

# GRAPH OF TRIGONOMETRIC FUNCTIONS

## TRIGONOMETRIC FUNCTION OF ANGLES

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## TOPIC OUTLINE

Graph of Trigonometric Functions

Amplitude and Period of Sine Function



# GRAPH OF TRIGONOMETRIC FUNCTIONS



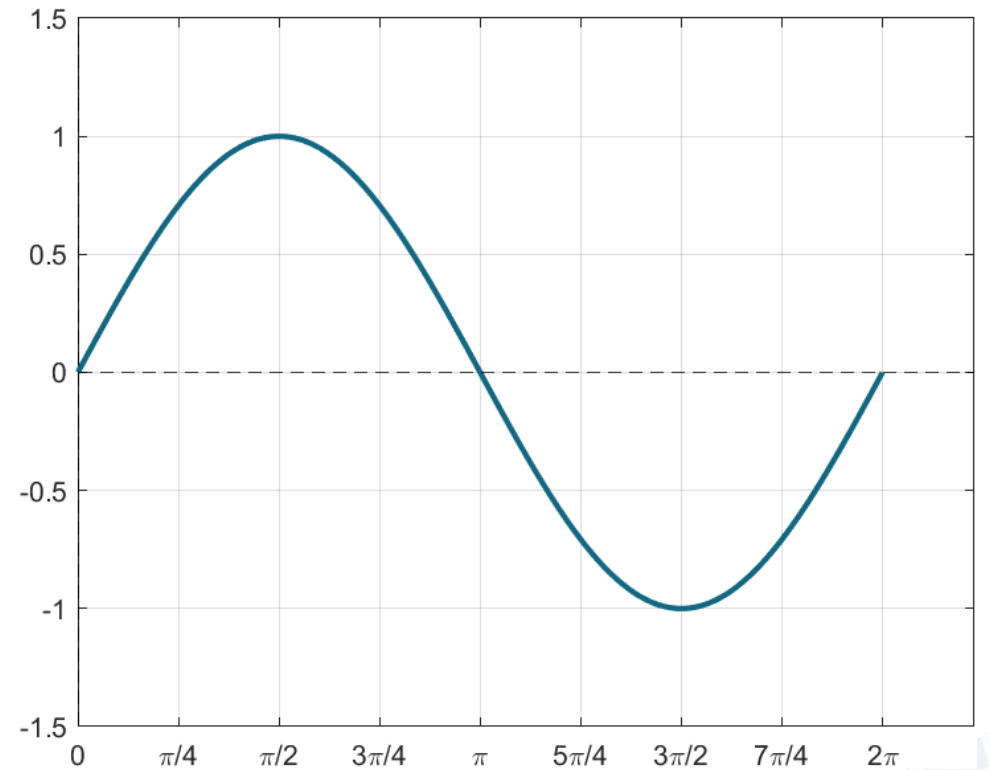
# SINE FUNCTION

$$f(x) = \sin x$$

$x$	$f(x)$
0	
$\pi/6$	
$\pi/4$	
$\pi/3$	
$\pi/2$	
$2\pi/3$	
$3\pi/4$	
$5\pi/6$	
$\pi$	

$x$	$f(x)$
$7\pi/6$	
$5\pi/4$	
$4\pi/3$	
$3\pi/2$	
$5\pi/3$	
$7\pi/4$	
$11\pi/6$	
$2\pi$	

