MATHEMATICS · GRADES 10-12

Finding missing sides using trigonometry

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you work out a height or distance you cannot measure directly. The height of a tree or the length of a ramp can be found from one side and one angle you can measure on the ground. Trigonometry turns those two measurements into the missing side. It is how you measure tall or far-away things without climbing them.



Rule

Trigonometric ratios: in a right triangle, $\sin = \frac{\text{opposite}}{\text{hypotenuse}}$, $\cos = \frac{\text{adjacent}}{\text{hypotenuse}}$, and $\tan = \frac{\text{opposite}}{\text{adjacent}}$.

Pick the ratio that uses the side you know and the side you need.

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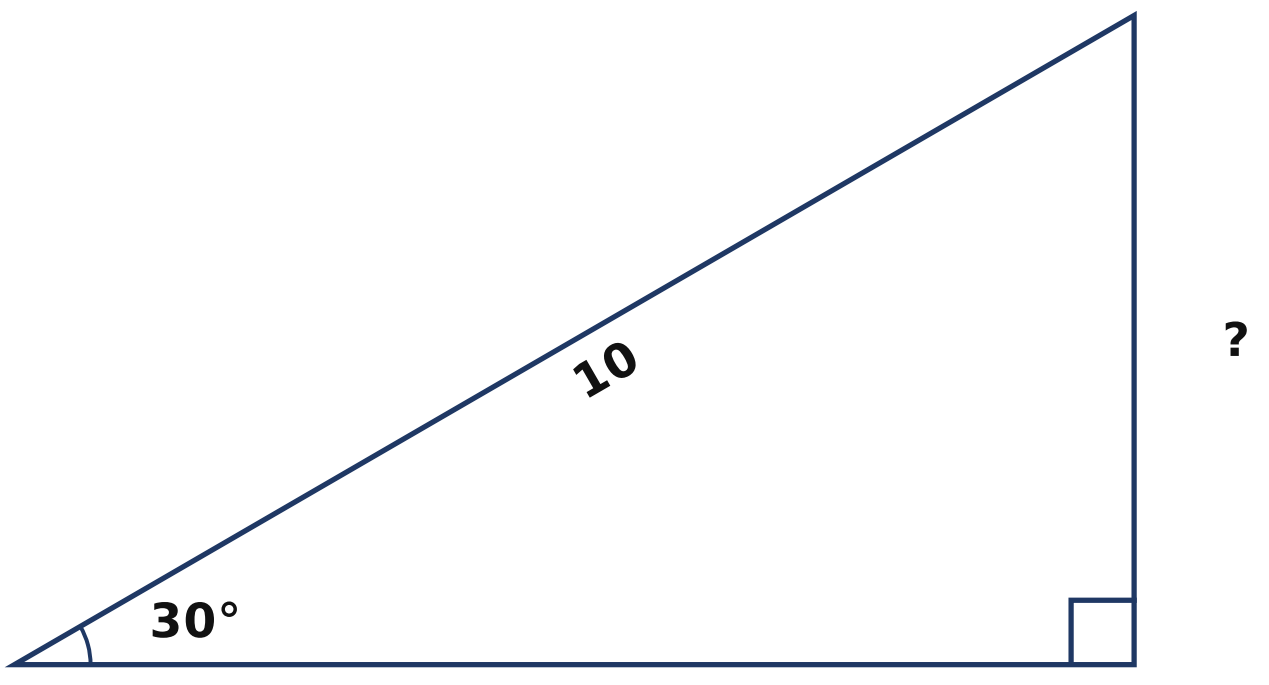
Worked examples

EXAMPLE 1

Q Right triangle, angle 30 degrees, hypotenuse 10, find the opposite side.



SOLUTION

The opposite side and the hypotenuse point to sine: sin 30 degrees = $\frac{\text{opposite}}{10}$

