

Solving Trigonometric Equations

Trigonometry Worksheet · Grade 10–12

Name: _____

Date: _____

Learning Objectives

- Apply algebraic techniques to isolate trigonometric expressions
- Use the unit circle to find exact angle solutions for trigonometric equations
- Apply reciprocal, quotient, and Pythagorean identities to simplify and solve trig equations

Problems

1. Solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$1 - 2\cos x = 0$$

2. Solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$2\sin x - \sqrt{2} = 0$$

3. Solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$\sin x + \sqrt{2} = -\sin x$$

4. Solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$2\cos x + \sqrt{3} = 0$$

5. Solve for x in the interval $[0, 2\pi]$ using a Pythagorean identity. Write your answer in radians.

$$\sin^2 x + \sin x = 0$$

6. Solve for x in the interval $[0, 2\pi]$ by factoring. Write your answer in radians.

$$2\cos^2 x - \cos x - 1 = 0$$

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7. Use the reciprocal identity for cosecant to solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$2\csc x - 4 = 0$$

8. Use the quotient identity and Pythagorean identity to solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$\tan^2 x - 1 = 0$$

9. Use a Pythagorean identity to rewrite and solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$2\sin^2 x - \cos x - 1 = 0$$

10. Use Pythagorean and reciprocal identities to solve for x in the interval $[0, 2\pi]$. Write your answer in radians.

$$\sec^2 x - \tan x - 3 = 0$$

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Solving Trigonometric Equations — Answer Key

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Answer Key

1. Answer: $x = \pi/3, 5\pi/3$

- Subtract 1 from both sides: $-2\cos x = -1$
 - Divide both sides by -2: $\cos x = 1/2$
 - Use the unit circle: $\cos x = 1/2$ at $x = \pi/3$ and $x = 5\pi/3$
-

2. Answer: $x = \pi/4, 3\pi/4$

- Add $\sqrt{2}$ to both sides: $2\sin x = \sqrt{2}$
 - Divide both sides by 2: $\sin x = \sqrt{2}/2$
 - Use the unit circle: $\sin x = \sqrt{2}/2$ at $x = \pi/4$ and $x = 3\pi/4$
-

3. Answer: $x = 5\pi/4, 7\pi/4$

- Add $\sin x$ to both sides: $2\sin x + \sqrt{2} = 0$
 - Subtract $\sqrt{2}$ from both sides: $2\sin x = -\sqrt{2}$
 - Divide by 2: $\sin x = -\sqrt{2}/2$
 - Use the unit circle: $\sin x = -\sqrt{2}/2$ at $x = 5\pi/4$ and $x = 7\pi/4$
-

4. Answer: $x = 5\pi/6, 7\pi/6$

- Subtract $\sqrt{3}$ from both sides: $2\cos x = -\sqrt{3}$
 - Divide by 2: $\cos x = -\sqrt{3}/2$
 - Use the unit circle: $\cos x = -\sqrt{3}/2$ at $x = 5\pi/6$ and $x = 7\pi/6$
-

5. Answer: $x = 0, \pi, 3\pi/2$

- Factor: $\sin x(\sin x + 1) = 0$
 - Set each factor to zero: $\sin x = 0$ or $\sin x = -1$
 - From $\sin x = 0$: $x = 0, \pi$
 - From $\sin x = -1$: $x = 3\pi/2$
-

6. Answer: $x = 0, 2\pi/3, 4\pi/3$

- Factor as a quadratic in $\cos x$: $(2\cos x + 1)(\cos x - 1) = 0$
 - Set each factor to zero: $\cos x = -1/2$ or $\cos x = 1$
 - From $\cos x = 1$: $x = 0$
 - From $\cos x = -1/2$: $x = 2\pi/3$ and $x = 4\pi/3$
-

7. Answer: $x = \pi/6, 5\pi/6$

- Add 4 to both sides: $2\csc x = 4$
 - Divide by 2: $\csc x = 2$
 - Use reciprocal identity: $\sin x = 1/2$
 - Use the unit circle: $\sin x = 1/2$ at $x = \pi/6$ and $x = 5\pi/6$
-

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8. Answer: $x = \pi/4, 3\pi/4, 5\pi/4, 7\pi/4$

- Add 1 to both sides: $\tan^2 x = 1$
 - Take the square root: $\tan x = \pm 1$
 - From $\tan x = 1$: $x = \pi/4$ and $x = 5\pi/4$
 - From $\tan x = -1$: $x = 3\pi/4$ and $x = 7\pi/4$
-

9. Answer: $x = \pi/3, \pi, 5\pi/3$

- Replace $\sin^2 x$ using identity: $\sin^2 x = 1 - \cos^2 x$
 - Equation becomes: $2(1 - \cos^2 x) - \cos x - 1 = 0$
 - Simplify: $-2\cos^2 x - \cos x + 1 = 0 \rightarrow 2\cos^2 x + \cos x - 1 = 0$
 - Factor: $(2\cos x - 1)(\cos x + 1) = 0$
 - $\cos x = 1/2 \rightarrow x = \pi/3, 5\pi/3$; $\cos x = -1 \rightarrow x = \pi$
-

10. Answer: $x = \pi/4, \arctan(-2) + \pi, \arctan(-2) + 2\pi$

- Use Pythagorean identity: $\sec^2 x = 1 + \tan^2 x$
 - Substitute: $1 + \tan^2 x - \tan x - 3 = 0 \rightarrow \tan^2 x - \tan x - 2 = 0$
 - Factor: $(\tan x - 2)(\tan x + 1) = 0$
 - $\tan x = 2$: $x = \arctan(2) \approx 1.107$ rad and $x = \arctan(2) + \pi \approx 4.249$ rad
 - $\tan x = -1$: $x = 3\pi/4$ and $x = 7\pi/4$
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