

Precalculus · Trigonometric Identities · Worksheet

Common Core F-TF.C.8, F-TF.C.9 · mathovore.fr

Name: _____ Date: ____/____/____ Score: _____

This precalculus trig identities worksheet gives 28 problems on trigonometric identities, ordered from easy to hard, with a separate answer key.

These 28 problems build fluency with the reciprocal, quotient and Pythagorean identities, with verifying identities, and with the sum, difference and double-angle formulas. They match standards F-TF.C.8 and F-TF.C.9.

Problems run from easy to hard. The last six are multi-step applications such as projectile range, a Ferris wheel, a rotating point, camera tilt and polarized light.

Precalculus Common Core: F-TF.C.8 · F-TF.C.9

Precalculus Trig Identities Worksheet: problems 1-5

Problem 1: Reciprocal and quotient forms

Rewrite each expression using only sine and cosine.

- a. $\sec \theta$
- b. $\csc \theta$
- c. $\cot \theta$
- d. $\tan \theta \csc \theta$

Problem 2: Reciprocal values

Find the reciprocal function value.

- a. $\sin \theta = \frac{3}{5}$. Find $\csc \theta$.
- b. $\cos \theta = -\frac{5}{13}$. Find $\sec \theta$.
- c. $\tan \theta = \frac{7}{24}$. Find $\cot \theta$.
- d. $\tan \theta = -2$. Find $\cot \theta$.

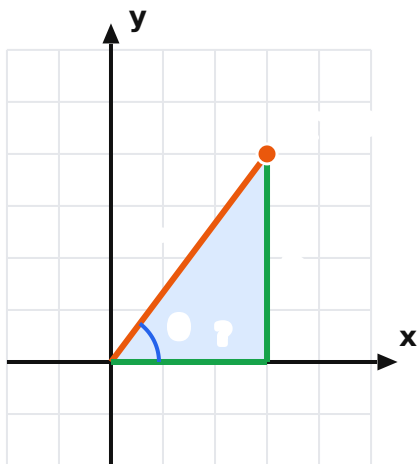
Problem 3: Pythagorean forms

Use a Pythagorean identity to find each value.

- $\cos\theta = 0.6$. Find $\sin^2\theta$.
- $\sin\theta = -\frac{1}{2}$. Find $\cos^2\theta$.
- $\tan\theta = 3$. Find $\sec^2\theta$.
- $\cot\theta = 2$. Find $\csc^2\theta$.

Problem 4: Cosine from sine, Quadrant I

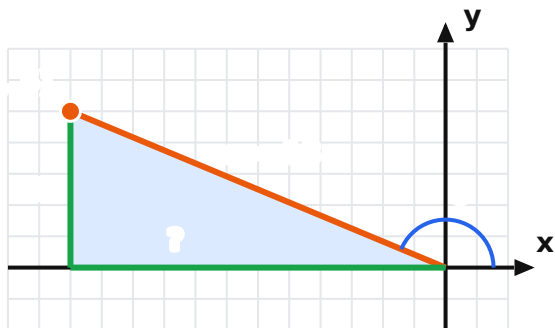
Angle θ is in Quadrant I and $\sin\theta = \frac{4}{5}$. Find $\cos\theta$ and $\tan\theta$.



The unknown horizontal leg.

Problem 5: Cosine from sine, Quadrant II

Angle θ is in Quadrant II and $\sin\theta = \frac{5}{13}$. Find $\cos\theta$ and $\tan\theta$.

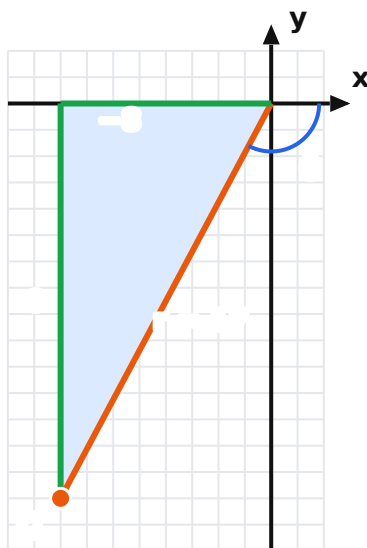


The unknown horizontal leg points left.

Precalculus Trig Identities Worksheet: problems 6-10

Problem 6: Sine from cosine, Quadrant III

Angle θ is in Quadrant III and $\cos\theta = -\frac{8}{17}$. Find $\sin\theta$ and $\tan\theta$.



The unknown vertical leg points down.

Problem 7: Sine and cosine from tangent

Angle θ is in Quadrant IV and $\tan\theta = -\frac{3}{4}$. Use $1 + \tan^2\theta = \sec^2\theta$ to find $\cos\theta$ and $\sin\theta$.

Problem 8: All six functions

Angle θ satisfies $\sin\theta = -\frac{24}{25}$ and $\cos\theta < 0$. Find the other five trigonometric functions of θ .

Problem 9: Simplify products

Simplify each expression to a single trigonometric function.

