

Algebra 2 - Graphs of Trigonometric Functions and Identities - Lesson

Common Core F-TF.B.5, F-TF.C.8, F-IF.C.7e · maths-pdf.fr/en/

Sine and cosine graphs are periodic waves with period 2π . For $y = A \sin(B(x - C)) + D$, the amplitude is $|A|$, the period is $2\pi/B$, the shift is C , and the midline is $y = D$. The identity $\sin^2 \theta + \cos^2 \theta = 1$ links sine and cosine.

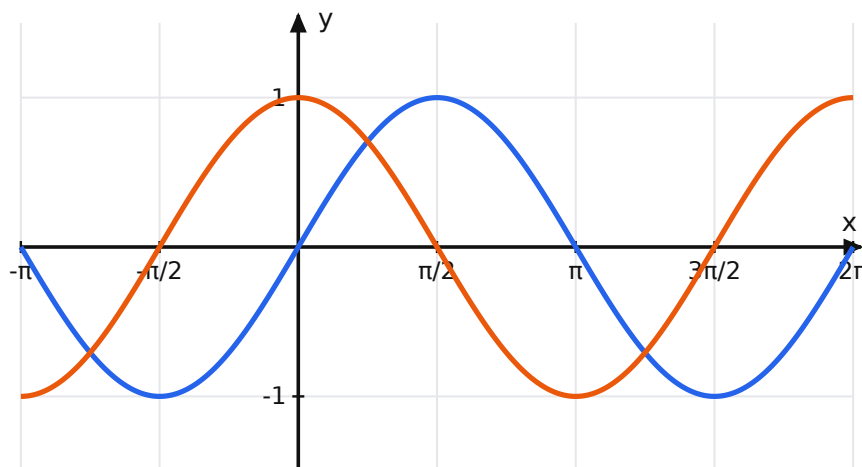
Algebra 2 · Common Core State Standards: **F-TF.B.5, F-TF.C.8, F-IF.C.7e**

Key facts

- Sine and cosine have period 2π and range -1 to 1.
- $y = A \sin(B(x - C)) + D$: amplitude $|A|$, period $2\pi/B$, shift C , midline D .
- Model cycles with a sinusoid: midline = average of max and min.
- $\sin^2 \theta + \cos^2 \theta = 1$.
- The quadrant gives the sign of the missing trig value.

What do sine and cosine graphs look like?

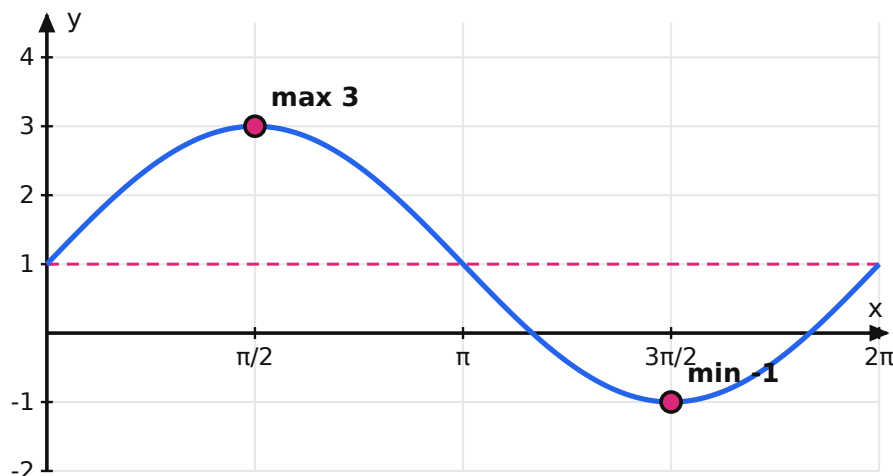
The graphs of $y = \sin x$ and $y = \cos x$ are smooth waves that repeat every 2π . They are **periodic**: $f(x+2\pi) = f(x)$. Sine starts at 0 and rises, while cosine starts at its maximum 1. Cosine is sine shifted left by $\frac{\pi}{2}$.



