MATHEMATICS · GRADES 10-12

Exact trigonometric ratios

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out exact heights and distances without a calculator. A builder checking a roof angle with a known triangle does not need a decimal that goes on forever, they need the exact answer. Certain angles give clean, exact ratios, and knowing them saves you from rounding errors. It is the precise answer for the angles that come up most often in real building and measuring.



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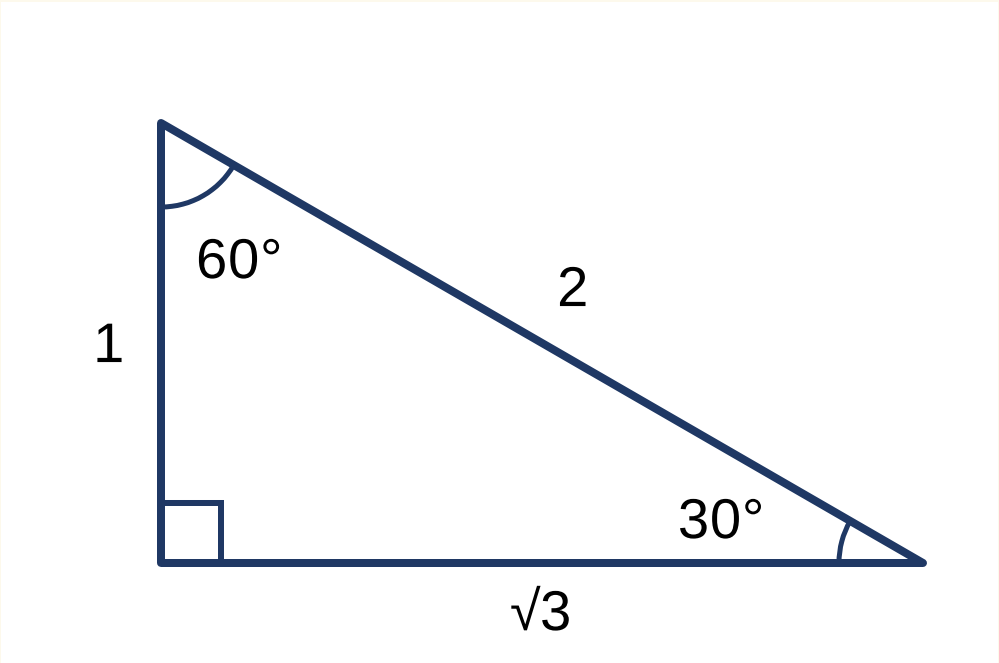
Worked examples

EXAMPLE 1

Q Find sin 30 degrees exactly.



SOLUTION

Draw a 30, 60, 90 triangle from half an equilateral triangle.

The side opposite 30 degrees is half the hypotenuse.

So sin 30 degrees = $\frac{1}{2}$ exactly.

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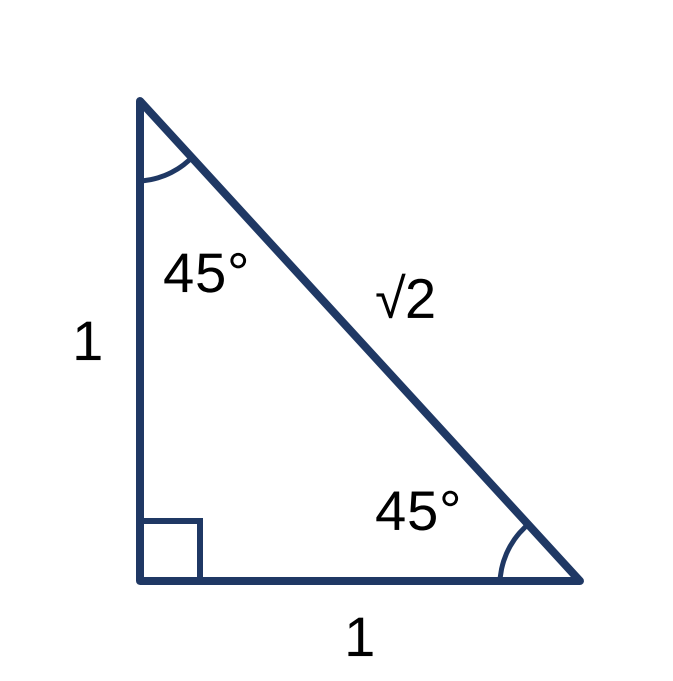
EXAMPLE 2

Q Find cos 45 degrees exactly.



SOLUTION

A 45, 45, 90 triangle has two equal legs; call each leg 1.

The hypotenuse is root 2 by the Pythagorean theorem.

So cos 45 degrees = $\frac{1}{\sqrt{2}}$, which is $\frac{\sqrt{2}}{2}$

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Practice questions

1 What is cos 90 degrees exactly?

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2 What is cos 60 degrees exactly?

A $\frac{1}{2}$

B $\frac{\sqrt{2}}{2}$

C $\frac{\sqrt{3}}{2}$

D 1

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3 What is sin 45 degrees exactly?

A $\frac{\sqrt{3}}{2}$

B $\frac{\sqrt{2}}{2}$

C $\frac{1}{2}$

D 1

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4 What is cos 0 degrees exactly?

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5 What is tan 45 degrees exactly?

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6 What is sin 60 degrees exactly?

A $\frac{1}{2}$

B $\frac{\sqrt{2}}{2}$

C $\frac{\sqrt{3}}{2}$

D $\sqrt{3}$

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7 What is cos 30 degrees exactly?

A $\frac{\sqrt{3}}{2}$

B $\frac{\sqrt{2}}{2}$

C 1

D $\frac{\sqrt{3}}{3}$

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8 What is tan 30 degrees exactly?

A $\frac{1}{2}$

B $\sqrt{3}$

C $\frac{\sqrt{3}}{2}$

D $\frac{\sqrt{3}}{3}$

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9 What is tan 60 degrees exactly?

A $\sqrt{3}$

B $\frac{\sqrt{3}}{2}$

C $\frac{1}{2}$

D 1

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10

What is sin 90 degrees exactly?

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ANSWER KEY

1. 0

2. $\frac{1}{2}$

3. $\frac{\sqrt{2}}{2}$

4. 1

5. 1

6. $\frac{\sqrt{3}}{2}$

7. $\frac{\sqrt{3}}{2}$

8. $\frac{\sqrt{3}}{3}$

9. $\sqrt{3}$

10. 1

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