## Section 5.1



Graph of  $y = \sin\theta$  for  $-2\pi \le \theta \le 2\pi$ 

Graph of  $y = \cos \theta$  for  $-2\pi \le \theta \le 2\pi$ .





## Graph of $y = \tan \theta$ for $-2\pi \le x \le 2\pi$ .



				1.0				
$-2\pi$	-3π/2	_π	-π/2		π/2	π	3π/2	2π
				-1.0				

Basic Transformations of  $y = \sin \theta$  and  $y = \cos \theta$  still hold true for angles measured in radians.

Amplitude  $\Rightarrow y = a \sin \theta$  and  $y = a \cos \theta$ 

- "a" is the amplitude of the function.
- When "a" is negative, a reflection exists over the x-axis.
- a = (maximum minimum) / 2

Vertical Displacement  $\Rightarrow y = \sin \theta + c$  and  $y = \cos \theta + c$ 

- The function moves up or down along the y-axis by "c" units.
- c = (maximum + minimum) / 2

Phase Shift  $\Rightarrow y = \sin(\theta - d)$  and  $y = \cos(\theta - d)$ 

• The function moves left or right along the  $\theta$ -axis by "d" units.

Period Change  $\Rightarrow y = \sin k\theta$  and  $y = \cos k\theta$ 

- The function has a new period given by  $p = 2\pi / k$ .
- So  $k = 2\pi / p$

Example: Transform the graph of  $y = \sin x$  to obtain  $y = \sin x - 2$ , over two cycles.



Amplitude:	Period:	Phase Shift:
Domain:	Range:	Vert.Displacement:

Example: Transform the graph of  $y = \cos x$  to obtain  $y = -3\cos x$ , over two cycles.

 			5.0					
 			4.0					
			3.0-					
 			2.0	-				
			1.0	_				
 2π -3	π/2 –	π —π	:/2	π	(2 1	τ 3π	./2 2	π
 2π -3	π/2 –	π	-1.0	π	/2 :	τ 3π	:/2 2	π
 2π -3	π/2 –	π —π	-1.0	π	/2 :	τ 3π	./2 2	π
 2π -3	π/2 -	π — π	-1.0 -2.0	π	/2 :	т Зл	/2 2	π
 2π -3	π/2 –	π	-1.0 -2.0 -3.0	π	/2 :	с Зл	/2 2	π
2π -3	π/2 -	π	-1.0 -2.0 -3.0 -4.0	π	(2 :	t Зл	/2 2	π
2π -3	π/2 –	π	-1.0 -2.0 -3.0 -4.0	π	(2 :	t 3π	/2 2	π
2π -3	π/2 -	π	-/2 -1.0 -2.0 -3.0 -4.0 -5.0	π	/2 :	t Зл	/2 2	π

Amplitude:	Period:	Phase Shift:
Domain:	Range:	Vert.Displacement:

Example: Transform the graph of  $y = \sin x$  to obtain  $y = \sin \left(x - \frac{\pi}{3}\right)$ , over two cycles.

				5.0					
				5.0					
				4.0	-				
				3.0					
				2.0					
				1.0					
$-2\pi$	π — 3	π/2. —	π –π	:/2.	π	12. 1	π 3π	/2. 2	π
2π	π –3	π/2 —	π —π	-1.0	π	/2 1	π 3π	./2 2	π
2π	π —3	π/2 —	π —π	-1.0	π	/2 :	π 3π	/2 2	π
2π	π —3:	π/2 –	π	-1.0 -2.0	π	/2 :	π 3π	¢/2 2	π
	π —3:	π/2 –	π	-1.0 -2.0 -3.0	π	/2 :	π 3π		π
	π —3:	π/2 -	π	-1.0 -2.0 -3.0 -4.0	π		π 3π	/2 2	π
	π —3:	π/2 -	π		π		π 3π	/2 2	π

Amplitude:

Period:

Phase Shift:

Domain:Range:Vert.Displacement:Example: Transform the graph of  $y = \cos x$  to obtain  $y = \cos 2x$ , over two cycles.

				5.0					
				4.0					
				3.0-	_				L
				2.0					
				2.0-					
				1.0					
		10		10		1.0		10	
-2	2π -3	π/2 —	π —π	:/2	π.	(2 :	т 3л	/2 2	π
-2	2π —3:	π/2 —	π —π	-1.0	π.	/2 :	τ 3π	./2 2	π
2	2π -3	π/2 —	π —π	-1.0	π.	/2 :	τ 3π	:/2 2	π
	2π -3	π/2 —	π —π	-1.0	π	/2 :	τ 3π	2/2 2	π
	2π —3:	π/2 -	π —π	-2.0	π.	(2 :	τ 3π	2/2 2	π
	2π —3:	π/2	π —π	-1.0 -2.0	π.	/2 :	τ 3π	./2 2	π
	2π —3	π/2 -	π — π	-1.0 -2.0 -3.0	π	/2 :	τ 3π	/2 2	π
	2π —3	π/2 –	π — π	-1.0 -1.0 -2.0 -3.0	π.	/2 :	t 3 <i>n</i>	/2 2	π
	2π —3	π/2 -	π — π	-1.0 -2.0 -3.0 -4.0	π.	2 :	τ 3π	/2 2	π
	2π —3	π/2 -	π — π	-/2 -1.0 -2.0 -3.0 -4.0	π.	2	τ 3π	/2 2	π
	2π —3	π/2 -	π — π	/2 -1.0 -2.0 -3.0 -4.0 -5.0	π.	2 :	τ 3π	/2 2	π
	2π —3:	π/2 -	π — π	/2 -1.0 -2.0 -3.0 -4.0 -5.0	π.		τ 3π	/2 2	π
	2π —3	π/2 –	π — π	-/2 -1.0 -2.0 -3.0 -4.0 -5.0	π.	2 .	t 3 <i>n</i>	/2 2	π

Amplitude:	Period:	Phase Shift:
Domain:	Range:	Vert.Displacement:

Example: A cosine function has a period of  $6\pi$ , a maximum value of 5, and a minimum value of -9. Assuming there is no phase shift, determine an equation representing this cosine function in the form y = acos(kx) + c. Example: One cycle of a sine function begins at  $x = -\pi/4$  and ends at  $x = 5\pi/4$ .

- a) Determine the period of the function.
- b) Determine the phase shift of the function.
- c) Write the equation of the function in the form y = sin[k(x d)]