjacent side?

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ANSWER KEY

1. 30 degrees

2. 60 degrees

3. 45 degrees

4. 53.13 degrees

5. 53.13 degrees

6. 36.87 degrees

7. Inverse sine

8. Inverse tangent

9. $\frac{6}{10}$

10. 12

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