MATHEMATICS · GRADES 10-12

Solving basic trigonometric equations

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you find every angle that fits a measurement, like the positions a Ferris wheel cabin passes through as it turns, instead of stopping at the first answer. A turning wheel passes the same height more than once in a single turn, so one answer is only part of the story. These equations collect every angle that gives the same result, all the way around the circle. That matters whenever something spins or swings, because the same measurement comes back again and again.



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Rule

Solving trigonometric equations: find the reference angle first, then use the sign of the function in each quadrant to find every angle in the range that works.

One answer is only part of the story when the same value comes back more than once around the circle.

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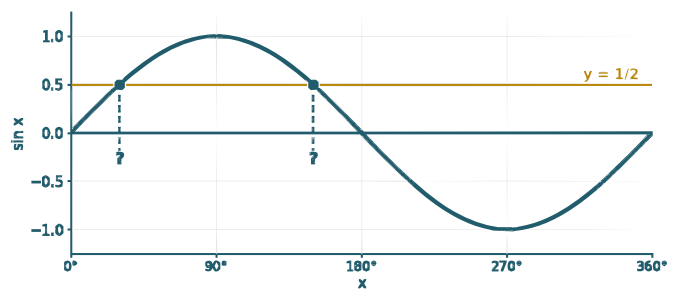
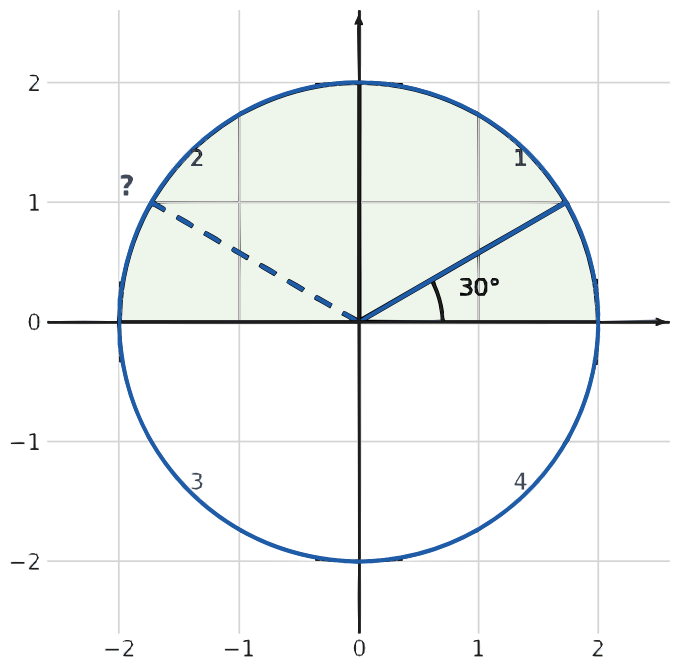
Worked examples

EXAMPLE 1

Q Solve $\sin x = \frac{1}{2}$ for x between 0 and 360 degrees.





SOLUTION

The reference angle is 30 degrees, since sin 30 degrees = $\frac{1}{2}$.

Sine is positive in quadrants 1 and 2. In quadrant 1, the angle is the reference angle itself: 30 degrees. In quadrant 2, the angle is 180 degrees minus the reference angle: 180 - 30 = 150 degrees.

Answers: 30 degrees and 150 degrees

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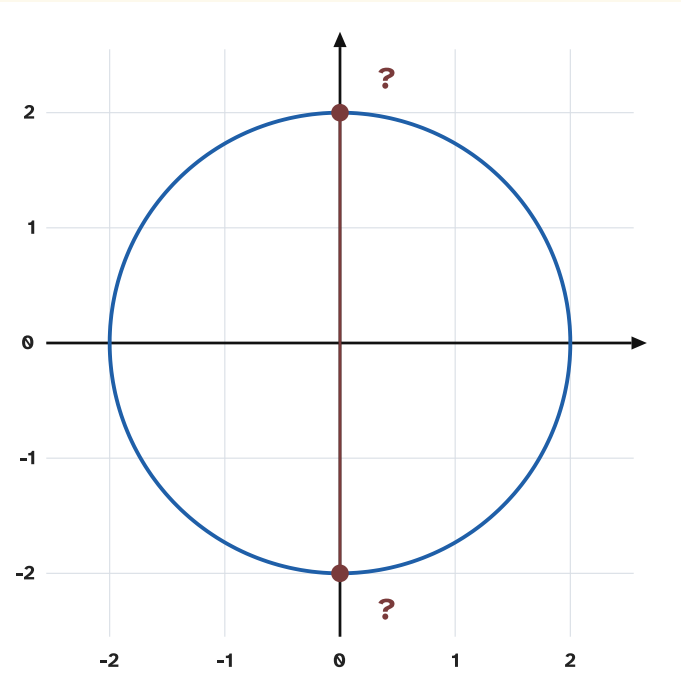
EXAMPLE 2

Q Solve cos x = 0 for x between 0 and 360 degrees.



SOLUTION

Cosine is 0 where the unit-circle point has x-coordinate 0.

That happens at the top and bottom of the circle.

Answers: 90 degrees and 270 degrees

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Practice questions

1

Solve sin x = 0 for x between 0 and 360 degrees.

A 0 degrees, 180 degrees, 360 degrees

B 90 degrees, 270 degrees

C 0 degrees, 360 degrees

D 90 degrees, 180 degrees, 270 degrees

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2

Solve cos x = 1 for x between 0 and 360 degrees.

A 0 degrees, 180 degrees

B 0 degrees, 360 degrees

C 90 degrees, 270 degrees

D 0 degrees, 90 degrees, 360 degrees

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3

Solve tan x = 1 for x between 0 and 360 degrees.

A 45 degrees, 135 degrees

B 30 degrees, 210 degrees

C 45 degrees, 225 degrees

D 0 degrees, 180 degrees

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4 Solve $\sin x = 1$ for x between 0 and 360 degrees.

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5 Solve $\cos x = -1$ for x between 0 and 360 degrees.

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6 Solve $\sin x = \frac{\sqrt{2}}{2}$ for x between 0 and 360 degrees.

A. 45 degrees, 225 degrees

B. 30 degrees, 150 degrees

C. 60 degrees, 120 degrees

D. 45 degrees, 135 degrees

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7 Solve $\cos x = \frac{1}{2}$ for x between 0 and 360 degrees.

- A 30 degrees, 330 degrees
- B 60 degrees, 300 degrees
- C 45 degrees, 315 degrees
- D 60 degrees, 120 degrees

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8 Solve $\sin x = -\frac{1}{2}$ for x between 0 and 360 degrees.

- A 210 degrees, 330 degrees
- B 30 degrees, 150 degrees
- C 210 degrees, 150 degrees
- D 30 degrees, 330 degrees

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9 How many answers does $\sin x = \frac{1}{2}$ have between 0 and 360 degrees?

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10 Solve $\cos x = \frac{\sqrt{3}}{2}$ for x between 0 and 360 degrees.

A. 30 degrees, 150 degrees

B. 45 degrees, 315 degrees

C. 30 degrees, 330 degrees

D. 60 degrees, 300 degrees

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ANSWER KEY

1. 0 degrees, 180 degrees, 360 degrees

2. 0 degrees, 360 degrees

3. 45 degrees, 225 degrees

4. 90 degrees

5. 180 degrees

6. 45 degrees, 135 degrees

7. 60 degrees, 300 degrees

8. 210 degrees, 330 degrees

9. 2

10. 30 degrees, 330 degrees

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