MATHEMATICS · GRADES 10-12

Reciprocal identities

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you switch between a trig ratio and its flip side, like a surveyor turning a measured slope into the angle it makes with the ground. A surveyor who measures a slope as a ratio can flip it to get the angle, and a roofer who knows the angle can flip it back to get the slope. A ramp builder works with both, since the slope tells you how steep it is and the angle tells you how to set the boards. Knowing that each ratio has a flip side means one measurement gives you both.



Rule

Cosecant is the reciprocal of sine: $\csc x = \frac{1}{\sin x}$.

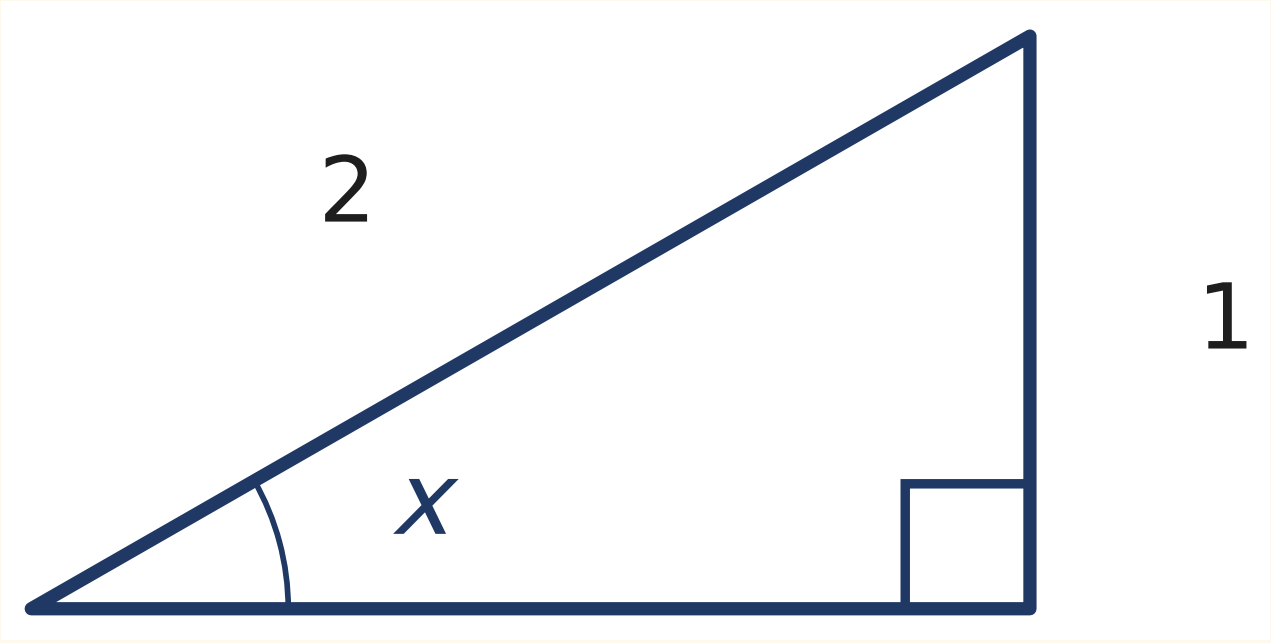
Secant is the reciprocal of cosine: $\sec x = \frac{1}{\cos x}$. Cotangent is the reciprocal of tangent: $\cot x = \frac{1}{\tan x}$, which is $\frac{\cos x}{\sin x}$.

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Worked examples

EXAMPLE 1

Q Find csc x if $\sin x = \frac{1}{2}$.



SOLUTION

Cosecant is the reciprocal of sine: $\csc \frac{1}{\sin x}$.