Graph of  $\sin x$



Domain: All real numbers  $(-\infty, \infty)$

Range:  $[-1, 1]$

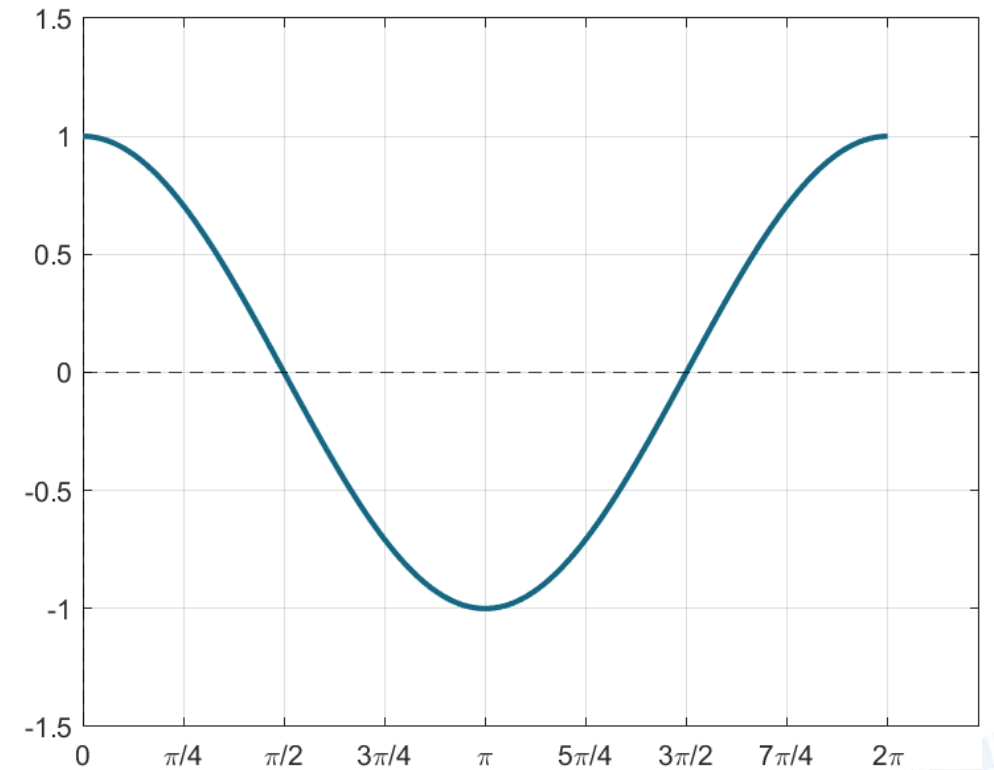
# COSINE FUNCTION

$$f(x) = \cos x$$

$x$	$f(x)$
0	
$\pi/6$	
$\pi/4$	
$\pi/3$	
$\pi/2$	
$2\pi/3$	
$3\pi/4$	
$5\pi/6$	
$\pi$	

$x$	$f(x)$
$7\pi/6$	
$5\pi/4$	
$4\pi/3$	
<b><math>3\pi/2</math></b>	
$5\pi/3$	
$7\pi/4$	
$11\pi/6$	
<b><math>2\pi</math></b>	

