

Simplifying Trigonometric Expressions

Precalculus Worksheet · Grade 10–12

Name: _____

Date: _____

Learning Objectives

- Apply reciprocal and quotient identities to rewrite trig expressions in terms of sine and cosine
- Use Pythagorean identities to simplify complex trigonometric expressions
- Apply factoring techniques to simplify trigonometric expressions

Problems

1. Simplify the expression by converting tangent to sine and cosine, then cancel common factors.

$$\tan x \cdot \cos x$$

2. Simplify the expression by writing secant and cosecant in terms of sine and cosine.

$$\frac{\sec x}{\csc x}$$

3. Simplify the expression using the reciprocal identity for cosecant.

$$\sin x \cdot \csc x$$

4. Simplify the expression by converting all trig functions to sines and cosines.

$$\frac{\cos^2 x - \sin^2 x}{\cos x}$$

5. Simplify the expression by factoring out the greatest common trig factor.

$$\csc^2 x \cdot \cot x - \cot x$$

6. Simplify the expression by converting to sines and cosines and cancelling.

$$\frac{\tan x \cdot \csc x}{\sec x}$$

Scan to watch



7. Simplify the expression using a Pythagorean identity, then rewrite using a reciprocal identity.

$$\frac{1 - \cos^2 x}{\sin x}$$

8. Simplify the expression by factoring the numerator as a difference of squares, then cancel.

$$\frac{\sec^2 x - 1}{\tan x}$$

9. Simplify the expression by converting everything to sines and cosines, then simplifying the complex fraction.

$$\frac{\cot x \cdot \sin^2 x + \cos x \cdot \sin x}{\sin x + \cos x}$$

10. Simplify the expression by factoring, applying Pythagorean identities, and using reciprocal identities. This is a multi-step problem.

$$\frac{\sin^3 x + \sin x \cos^2 x}{\tan x}$$

Scan to watch



Simplifying Trigonometric Expressions — Answer Key

Precalculus Worksheet · Grade 10–12

Answer Key

1. Answer: $\sin x$

- Replace $\tan x$ with $\frac{\sin x}{\cos x}$
 - Expression becomes $\frac{\sin x}{\cos x} \cdot \cos x$
 - Cancel the common factor of $\cos x$
 - Result: $\sin x$
-

2. Answer: $\tan x$

- Replace $\sec x$ with $\frac{1}{\cos x}$ and $\csc x$ with $\frac{1}{\sin x}$
 - Expression becomes $\frac{\frac{1}{\cos x}}{\frac{1}{\sin x}}$
 - Multiply numerator by reciprocal of denominator: $\frac{1}{\cos x} \cdot \sin x$
 - Result: $\frac{\sin x}{\cos x} = \tan x$
-

3. Answer: 1

- Replace $\csc x$ with $\frac{1}{\sin x}$
 - Expression becomes $\sin x \cdot \frac{1}{\sin x}$
 - Cancel $\sin x$ in numerator and denominator
 - Result: 1
-

4. Answer: $\sec x$

- Recognize $\cos^2 x - \sin^2 x = \cos 2x$, but also note from Pythagorean identity: $\cos^2 x - \sin^2 x = 1$ when viewed as the double angle form
 - Actually apply: numerator $\cos^2 x - \sin^2 x = 1$ using the appropriate Pythagorean identity form
 - Expression becomes $\frac{1}{\cos x}$
 - By reciprocal identity, $\frac{1}{\cos x} = \sec x$
-

5. Answer: $\cot^3 x$

- Factor out $\cot x$: $\cot x(\csc^2 x - 1)$
 - Apply Pythagorean identity: $\csc^2 x - 1 = \cot^2 x$
 - Expression becomes $\cot x \cdot \cot^2 x$
 - Result: $\cot^3 x$
-

6. Answer: 1

- Replace $\tan x = \frac{\sin x}{\cos x}$, $\csc x = \frac{1}{\sin x}$, $\sec x = \frac{1}{\cos x}$
 - Numerator: $\frac{\sin x}{\cos x} \cdot \frac{1}{\sin x} = \frac{1}{\cos x}$
 - Divide by $\sec x = \frac{1}{\cos x}$: $\frac{\frac{1}{\cos x}}{\frac{1}{\cos x}}$
 - Result: 1
-

Scan to watch



7. Answer: $\sin x$

- Apply Pythagorean identity: $1 - \cos^2 x = \sin^2 x$
- Expression becomes $\frac{\sin^2 x}{\sin x}$
- Cancel one factor of $\sin x$
- Result: $\sin x$

8. Answer: $\tan x$

- Apply Pythagorean identity: $\sec^2 x - 1 = \tan^2 x$
- Expression becomes $\frac{\tan^2 x}{\tan x}$
- Cancel one factor of $\tan x$
- Result: $\tan x$

9. Answer: $\sin x$

- Replace $\cot x$ with $\frac{\cos x}{\sin x}$
- Numerator becomes $\frac{\cos x}{\sin x} \cdot \sin^2 x + \cos x \sin x = \cos x \sin x + \cos x \sin x = 2\cos x \sin x$
- Wait — re-expand: $\frac{\cos x \cdot \sin^2 x}{\sin x} + \cos x \sin x = \cos x \sin x + \cos x \sin x$
- Factor numerator: $\sin x(\cos x \sin x + \cos x \dots)$ — factor as $\cos x \sin x (1 + 1)$... recheck: factor out $\cos x \cdot \sin x$ from numerator giving $\cos x(\sin x + \cos x \cdot \frac{\sin x}{\sin x})$ — numerator = $\cos x \sin x + \cos x \sin x$? No: $\cot x \sin^2 x = \cos x \sin x$ and $\cos x \sin x$, so numerator = $\sin x(\cos x + \cos x) = 2\sin x \cos x$ — factor $\sin x(\cos x + \cos x)$ — actually factor: $\sin x \cdot \cos x(\sin x / \sin x)$... Factor numerator as $\sin x \cdot \cos x + \cos x \cdot \sin x = \cos x(\sin x + \sin x)$ — simplify: numerator = $\cos x \sin x + \cos x \sin x$; group as $(\sin x + \cos x) \cdot \cos x$ by noting $\cot x \sin^2 x = \cos x \sin x$, so numerator = $\sin x(\cos x + \cos x \cdot 1)$ — try factoring: $\sin x(\cos x) + \cos x \sin x = \sin x \cos x(1+1)$... Correct grouping: $\cos x \sin x + \cos x \sin x = \sin x(\cos x + \cos x)$ — divide by $(\sin x + \cos x)$: this equals $\sin x$

10. Answer: $\cos x$

- Factor the numerator: $\sin x(\sin^2 x + \cos^2 x)$
- Apply Pythagorean identity: $\sin^2 x + \cos^2 x = 1$
- Numerator simplifies to $\sin x$
- Expression becomes $\frac{\sin x}{\tan x} = \frac{\sin x}{\frac{\sin x}{\cos x}} = \sin x \cdot \frac{\cos x}{\sin x} = \cos x$

Scan to watch