- $\sin\theta \cot\theta$
- $\cos\theta \tan\theta$
- $\csc\theta \tan\theta$
- $1 - \cos^2\theta$

Problem 10: Simplify with Pythagorean identities

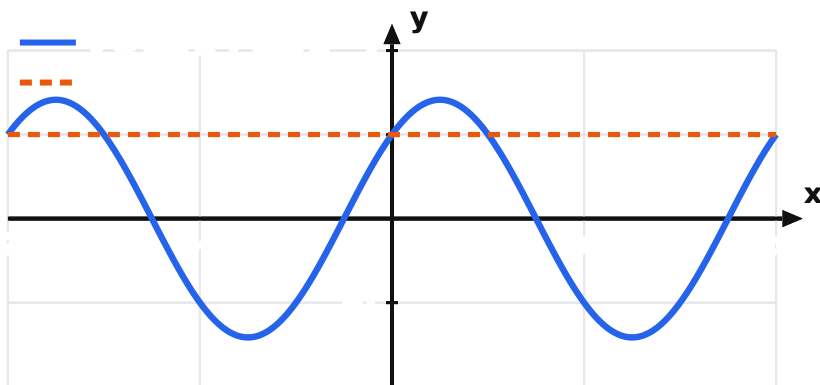
Simplify each expression.

- $\sin^2\theta + \cos^2\theta + \tan^2\theta$
- $(1 - \sin\theta)(1 + \sin\theta)$
- $\frac{\sec^2\theta - 1}{\tan\theta}$
- $\cos^2\theta(1 + \tan^2\theta)$

Precalculus Trig Identities Worksheet: problems 11-15

Problem 11: Identity or not?

The graph compares $y = \sin x + \cos x$ with $y = 1$.



Do the two graphs coincide?

- Explain why the graph shows that $\sin x + \cos x = 1$ is not an identity.
- Show that it fails at $x = \frac{\pi}{4}$.
- Check that $\sin^2 x + \cos^2 x = 1$ holds at $x = \frac{\pi}{3}$.

Problem 12: Simplify rational expressions

Simplify each expression.

- $\frac{\sin^2 \theta}{1 - \cos \theta}$
- $\frac{\cos^2 \theta}{1 - \sin \theta}$
- $\frac{1}{1 - \sin \theta} + \frac{1}{1 + \sin \theta}$

Problem 13: Verify an identity: sum of fractions

Verify the identity $\frac{\sin \theta}{1 + \cos \theta} + \frac{1 + \cos \theta}{\sin \theta} = 2 \csc \theta$.

Problem 14: Verify an identity: tangent plus cotangent

Verify the identity $\tan \theta + \cot \theta = \sec \theta \csc \theta$.

Problem 15: Verify an identity: secant minus cosine

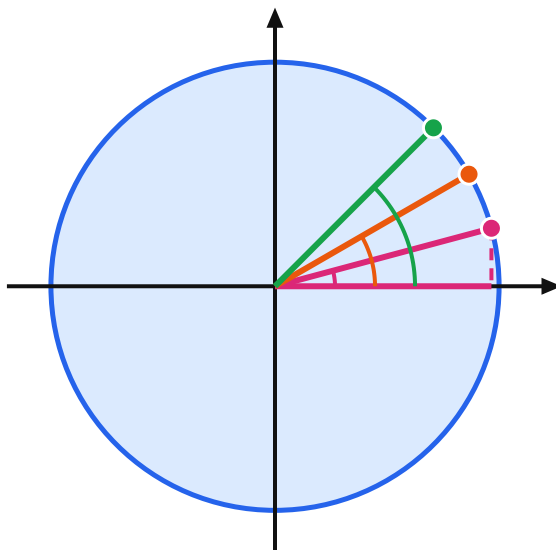
Verify the identity $\frac{\sec \theta - \cos \theta}{\tan \theta} = \sin \theta$.

Precalculus Trig Identities Worksheet: problems 16-20

Problem 16: Exact values with the sum formula

Find the exact value of each expression.

- a. $\sin 75^\circ$
- b. $\cos 105^\circ$
- c. $\tan 15^\circ$



The angles 15, 30 and 45 degrees.

Problem 17: Exact values in radians

Write each angle as a sum or difference of special angles and find the exact value.

- a. $\sin \frac{\pi}{12}$
- b. $\tan \frac{5\pi}{12}$
- c. $\cos \frac{7\pi}{12}$

Problem 18: Sum formulas from two triangles

Angle A is in Quadrant I with $\sin A = \frac{3}{5}$. Angle B is in Quadrant II with $\cos B = -\frac{5}{13}$. Find $\sin(A+B)$ and $\cos(A+B)$, then name the quadrant of $A+B$.

Problem 19: Recognize the formula

Rewrite each expression as one trigonometric value and evaluate it.

