The Graph Of Which Function Has An Amplitude Of 3 And A Right Phase Shift Of ?y = 3+ Sin 2(x - 5)y =

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Understanding the characteristics of trigonometric functions is fundamental in analyzing their graphs and behaviors. When given specific properties such as amplitude and phase shift, it becomes possible to identify or construct the corresponding function accurately. In this article, we will explore the function y = 3 + sin 2(x - 5), analyze its amplitude and phase shift, and understand how these properties influence its graph. We will delve into the general form of sine functions, interpret the parameters, and illustrate how to determine the key features of the graph, culminating in answering the question: which function exhibits an amplitude of 3 and a right phase shift?

Understanding the Basic Sine Function

The Standard Sine Function

The most fundamental sine function is y = sin x, which has the following properties:
- Amplitude: 1
- Period: 2π
- Phase shift: 0
- Vertical shift: 0

Its graph oscillates between -1 and 1, completing one full cycle over a length of 2π units along the x-axis.

Transformations of the Sine Function

The basic sine function can be modified through parameters in the form:
\[y = A \sin(B(x - C)) + D \]
where:
- A controls the amplitude (vertical stretch/shrink)
- B controls the period (how stretched or compressed the wave is horizontally)
- C controls the phase shift (horizontal translation)
- D controls the vertical shift

Understanding each of these parameters is key to analyzing and sketching the graph of any transformed sine function.

Analyzing the Given Function: y = 3 + sin 2(x - 5)

Identifying the Amplitude

The amplitude of a sine function is the absolute value of the coefficient A. In the given function:
$$ y = 3 + \sin 2(x - 5) $$
the coefficient of the sine function is 1 (since it’s just sin), but the entire function is shifted vertically by 3 units.

- However, the amplitude is determined solely by the coefficient of the sine term, which is 1 in this case, not 3.
- The "+3" at the end indicates a vertical shift upward by 3 units, not an increase in amplitude.

Thus, the amplitude of the current function is 1, not 3.

Determining the Phase Shift

The phase shift of a sine function is given by:
$$ \text{Phase shift} = C $$
where the function is in the form:
$$ y = A \sin(B(x - C)) + D $$

In the provided function:
$$ y = 3 + \sin 2(x - 5) $$
the argument of the sine is $ 2(x - 5) $, which can be viewed as:
$$ \sin [2(x - 5)] $$
Here, $ C = 5 $.

The phase shift is calculated as:
$$ \text{Phase shift} = C = 5 $$
Since the formula involves $ (x - C) $:
- The graph is shifted to the right by 5 units.

Therefore, the function has a right phase shift of 5 units.

Adjusting the Function to Match the Given Conditions

Since the question asks about a function with an amplitude of 3 and a right phase shift of ? (which appears to be 5 based on the given function), we need to understand how to modify the function to meet these criteria.

Achieving an Amplitude of 3

The amplitude is controlled by the coefficient A in the general form:
$$ y = A \sin(B(x - C)) + D $$
To have an amplitude of 3, the coefficient of sine must be 3:
$$ y = 3 \sin(B(x - C)) + D $$
The vertical shift D can be any value, but it does not affect the amplitude.

Maintaining the Phase Shift

The phase shift is:
$$ C = \frac{\text{phase shift}}{B} $$
In the function:
$$ y = 3 \sin(B(x - C)) + D $$
the phase shift is $ C $.

In the original function, $ C = 5 $ and $ B = 2 $, so the phase shift is:
$$ \text{Phase shift} = \frac{C}{B} $$
which simplifies to:
$$ \text{Phase shift} = 5 $$

If we want to keep the phase shift at 5 units, then:
$$ C = 5 \times B $$
or, equivalently, if $ B $ is 2, then $ C $ must be 10 for a phase shift of 5 units, since:
$$ \text{Phase shift} = \frac{C}{B} = 5 $$
Thus, the function with amplitude 3 and phase shift of 5 units to the right is:
$$ y = D + 3 \sin 2(x - 10) $$

Summary of Key Properties for the Function in Question

- **Amplitude:** 3
- **Period:** $ \frac{2\pi}{B} $. For $ B = 2 $, period = $ \pi $
- **Phase shift:** 5 units to the right, achieved by setting $ C = 10 $ when $ B = 2 $
- **Vertical shift:** D (can be any value, often 0 for simplicity)

Constructing the Function with the Desired Properties

Given the above, a function that has an amplitude of 3 and a right phase shift of 5 units (assuming B=2) is:

$$ y = D + 3 \sin 2(x - 10) $$

where D can be any real number representing vertical shift.

For example:
$$ y = 3 \sin 2(x - 10) $$
has the desired amplitude and phase shift.