Graph of  $\cos x$



Domain: All real numbers  $(-\infty, \infty)$

Range:  $[-1, 1]$

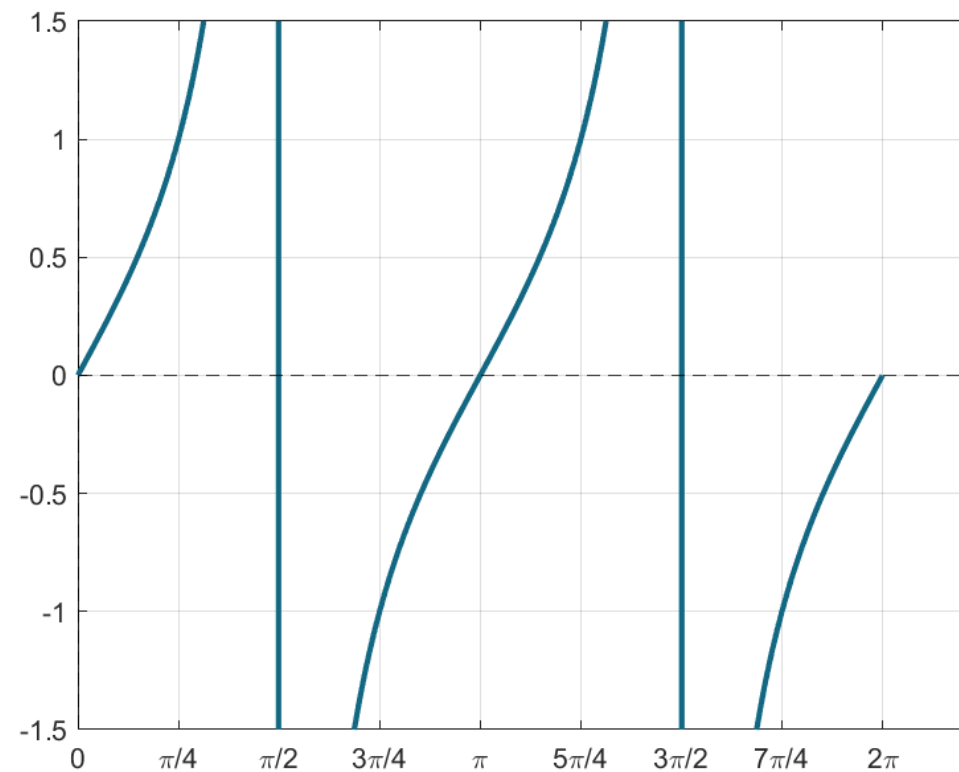
# TANGENT FUNCTION

$$f(x) = \tan x$$

$x$	$f(x)$
0	
$\pi/6$	
$\pi/4$	
$\pi/3$	
$\pi/2$	
$2\pi/3$	
$3\pi/4$	
$5\pi/6$	
$\pi$	

$x$	$f(x)$
$7\pi/6$	
$5\pi/4$	
$4\pi/3$	
<b><math>3\pi/2</math></b>	
$5\pi/3$	
$7\pi/4$	
$11\pi/6$	
<b><math>2\pi</math></b>	

Graph of  $\tan x$



Domain: All real numbers except odd multiples of  $\pi/2$

Range:  $[-\infty, \infty]$

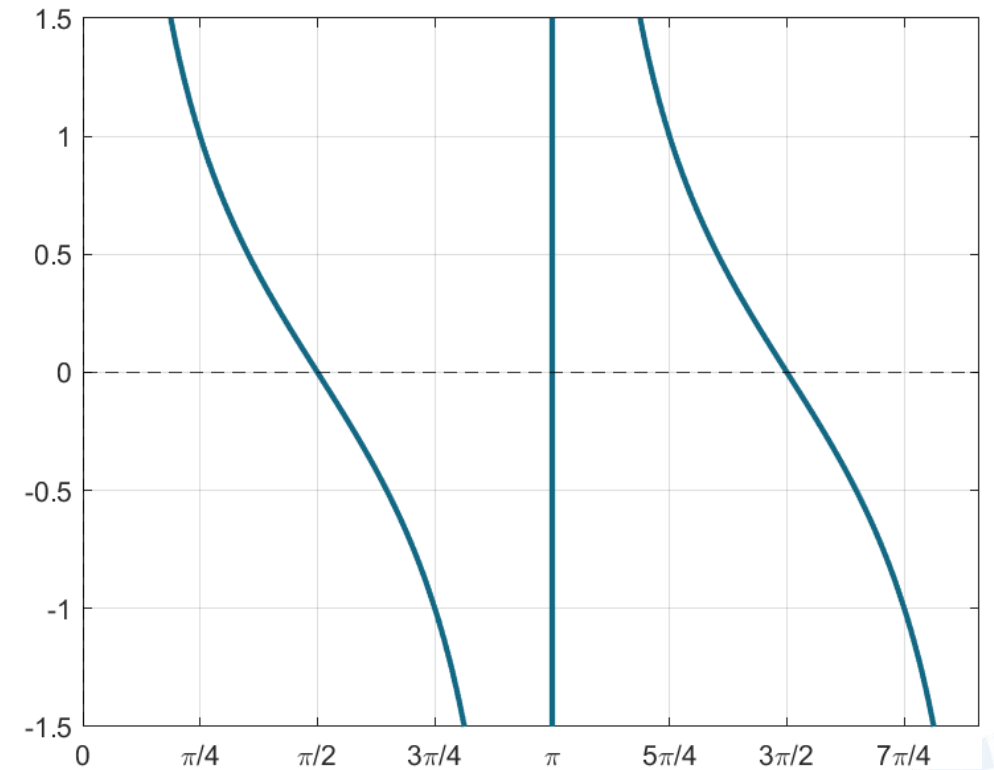
# COTANGENT FUNCTION

$$f(x) = \cot x$$

$x$	$f(x)$
0	
$\pi/6$	
$\pi/4$	
$\pi/3$	
$\pi/2$	
$2\pi/3$	
$3\pi/4$	
$5\pi/6$	
$\pi$	

$x$	$f(x)$
$7\pi/6$	
$5\pi/4$	
$4\pi/3$	
<b><math>3\pi/2</math></b>	
$5\pi/3$	
$7\pi/4$	
$11\pi/6$	
<b><math>2\pi</math></b>	

