MATHEMATICS · GRADES 10-12

Sine and cosine graphs

Difficulty level: Advanced

Mathematics: Grades 10-12

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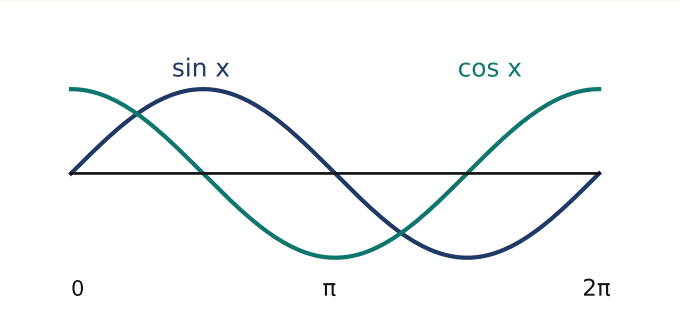
Overview of the concept

This is how you read a repeating pattern, like the rise and fall of tides, the swing of a pendulum, or the sound wave from a speaker, all on one picture. Anything that goes up and down in a regular cycle can be drawn as a wave, and the graph shows you the whole pattern at once. You can read off how high it goes, how long each cycle takes, and where it starts. That is how a sailor reads the tides, a musician reads a sound, or an engineer reads a vibration.





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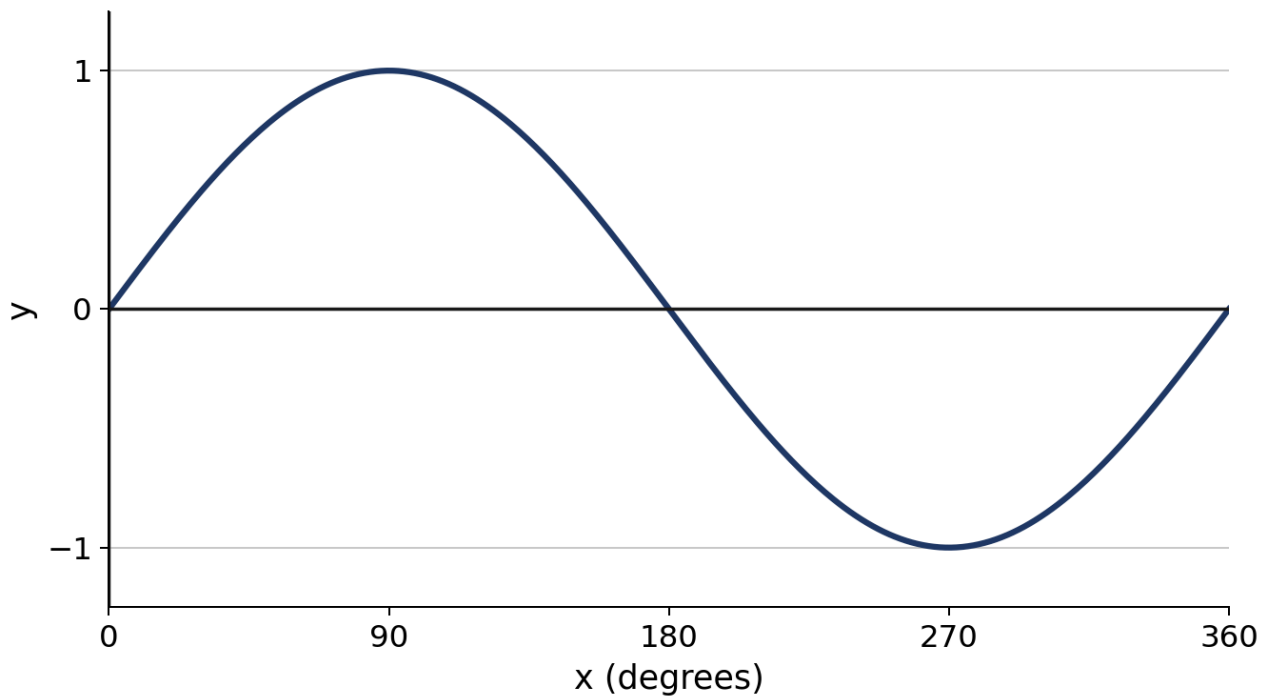
Worked examples

EXAMPLE 1

Q Sketch y = sin x from 0 to 360 degrees.



SOLUTION

At 0 degrees, sin is 0, so the graph starts on the axis.

It rises to 1 at 90 degrees, back to 0 at 180, down to -1 at 270.

It returns to 0 at 360 degrees, completing one wave.

