LESSON MAKER PRO

# Angles in Motion

*For every problem, find all $x$ in $0 \le x < 2\pi$. Give exact answers in radians.*

**HIGH SCHOOL · MT.PLUS.ALG.TRIG.4**

**MT.PLUS.ALG.TRIG.4** "Solve trigonometric equations with and without the use of technology."

NAME _____ DATE _____

## FIND EVERY ANGLE

First, isolate the trigonometric expression and find its reference angle. Use the sign of the expression to choose the correct quadrants, then list every solution in the given interval. If the expression contains 2x, find the possible values of 2x before dividing by 2.

## WORKED EXAMPLE

Solve $\tan x = \sqrt{3}/3$.

1. The reference angle is $\pi/6$ because $\tan(\pi/6) = \sqrt{3}/3$.
2. Tangent is positive in Quadrants I and III.
3. The angles are $\pi/6$ and $\pi + \pi/6 = 7\pi/6$.

**Answer: $x = \pi/6, 7\pi/6$**

## PRACTICE 6 problems

**1** Solve $\sin x = 1/2$.

**ANSWER** _____

**2** Solve $\cos x = -\sqrt{2}/2$.

**ANSWER** _____

**3** Solve $\tan x = -1$.

**ANSWER** _____

**4** Solve $2\sin x + \sqrt{3} = 0$.

**ANSWER** _____

**5** Solve $\cos(2x) = 1$.

**ANSWER** _____

**6** Solve $2\cos x - \sqrt{3} = 0$.

**ANSWER** _____

## APPLY IT Show your work

**1** During one full turn, a ride in a video game has height h = 10 + 6sin x meters, where x is its angle of rotation. At which angles is the ride 7 meters high?

WORK SPACE

**ANSWER** _____

**2** A concert light's brightness during one full turn is B = 60 + 20cos x percent, where x is its angle of rotation. At which angles is the brightness 60%?

WORK SPACE

**ANSWER** _____

## CHALLENGE One step up

Solve sin(2x) = sin x. Show how you know your list includes every solution in the given interval.

WORK SPACE AND ANSWER

# Angles in Motion



## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | Solve sin x = 1/2. | **x = π/6, 5π/6** |
| 2 | Solve cos x = -√2/2. | **x = 3π/4, 5π/4** |
| 3 | Solve tan x = -1. | **x = 3π/4, 7π/4** |
| 4 | Solve 2sin x + √3 = 0. | **x = 4π/3, 5π/3** |
| 5 | Solve cos(2x) = 1. | **x = 0, π** |
| 6 | Solve 2cos x - √3 = 0. | **x = π/6, 11π/6** |

## PART 2 · APPLY IT

1. **x = 7π/6, 11π/6** Set 10 + 6sin x = 7 to get sin x = -1/2. Sine is negative at 7π/6 and 11π/6.
2. **x = π/2, 3π/2** Set 60 + 20cos x = 60 to get cos x = 0. Cosine is zero at π/2 and 3π/2.

## CHALLENGE

**sin(2x) = 2sin x cos x, so sin x(2cos x - 1) = 0. Either sin x = 0, giving x = 0 or π, or cos x = 1/2, giving x = π/3 or 5π/3. Thus x = 0, π/3, π, 5π/3.**

Accept solutions in any order. For the challenge, accept equivalent reasoning that checks both factors and excludes 2π.