Graph of  $\cot x$



Domain: All real numbers except integer multiples of  $\pi$

Range:  $[-\infty, \infty]$

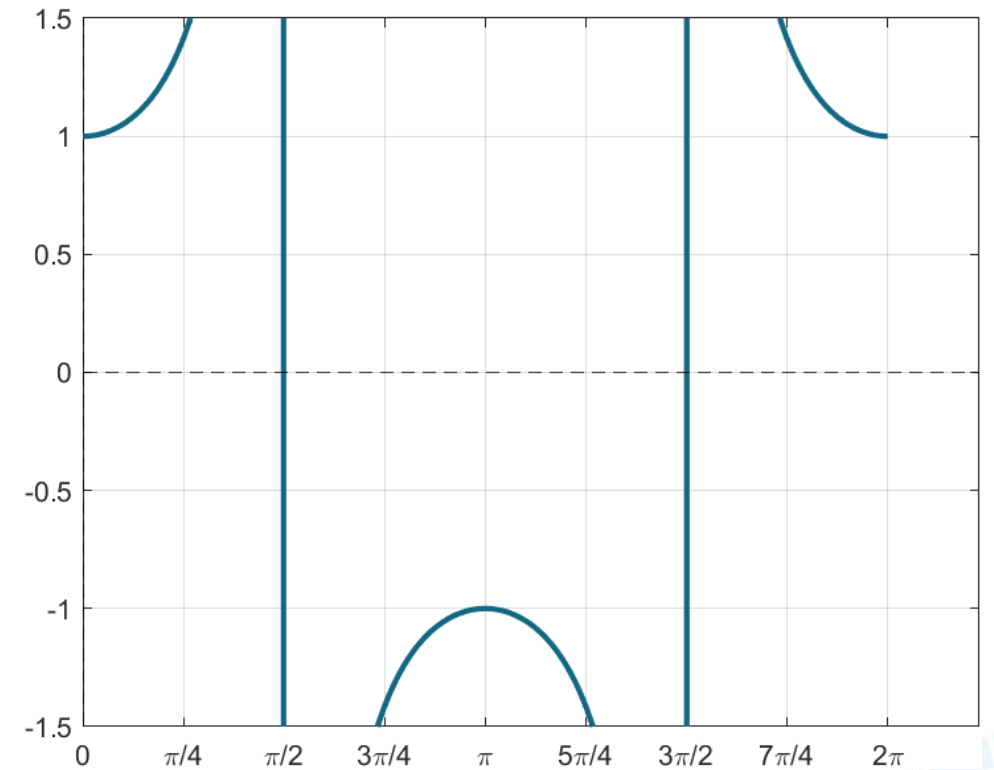
# SECANT FUNCTION

$$f(x) = \sec x$$

$x$	$f(x)$
0	
$\pi/6$	
$\pi/4$	
$\pi/3$	
$\pi/2$	
$2\pi/3$	
$3\pi/4$	
$5\pi/6$	
$\pi$	

$x$	$f(x)$
$7\pi/6$	
$5\pi/4$	
$4\pi/3$	
<b><math>3\pi/2</math></b>	
$5\pi/3$	
$7\pi/4$	
$11\pi/6$	
<b><math>2\pi</math></b>	