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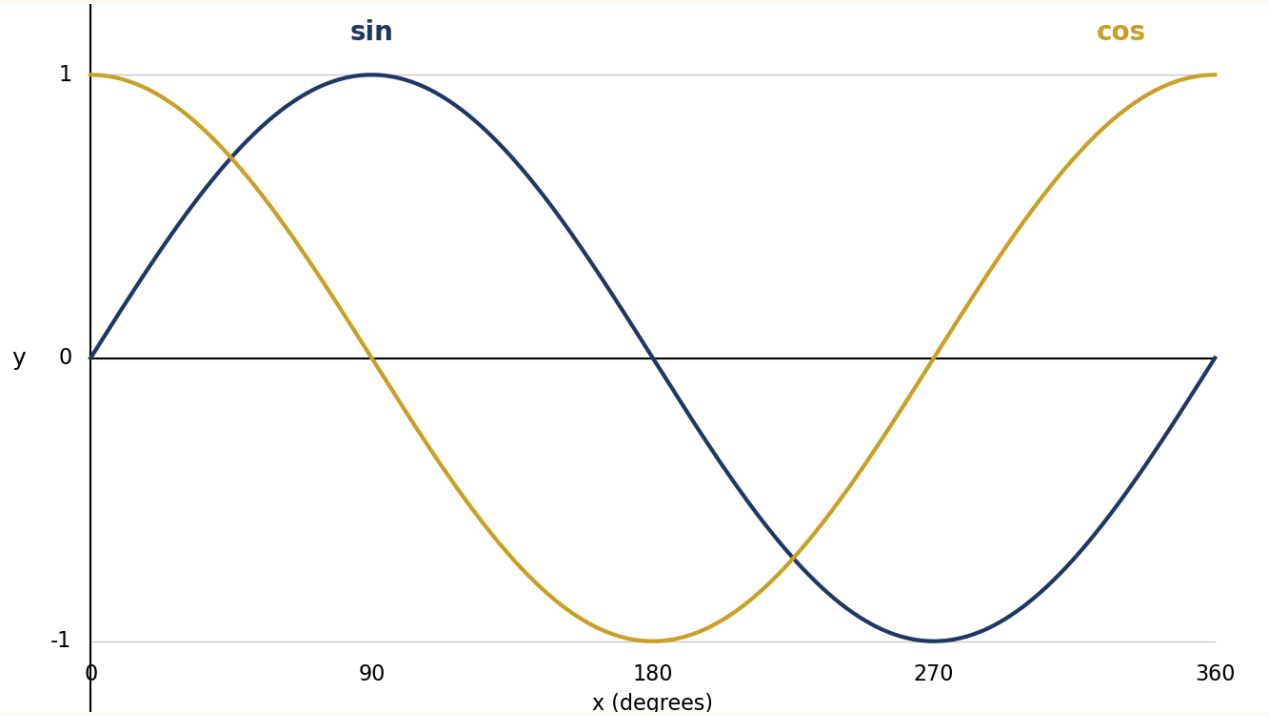
EXAMPLE 2

Q How does y = cos x differ from y = sin x?



SOLUTION

Cos starts at its highest point: cos 0 degrees = 1.

It falls to 0 at 90 degrees, to -1 at 180, and back to 1 at 360.

The cosine graph is the sine graph shifted left by 90 degrees.

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Practice questions

1 Sketch y = sin x from 0 to 720 degrees.

- **A** One wave from 0 to 360, then a flat line at 0 to 720
- **B** One wave from 0 to 720, rising to 1 at 360
- **C** Two waves, the second rising to 2
- **D** Two identical waves, one from 0 to 360 and one from 360 to 720

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Sketch y = cos x from 0 to 360 degrees.

A. Starts at 1, falls to 0 at 90 degrees, to -1 at 180, to 0 at 270, back to 1 at 360

B. Starts at 0, rises to 1 at 90 degrees, back to 0 at 180, down to -1 at 270, back to 0 at 360

C. Starts at 1, rises to 2 at 90 degrees, back to 1 at 360

D. Starts at -1, rises to 0 at 90 degrees, to 1 at 180, back to -1 at 360

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3 **What is y = cos x at 270 degrees, and what is y = sin x at 270 degrees?**

- **A** cos 270 = 1, sin 270 = 0
- **B** cos 270 = 0, sin 270 = -1
- **C** cos 270 = -1, sin 270 = 0
- **D** cos 270 = 0, sin 270 = 1

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4 **Sketch y = sin x from 0 to 180 degrees.**

- **A** Starts at 1, falls to 0 at 90 degrees, to -1 at 180
- **B** Starts at 0, rises to 1 at 180, back to 0 at 360
- **C** Starts at 0, rises to 1 at 90 degrees, back to 0 at 180
- **D** Starts at 0, falls to -1 at 90 degrees, back to 0 at 180

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5 Sketch y = -sin x from 0 to 360 degrees.

A. Starts at 0, falls to -1 at 90 degrees, back to 0 at 180, rises to 1 at 270, back to 0 at 360

B. Starts at 0, rises to 1 at 90 degrees, back to 0 at 180, down to -1 at 270, back to 0 at 360

C. Starts at 1, falls to 0 at 90 degrees, to -1 at 180, to 0 at 270, back to 1 at 360

D. Starts at -1, rises to 0 at 90 degrees, to 1 at 180, back to -1 at 360

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6 What is sin 0 degrees?

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7 What is the amplitude of y = sin x (how high the wave goes above the middle)?

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8 At what angle between 0 degrees and 360 degrees is cos x = -1?

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9 What is the period of sin x (the length of one full wave), in degrees?

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What is the range of sin x?

A From -1 to 1

B From 0 to 1

C From -1 to 0

D From -2 to 2

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ANSWER KEY

1. Two identical waves, one from 0 to 360 and one from 360 to 720

2. Starts at 1, falls to 0 at 90 degrees, to -1 at 180, to 0 at 270, back to 1 at 360

3. cos 270 = 0, sin 270 = -1

4. Starts at 0, rises to 1 at 90 degrees, back to 0 at 180

5. Starts at 0, falls to -1 at 90 degrees, back to 0 at 180, rises to 1 at 270, back to 0 at 360

6. 0

7. 1

8. 180

9. 360

10. From -1 to 1

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