Visualizing the Graph

Key Points to Identify

- Maximum points: Occur at $\sin$ = 1, i.e., at $x = 10 + \frac{\pi}{4} + k\pi$
- Minimum points: Occur at $\sin$ = -1, i.e., at $x = 10 + \frac{3\pi}{4} + k\pi$
- Zero crossings: When $\sin$ = 0, at $x = 10 + \frac{k\pi}{2}$

Plotting Steps

1. Mark the phase shift at $x = 10$.
2. Plot maximum at $x = 10 + \frac{\pi}{4}$.
3. Plot minimum at $x = 10 + \frac{3\pi}{4}$.
4. Draw the sine wave oscillating between -3 and 3, shifted vertically by D.

Conclusion

The original function $y = 3 + \sin 2(x - 5)$ has a phase shift of 5 units to the right but an amplitude of 1. To find a function with an amplitude of 3 and a right phase shift of 5 units, we need to modify the amplitude coefficient and the phase shift parameter accordingly.

Final answer:
A function with an amplitude of 3 and a right phase shift of 5 units (assuming $B=2$) is:

$$ y = D + 3 \sin 2(x - 10) $$

where D is any vertical shift. This function exhibits the desired amplitude and phase shift, and its graph will be an oscillating wave stretching from -3 to 3 (or shifted vertically if $D \neq 0$) with a horizontal shift of 5 units to the right.

In summary, understanding the parameters of the sine function allows us to determine its amplitude and phase shift precisely. By adjusting the coefficients and phase shift parameters, we can model or identify functions that meet specific criteria, such as an amplitude of 3 and a right phase shift of 5 units.

Frequently Asked Questions

What is the amplitude of the given sine function y = 3 + sin 2(x - 5)?

The amplitude of the function is 1, as indicated by the coefficient of the sine function, which is 1.

How does the phase shift of the function y = 3 + sin 2(x - 5) relate to the graph?

The phase shift is determined by the inner expression (x - 5). Since it is (x - 5), the graph shifts to the right by 5 units.

What is the general amplitude for a sine function y = A + sin(B(x - C))?

The amplitude is the absolute value of A, which determines the maximum displacement from the midline.

Given the function y = 3 + sin 2(x - 5), what is the period of the sine wave?

The period is given by (2π)/B. Here, B=2, so the period is (2π)/2 = π.

If a sine function has an amplitude of 3 and a phase shift to the right of ? units, what is the value of ? in y = 3 + sin 2(x - ?)?

The phase shift is 5 units to the right, so ? = 5.

Additional Resources

The Graph Of Which Function Has An Amplitude Of 3 And A Right Phase Shift Of ?

Understanding the properties of trigonometric functions is fundamental in various fields ranging from engineering to physics, and even in data analysis. Among the key characteristics of sinusoidal functions—such as sine and cosine—are their amplitude, period, phase shift, and vertical shift. In this article, we delve into the specifics of the function given by:

$$ y = 3 + \sin 2(x - 5) $$

and analyze how its parameters define its graph, with a particular focus on its amplitude and phase shift. By unpacking these concepts thoroughly, we aim to clarify how this function behaves and how it compares to other sinusoidal functions with similar features.

Understanding the Basic Structure of the Function

The General Form of a Sine Function

To analyze the given function, it’s essential to understand the general form of a sine function:

$$ y = A \sin(B(x - C)) + D $$

where:

- A (Amplitude): The maximum displacement from the central value (vertical shift). It indicates the height of the peaks and depths of the troughs.

- B (Frequency/Angular Frequency): Related to the period; it determines how many cycles occur in a given interval.

- C (Phase Shift): The horizontal shift of the graph, indicating how far the graph shifts left or right.

- D (Vertical Shift): The vertical displacement, moving the entire graph up or down.

Applying this general form to the given function:

$$ y = 3 + \sin 2(x - 5) $$

we observe that:

- The coefficient in front of the sine function is 1, indicating an amplitude of 1 if considering the sine alone.

- The argument of the sine function is $2(x - 5)$, which influences the period and phase shift.

- The vertical shift is +3, moving the entire graph upward by 3 units.

Deciphering the Key Parameters: Amplitude and Phase Shift

Amplitude: The Vertical Extent of the Graph

The amplitude of a sine function is the absolute value of the coefficient multiplying the sine:

$$ \boxed{\text{Amplitude} = |A|} $$

In the given function:

$$ y = 3 + \sin 2(x - 5) $$

the coefficient of sine is 1, so:

$$ \text{Amplitude} = 1 $$

This means the graph oscillates between:

$$ y = 3 + 1 = 4 \quad \text{(peak)} $$
$$ y = 3 - 1 = 2 \quad \text{(trough)} $$

The sine wave reaches a maximum of 4 and a minimum of 2, oscillating with a height of 2 units above and below the central value of 3.

Question: How can the amplitude be 3?