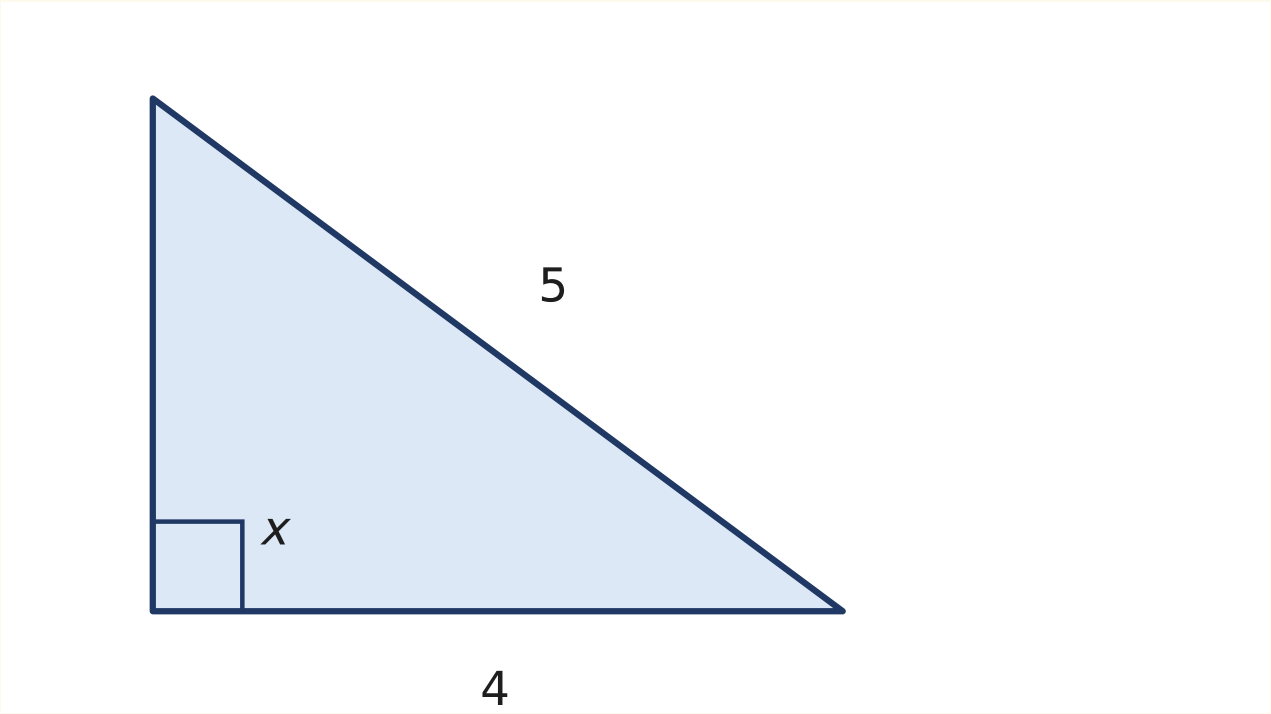
So $\csc x = \left(\frac{1}{2} \right)$

Dividing by a half doubles: csc x = 2.

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EXAMPLE 2

Q Find sec x if $\cos x = \frac{4}{5}$.



SOLUTION

Secant is the reciprocal of cosine: $\sec \frac{1}{\cos x}$.

So $\sec x = \left(\frac{4}{5} \right)$

$\text{Sec } x = \frac{5}{4}$

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Practice questions

1 What is csc x in terms of sin x?

- **A** $\frac{1}{\sin x}$
- **B** sin x
- **C** $\frac{1}{\cos x}$
- **D** 1 - sin x

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2 What is sec x in terms of cos x?

- **A** $\frac{1}{\cos x}$
- **B** cos x
- **C** $\frac{1}{\sin x}$
- **D** 1 - cos x

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3 What is cot x in terms of tan x?

A $\frac{1}{\tan x}$

B $\tan x$

C $\frac{1}{\sin x}$

D $1 - \tan x$

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4 If $\sin x = \frac{2}{3}$, what is csc x?

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5 If $\cos x = \frac{1}{3}$, what is sec x?

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6 If $\tan x = 2$, what is $\cot x$?

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7 What is $\cot x$ in terms of sin and cos?

A $\frac{\cos x}{\sin x}$

B $\frac{\sin x}{\cos x}$

C $\sin x$

D $\cos x$

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8 If $\csc x = 3$, what is $\sin x$?

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9

If sec x = 2, what is cos x?

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10

What does reciprocal mean here?

A One over the ratio

B The ratio itself

C The square of the ratio

D One minus the ratio

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ANSWER KEY

1. $\frac{1}{\sin x}$

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

3. $\frac{1}{\tan x}$

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

5. 3

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

7. $\frac{\cos x}{\sin x}$

8. $\frac{1}{3}$

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

10. One over the ratio

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