Graph of  $\sec x$



Domain: All real numbers except odd multiples of  $\pi/2$

Range:  $(-\infty, -1] \cup [1, \infty)$



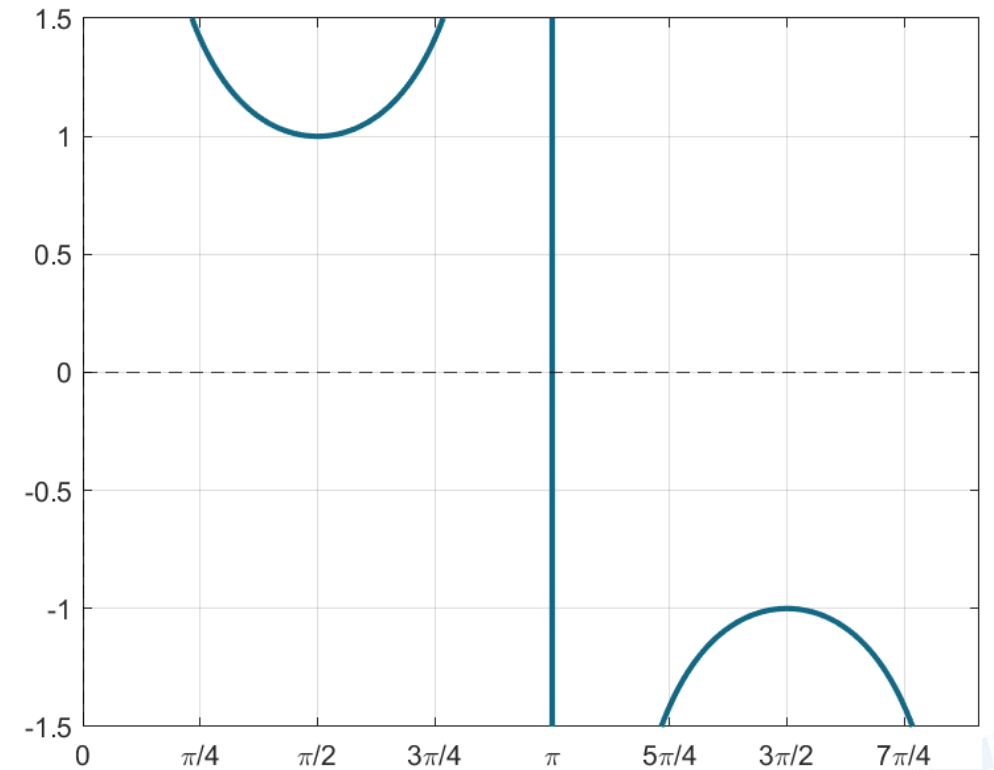
# COSECANT FUNCTION

$$f(x) = \csc x$$

$x$	$f(x)$
0	
$\pi/6$	
$\pi/4$	
$\pi/3$	
$\pi/2$	
$2\pi/3$	
$3\pi/4$	
$5\pi/6$	
$\pi$	

$x$	$f(x)$
$7\pi/6$	
$5\pi/4$	
$4\pi/3$	
<b><math>3\pi/2</math></b>	
$5\pi/3$	
$7\pi/4$	
$11\pi/6$	
<b><math>2\pi</math></b>	

