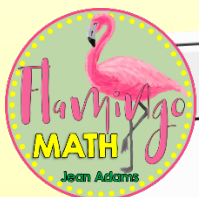


Precalculus Honors

Graphs of Sine and Cosine

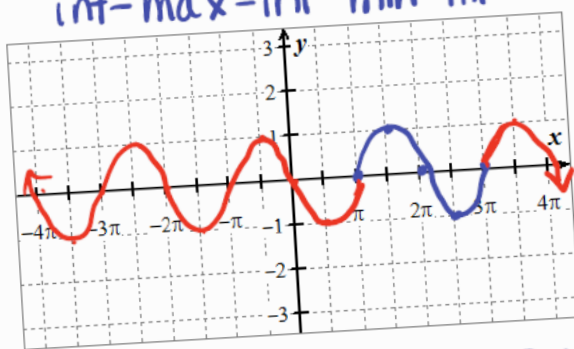


Phase Shift and Vertical Shift of Sine and Cosine

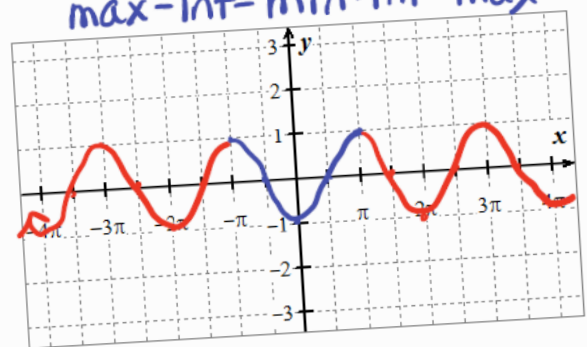
Phase Shift

A "phase shift" for a trigonometric function is a *horizontal transformation* of the graph's initial point.

EX #5A: Graph $y = \sin(x - \pi)$



EX #5B: Graph $y = \cos(x + \pi)$



In both examples, the phase shift is π . In general, we can say that if $y = A \sin(Bx - C)$

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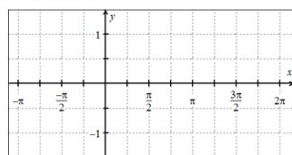
4.6

Lesson 6: Graphs of Sine and Cosine Functions

The graphs of sine and cosine functions are periodic. This means that the function values will repeat as x increases. The sine value of a function is equal to the y -value at the corresponding point (angle) on the unit circle. Also, the cosine value is equal to the x -value at this same point (angle).

The Graph of $y = \sin x$

EX #1: Since the graph will complete one full cycle in the interval of $[0, 2\pi]$ the **period** of $y = \sin x$ is 2π .

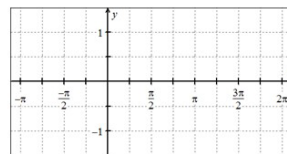


Characteristics of the Sine Function

Domain	
Range	
x-intercepts	
y-intercept	
maximum	
minimum	
Other	Continuous Bounded Above Bounded Below
Symmetry	Even Odd
Key Points	

The Graph of $y = \cos x$

EX #2: Since the graph will complete one full cycle in the interval of $[0, 2\pi]$ the **period** of $y = \cos x$ is 2π .



Characteristics of the Cosine Function

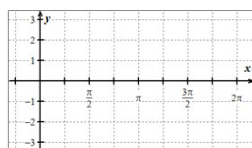
Domain	
Range	
x-intercepts	
y-intercept	
maximum	
minimum	
Other	Continuous Bounded Above Bounded Below
Symmetry	Even Odd
Key Points	

Amplitude and Period of Sine and Cosine Functions

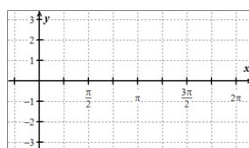
Amplitude

We can change the height, or amplitude of the graphs of sine and cosine functions by transforming the equation of the function. This will change the range of the parent function.

