MATHEMATICS · GRADES 10-12

Fundamental trigonometric identities

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you rewrite a trig expression in a simpler form, the way an engineer simplifies a formula before using it to design something. Trig identities are the reliable swaps that let you trade a messy expression for a cleaner one that means the same thing. Engineers use them to simplify the maths behind waves, signals, and rotating parts before they build anything, and a simpler formula is one you can actually use without mistakes.



Rule

Fundamental trigonometric identities: $\tan x = \dfrac{\sin x}{\cos x}$, and $\sin^2 x + \cos^2 x = 1$.

These two swaps let you rewrite a trig expression in a simpler form.

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Worked examples

EXAMPLE 1

Q Simplify $\tan x \times \cos x$.

SOLUTION

This is a simplify-with-identities question, and the one rule to remember is to replace $\tan x$ with $\frac{\sin x}{\cos x}$ before you do anything else.

$\tan x \times \cos x$ becomes $\frac{\sin x}{\cos x} \times \cos x$.

The $\cos x$ on top and the $\cos x$ underneath cancel, leaving $\sin x$.

EXAMPLE 2

Q If $\sin x = \frac{3}{5}$ and x is acute, what is $\cos x$?

SOLUTION

This is a find-the-other-ratio question, and the one rule to remember is $\sin^2 x + \cos^2 x = 1$, so one ratio gives you the other.

$\sin^2 x$ is $\frac{9}{25}$, so $\cos^2 x$ is $1 - \frac{9}{25} = \frac{16}{25}$.

Take the square root: $\cos x = \frac{4}{5}$. For an acute angle the answer is positive, so there is no second answer to worry about.

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Practice questions

1 What is tan x in terms of sin x and cos x?

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

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2 What is $\sin^2 x + \cos^2 x$?

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3 What is $1 - \cos^2 x$ equal to?

- A $\cos^2 x$
- B $\sin^2 x$
- C $\tan^2 x$
- D 1

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4 Simplify $(1 - \sin^2 x)$ divided by $\cos x$.

- A $\cos x$
- B $\sin x$
- C $\tan x$
- D 1

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5 Simplify $\tan x \times \cos x$.

- **A** $\sin x$
- **B** $\cos x$
- **C** $\tan x$
- **D** 1

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6 If $\sin x = \frac{3}{5}$, what is $\cos x$ for an acute angle x?

- **A** $\frac{3}{5}$
- **B** $\frac{5}{4}$
- **C** $\frac{4}{5}$
- **D** $\frac{3}{4}$

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7 If $\tan x = \frac{3}{4}$ and x is acute, what is $\sin x$?

A $\frac{3}{5}$

B $\frac{4}{5}$

C $\frac{3}{4}$

D $\frac{5}{3}$

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8 Simplify $\frac{\sin x}{\cos x}$.

A $\sin x$

B $\tan x$

C $\cos x$

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

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9 Simplify $(\sin^2 x + \cos^2 x) \times \cos x$.

- **A** cos x
- **B** sin x
- **C** tan x
- **D** 1

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10 If $\sin x = \frac{3}{5}$ and $\cos x = \frac{4}{5}$, what is tan x?

- **A** $\frac{4}{3}$
- **B** $\frac{3}{4}$
- **C** $\frac{4}{5}$
- **D** $\frac{3}{5}$

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ANSWER KEY

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

2. 1

3. $\sin^2 x$

4. $\cos x$

5. $\sin x$

6. $\frac{4}{5}$

7. $\frac{3}{5}$

8. $\tan x$

9. $\cos x$

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

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