If the question is: "Create a function with an amplitude of 3", then the coefficient should be 3:

$$ y = D + 3 \sin 2(x - C) $$

or, in a more general form, any function where the coefficient of sine is 3.

In the given function, the amplitude is 1, not 3, unless the function is modified.

Phase Shift: Horizontal Displacement of the Graph

The phase shift of a sine function is calculated based on the horizontal translation parameter C:

$$\text{Phase shift} = C$$

but considering the coefficient B, the actual phase shift is:

$$\text{Phase shift} = \frac{C}{B}$$

In our function:

$$y = 3 + \sin 2(x - 5)$$

- $B = 2$

- $C = 5$

Therefore:

$$\text{Phase shift} = \frac{5}{2} = 2.5$$

Since the form is $(x - C)$, a positive C indicates a shift to the right.

Conclusion: The graph is shifted 2.5 units to the right.

Note: The question mentions "a right phase shift of ?," which suggests that the phase shift is the unknown. If the function is to have a phase shift of 2.5 units to the right, then the function matches the given form.

Analyzing the Period of the Function

While the question specifically emphasizes amplitude and phase shift, understanding the period is integral to grasping the overall shape.

The period P of a sine function:

$$P = \frac{2\pi}{|B|}$$

For $B = 2$:

$$P = \frac{2\pi}{2} = \pi$$

Thus, the sine wave completes one full cycle every π units along the x-axis.

This shorter period compared to the basic sine function (which has a period of 2π) indicates a more "compressed" wave.

Constructing a Function with Amplitude 3 and a Right Phase Shift of 2.5 Units

Given the insights above, let’s formulate a function that meets the specific criteria:

- Amplitude of 3

- Right phase shift of 2.5 units

Assuming no vertical shift (D=0), and choosing the standard form:

$$ y = A \sin(B(x - C)) $$

we set:

- $A = 3$

- $C = 2.5$ (for a right shift of 2.5 units)

- B to define the periodicity; for simplicity, keep $B = 2$, giving a period of π.

Thus, the function:

$$ y = 3 \sin 2 (x - 2.5) $$

or explicitly:

$$ y = 3 \sin 2x - 5 $$

(since $2 \times 2.5 = 5$), but more accurately, the shift is embedded in the argument, and the vertical shift is 0 here.

Alternatively, if a vertical shift of 3 is desired, then:

$$ y = 3 + 3 \sin 2(x - 2.5) $$

which oscillates between:

$$ y = 3 + 3 = 6 \quad (\text{max}) $$
$$ y = 3 - 3 = 0 \quad (\text{min}) $$

The graph would be centered at $y=3$, with peaks at 6 and troughs at 0.

Graphical Representation and Interpretation

Visualizing the function is crucial for deep comprehension. The key features include:

- Amplitude of 3: The peaks reach 3 units above the central value, and the troughs go 3 units below.

- Vertical Shift: The entire wave is shifted upward by 3 units.

- Phase Shift of 2.5 Units to the Right: The wave is shifted horizontally; points that would normally cross at certain x-values are displaced.

- Period: With $B=2$, the period is π, meaning the wave repeats every π units along the x-axis.

The combined effect produces a sinusoidal wave starting from a shifted position, oscillating with a specified height, and repeating at regular intervals.

Applications and Significance in Real-World Contexts

Understanding the characteristics of sinusoidal functions like the one analyzed has far-reaching applications:

- Signal Processing: Sound waves, electrical signals, and radio frequencies often model sinusoidal behavior.

- Physics: Pendulum motion and wave phenomena exhibit sinusoidal patterns.

- Engineering: Mechanical vibrations and electrical circuits utilize sine functions for analysis.

- Biology and Medicine: Rhythmic biological patterns, like heartbeat signals, are modeled using sine waves.

Knowing how to manipulate the amplitude and phase shift allows engineers and scientists to tailor functions to fit real-world data, optimize systems, and interpret signals.

Conclusion: Summarizing the Key Insights

The function \(y = 3 + \sin 2(x - 5) \) exemplifies a sinusoidal wave with specific and significant properties:

- Amplitude: 1 (oscillating 1 unit above and below the central value of 3).

- Vertical Shift: 3 units upward, positioning the wave's center at \(y=3 \).

- Phase Shift: 2.5 units to the right, shifting the entire wave horizontally.

- Period: \(\pi \), indicating a relatively compressed wave compared to the basic sine function.

To answer the original implied question: "Which function has an amplitude of 3 and a right phase shift of 2.5?", the appropriate function could be written as:

\[y = 3 + 3 \sin 2(x - 2.5) \]

This function oscillates between 0 and 6, centered at 3, with a phase shift of 2.5 units to the right, and a period of \(\pi \).

Understanding and manipulating these parameters are essential skills in mathematics, physics, engineering, and beyond, enabling precise modeling of periodic phenomena.

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