EX #3A: Graph $y = 2 \sin x$



EX #3B: Graph $y = -2 \cos x$

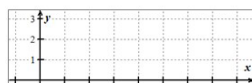


In both examples, the amplitude is _____. In general, we can say that if $y = A \sin(Bx)$ or $y = A \cos(Bx)$, then the **amplitude is defined to be the absolute value of A . Amplitude = $|A|$** . When the value of $A < 0$, describe the behavior of the graph's key points.

Period

We've already established that the period of a parent sine or cosine graph is 2π . Let's explore how the general form of the equations can change the period of the graph, as well.

EX #4A: Graph $y = \sin(2x)$



EX #4B: Graph $y = \cos(\frac{x}{2})$

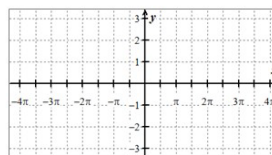


Phase Shift and Vertical Shift of Sine and Cosine

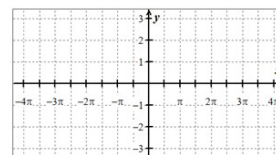
Phase Shift

A "phase shift" for a trigonometric function is a **horizontal transformation** of the graph's initial point.

EX #5A: Graph $y = \sin(x - \pi)$



EX #5B: Graph $y = \cos(x + \pi)$



In both examples, the phase shift is _____. In general, we can say that if $y = A \sin(Bx - C)$ or $y = A \cos(Bx - C)$, then the **phase shift is found by $\frac{C}{B}$** .

When the argument is $(Bx - C)$ then the phase shift is to the _____.

When the argument is $(Bx + C)$, then the phase shift is to the _____.

Vertical Shift (Midline)

If you add or subtract a number from the entire equation you can shift a trigonometric graph "up or down." This is a shift in the y -axis, which creates a new "midline" for the graph.

EX #6A: Graph $y = \sin x + 1$

EX #6B: Graph $y = \cos x - 2$

NOTES

$y = A \sin(Bx)$ or $y = A \cos(Bx)$, then the **period is found by $\frac{2\pi}{B}$** .

Compare and contrast what occurs to the period when $B > 1$ to when $0 < B < 1$.

Therefore, if $y = A \sin(Bx - C) + D$ or $y = A \cos(Bx - C) + D$ then, the vertical shift of the entire graph is equal to D . The midline of the graph is $y = D$.

4.6

Graphs of Sine and Cosine Homework

Name _____

Date _____ Period _____

Problems 1 – 4, Determine the amplitude and period of each function without graphing.

1. $y = 5 \sin(\pi x)$

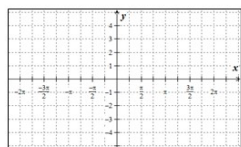
2. $y = -4 \cos\left(\frac{3}{2}x\right)$

3. $y = 2 \sin(3x - \pi) + 4$

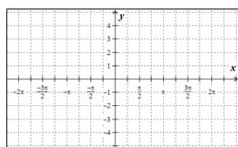
4. $y = 7 \cos(4x + \pi) - 3$

Problems 5 – 8, Use transformations to graph each equation from $(-2\pi, 2\pi)$

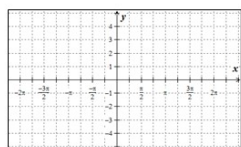
5. $y = 2 \sin x$



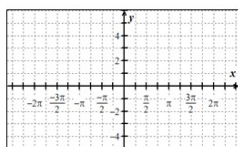
6. $y = -\sin\left(\frac{1}{2}x\right)$



7. $y = 2 \cos(x) - 1$



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

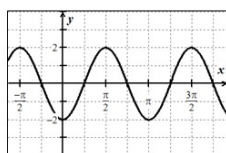


Problems 9-12, Graph each equation.