Sin 30 degrees is $\frac{1}{2}$, so $\frac{\text{opposite}}{10} = \frac{1}{2}$

$$\frac{\text{opposite}}{10} = \frac{1}{2}$$

$$\frac{\text{opposite}}{10} \times 10 = \frac{1}{2} \times 10$$

opposite = 5

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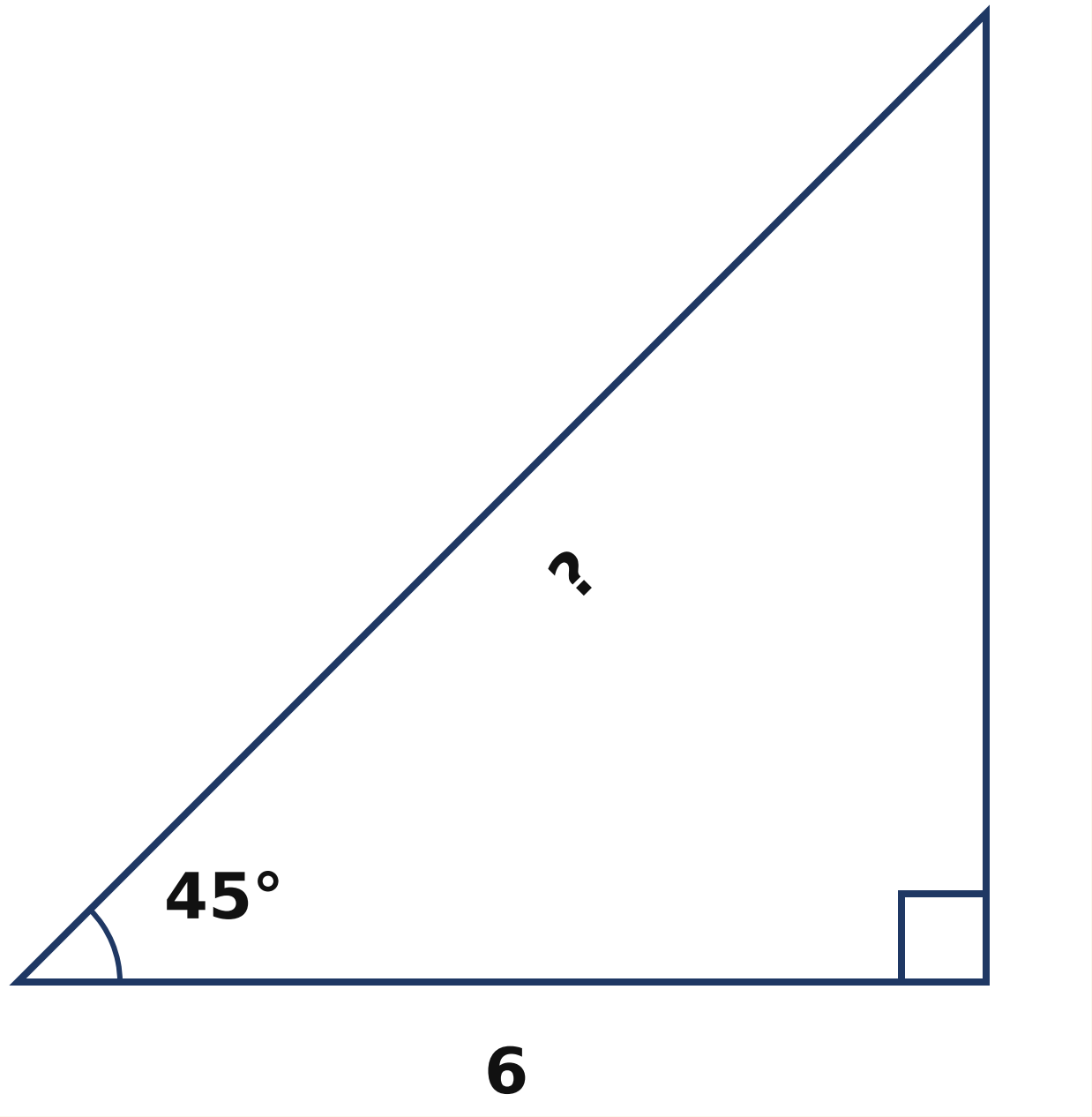
EXAMPLE 2

Q Angle 45 degrees, adjacent 6, find the hypotenuse.



SOLUTION

Adjacent and hypotenuse point to cosine: $\cos 45 \text{ degrees} = \frac{6}{\text{hypotenuse}}$

Cos 45 degrees is about 0.707, so hypotenuse = $\frac{6}{0.707}$

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Hypotenuse is about 8.49

Practice questions

1 **Angle 30 degrees, hypotenuse 12: find the opposite side.**

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2 **Angle 30 degrees, hypotenuse 12: find the adjacent side, using cos 30 degrees about 0.866.**

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3 **Angle 45 degrees, hypotenuse 10: find the opposite side, using sin 45 degrees about 0.707.**

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4 A kite string is 8 m long and makes an angle of 60 degrees with the ground. How high is the kite? Use sin 60 degrees about 0.866.

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5 A ladder 8 m long leans at 60 degrees to the ground. How far is its foot from the wall? Use cos 60 degrees about 0.5.

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6 Angle 45 degrees, opposite 7: find the hypotenuse, using sin 45 degrees about 0.707.

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7 Angle 30 degrees, opposite 4: find the hypotenuse.

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8 Angle 45 degrees, adjacent 9: find the opposite side.

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9 Which ratio links opposite and hypotenuse?

A Sine

B Cosine

C Tangent

D Secant

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10

Which ratio links adjacent and hypotenuse?

A Sine

B Cosine

C Tangent

D Secant

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ANSWER KEY

1. 6

2. 10.39

3. 7.07

4. 6.93

5. 4

6. 9.90

7. 8

8. 9

9. Sine

10. Cosine

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