$y = \sin x$ (blue) and $y = \cos x$ (orange) both have period 2π and amplitude 1.

Sinusoidal functions

A sinusoidal function has the form $y = A\sin(B(x-C))+D$ or $y = A\cos(B(x-C))+D$. The **amplitude** is $|A|$, the **period** is $\frac{2\pi}{B}$, the **phase shift** is C (right if positive), and the **midline** is $y = D$.



$y = 2 \sin x + 1$: midline $y = 1$, amplitude 2, period 2π .

For $y = 2\sin x + 1$, the midline is $y = 1$, the maximum is $1 + 2 = 3$, the minimum is $1 - 2 = -1$, and the period is 2π . A negative A reflects the wave over the midline.

How do you model periodic situations?

Many real-world cycles are sinusoidal: tides, daylight hours, temperature, and a rider on a Ferris wheel. Match each feature: half the distance between the maximum and minimum is the amplitude, their average is the midline, and the time for one cycle is the period, from which $B = \frac{2\pi}{\text{period}}$. A wheel with radius 20 feet, center 25 feet above the ground, and a 30 second turn has height $h(t) = 25 - 20\cos\left(\frac{\pi}{15}t\right)$.

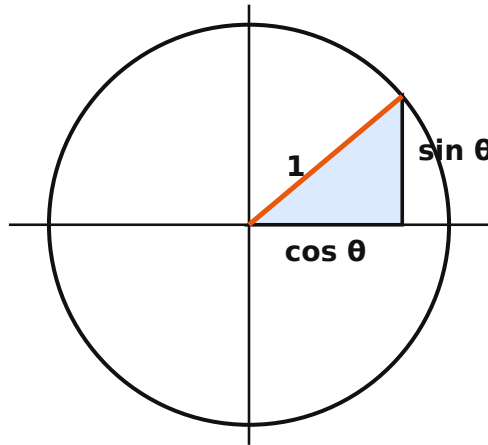
Feature	Formula	Example $y = 3 \sin(2x) + 1$
Amplitude	$ A $	3
Period	$2\pi / B$	π
Midline	$y = D$	$y = 1$
Phase shift	C	0

Reading the parameters of a sinusoidal function.

What is the Pythagorean identity?

A point on the unit circle at angle θ is $(\cos\theta, \sin\theta)$. By the Pythagorean theorem, $\sin^2\theta + \cos^2\theta = 1$

for every angle. If you know one of sine or cosine and the quadrant, you can find the others. If $\sin \theta = \frac{3}{5}$ and θ is in quadrant II, then $\cos^2 \theta = 1 - \frac{9}{25} = \frac{16}{25}$. Cosine is negative in quadrant II, so $\cos \theta = -\frac{4}{5}$ and $\tan \theta = -\frac{3}{4}$.



The right triangle in the unit circle: $\cos^2 \theta + \sin^2 \theta = 1$.

Questions about graphs of trigonometric functions and identities

What is the amplitude of a sine function?

The amplitude is half the distance between the maximum and the minimum. For $y = A \sin x$ it equals the absolute value of A .

How do you find the period of $y = \sin(Bx)$?

The period is 2π divided by B . For $y = \sin(3x)$ the period is $2\pi/3$, so the graph completes three cycles from 0 to 2π .

What does the Pythagorean identity say?

It says sine squared of an angle plus cosine squared of the same angle equals 1. It follows from the unit circle having radius 1.

How do you find cosine if you know sine and the quadrant?

Use $\cos^2 \theta = 1 - \sin^2 \theta$, take the square root, and choose the sign that matches the quadrant.

What is the midline of a trig graph?

The midline is the horizontal line halfway between the maximum and minimum, $y = D$ in $y = A \sin(B(x - C)) + D$.