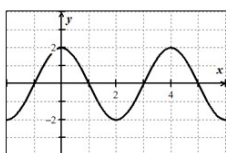
Equation	Characteristics	Graph
9. $y = \sin\left(x - \frac{\pi}{4}\right) + 1$	Amplitude: Period: Phase Shift: Midline:	
10. $y = -\cos\left[2\left(x - \frac{\pi}{2}\right)\right]$	Amplitude: Period: Phase Shift: Midline:	
11. $y = 2 \sin\frac{1}{2}(\theta - \pi) + 2$	Amplitude: Period: Phase Shift: Midline:	
12. $y = -3 \cos\frac{\pi}{3}(\theta + 1) - 2$	Amplitude: Period: Phase Shift: Midline:	

Problems 13-16, Match the given function to one of the graphs [A] – [D].

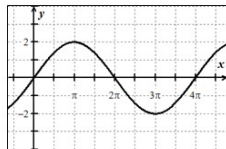
[A]



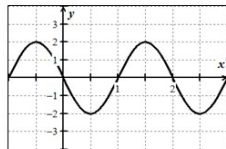
[B]



[C]



[D]



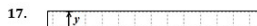
13. $y = 2 \cos\left(\frac{\pi}{2}x\right)$

14. $y = -2 \sin(\pi x)$

15. $y = -2 \cos(2x)$

16. $y = 2 \sin\left(\frac{1}{2}x\right)$

Problems 17-18, Find an equation for each graph.



Problems 19-20, Solve.

19. The voltage V produced by an ac (alternating current) generator is $V = 120 \sin(120\pi t)$

A. What is the amplitude?

B. What is the period?

C. Ohm's Law states $V = IR$, where R is the resistance and I is the current. If a resistance of $R = 5$ ohms is present, what is the current I ?D. What is the amplitude and period of the current I ?

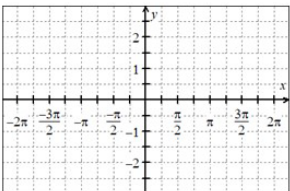
20. One day all 330 million people in the United States climb up on tables and jump off ($t = 0$). The shock as we hit the Earth's surface starts the entire Earth vibrating in such a way that its surface first moves down from its normal position, and then moves up an equal distance above its normal position. Assuming that the amplitude is 50 feet, the displacement (distance above and below the normal position) of the surface will be a sinusoidal function of time with a period of 54 minutes.

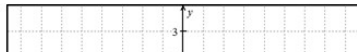
A. Sketch the graph showing displacement versus time.

B. Write an equation expressing displacement in terms of time elapsed since the people jumped.

Practice Sets

Lesson Warm-Ups

Name _____ Date _____ Period _____	
Lesson 4.6 - Graphs of Sine and Cosine Functions Warm-Up # I	
1. Find the period and amplitude. $y = \frac{1}{2} \sin\left(\frac{\pi}{6}x\right)$	2. Find the starting and ending values of one period of this graph. $y = \cos\left(x + \frac{\pi}{2}\right)$
3. Sketch the graph of $y = -2 \sin\left(\frac{1}{2}x\right)$. Label the 5 key points on the x-axis.	
	

Name _____ Date _____	Name _____ Date _____	Name _____ Date _____
Lesson 4.6 - Graphs of Sine and Cosine Functions		
1. Find the period and amplitude. $y = 2 \sin(2\pi x)$	2. Find the starting and ending values of one period of this graph. $y = \cos\left(x - \frac{\pi}{2}\right)$	1. Find the period and the amplitude. $y = \frac{1}{4} \sin(2\pi x)$ Amplitude: _____ Period: _____
3. Sketch the graph of $y = 2 \sin(2x)$. Label the 5 key points on the x-axis.		2. Find the starting and ending values of one period of this graph. $y = \cos\left(x + \frac{\pi}{4}\right)$
		

Daily Lesson Quiz

Grade: _____

Grade: _____