- a. $\sin 50^\circ \cos 20^\circ - \cos 50^\circ \sin 20^\circ$
- b. $\cos 80^\circ \cos 20^\circ + \sin 80^\circ \sin 20^\circ$
- c. $\frac{\tan 40^\circ + \tan 5^\circ}{1 - \tan 40^\circ \tan 5^\circ}$
- d. $\sin \frac{2\pi}{9} \cos \frac{\pi}{9} + \cos \frac{2\pi}{9} \sin \frac{\pi}{9}$

Problem 20: Prove shift identities

Use a sum formula to prove each identity.

- a. $\sin\left(\theta + \frac{\pi}{2}\right) = \cos\theta$
- b. $\cos(\theta + \pi) = -\cos\theta$
- c. $\tan(\theta + \pi) = \tan\theta$

Precalculus Trig Identities Worksheet: problems 21-25

Problem 21: Double-angle values

Angle θ is in Quadrant IV and $\sin\theta = -\frac{5}{13}$. Find $\sin 2\theta$, $\cos 2\theta$ and $\tan 2\theta$.

Problem 22: Double-angle simplifications

Rewrite each expression as one value and evaluate it exactly.

- a. $2\sin 15^\circ \cos 15^\circ$
- b. $\cos^2 22.5^\circ - \sin^2 22.5^\circ$
- c. $1 - 2\sin^2 \frac{\pi}{12}$
- d. $\frac{2\tan 15^\circ}{1 - \tan^2 15^\circ}$

Problem 23: Work backward from $\cos 2\theta$

Maya knows that $\cos 2\theta = \frac{7}{25}$ and that θ is in Quadrant I. Use $\cos 2\theta = 2\cos^2\theta - 1$ and $\cos 2\theta = 1 - 2\sin^2\theta$ to find $\cos\theta$, $\sin\theta$ and $\tan 2\theta$.

Problem 24: Soccer kick range

The range of a kicked ball is $R = \frac{v^2 \sin 2\theta}{g}$ with $g = 32 \text{ ft/s}^2$. Jamal kicks a ball at $v = 40 \text{ ft/s}$ with $\sin\theta = 0.6$ and $\cos\theta = 0.8$.

- a. Find $\sin 2\theta$ and the range.
- b. Find the range for a 45° kick at the same speed.
- c. How many feet farther does the 45° kick travel?

Problem 25: Ferris wheel doubling

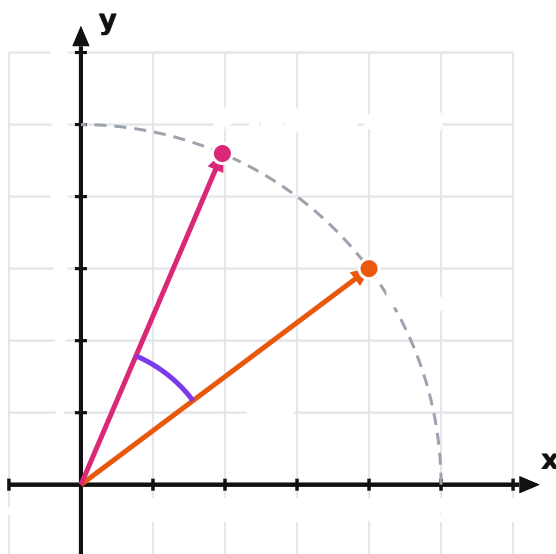
A Ferris wheel has radius 50 ft and its center is 60 ft above the ground. Ethan sits at angle θ with his seat 30 ft above the center and to the left of it. The wheel turns until his angle is 2θ .

- a. Find $\cos\theta$ and $\sin\theta$.
- b. Use double-angle formulas to find his new coordinates relative to the center.
- c. How high above the ground is he at the new position?

Precalculus Trig Identities Worksheet: problems 26-28

Problem 26: Rotating a point

A graphics app rotates a point $P(x,y) = (5[\cos A], 5[\sin A])$ counterclockwise about the origin by 30° . Mei starts with $P(4,3)$.



Rotation by 30 degrees.

- Find $\cos A$ and $\sin A$.
- Use the sum formulas to find the exact coordinates of the rotated point P' .
- Show that P' is still 5 units from the origin (use decimals).

Problem 27: Camera tilt

Diego tilts a drone camera upward in two steps. The first tilt is angle A with $\tan A = \frac{1}{2}$ and the second is angle B with $\tan B = \frac{1}{3}$. Both are acute.

- Find $\tan(A+B)$.
- Find the total tilt $A+B$ in degrees.
- Find A and B separately to the nearest hundredth of a degree and check the sum.

Problem 28: Polarizing filter

Light passing through a polarizing filter has intensity $I = 80\cos^2\theta$ lumens. Aisha rewrites it with $\cos^2\theta = \frac{1+\cos 2\theta}{2}$.

- Show that this rewrite follows from $\cos 2\theta = 2\cos^2\theta - 1$.
- Find I for $\theta = 30^\circ$.
- Find the exact intensity for $\theta = 15^\circ$ and round to the nearest hundredth.
- Find the exact intensity for $\theta = 22.5^\circ$ and round to the nearest hundredth.

How to use this precalculus trig identities worksheet

Print this precalculus trig identities worksheet as a PDF, solve every problem on paper, then compare with the answer key.