Graph of  $\csc x$



Domain: All real numbers except odd multiples of  $\pi$

Range:  $(-\infty, -1] \cup [1, \infty)$

# AMPLITUDE AND PERIOD OF SINE FUNCTION



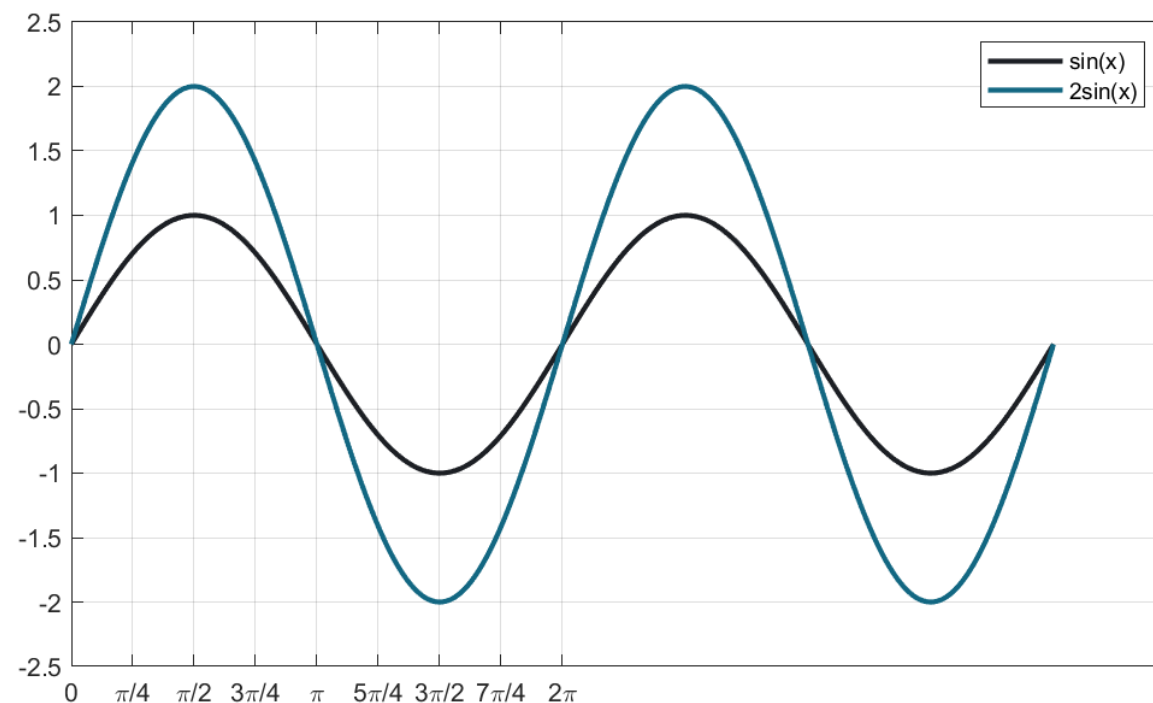
# AMPLITUDE

$$f(x) = a \sin x$$

Let the amplitude  $a = 2$

$x$	$\sin x$	$2 \sin x$
0		
$\pi/4$		
$\pi/2$		
$3\pi/4$		
$\pi$		
$5\pi/4$		
$3\pi/2$		
$7\pi/4$		
$2\pi$		

Graph of  $2 \sin x$



What would be the graph of  $3 \sin x$ ?



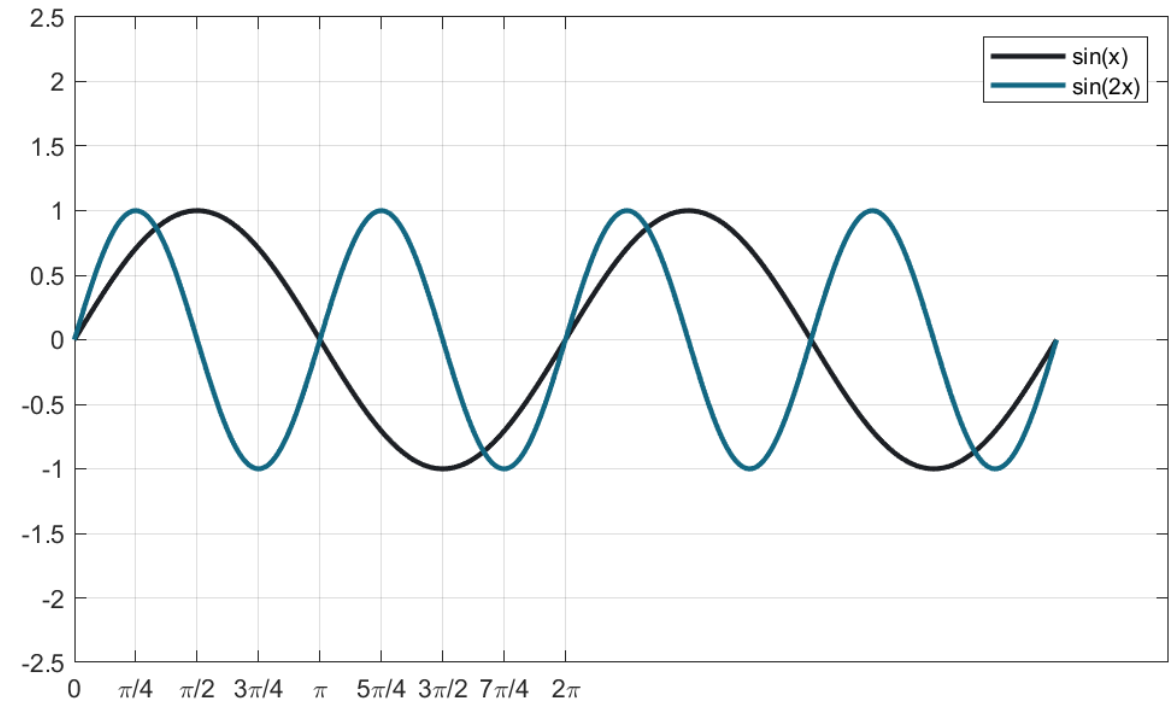
# PERIOD

$$f(x) = \sin bx$$

Let  $b = 2$

$x$	$\sin x$	$\sin 2x$
0		
$\pi/4$		
$\pi/2$		
$3\pi/4$		
$\pi$		
$5\pi/4$		
$3\pi/2$		
$7\pi/4$		
$2\pi$		

Graph of  $\sin 2x$



$$\text{period} = \frac{2\pi}{b}$$



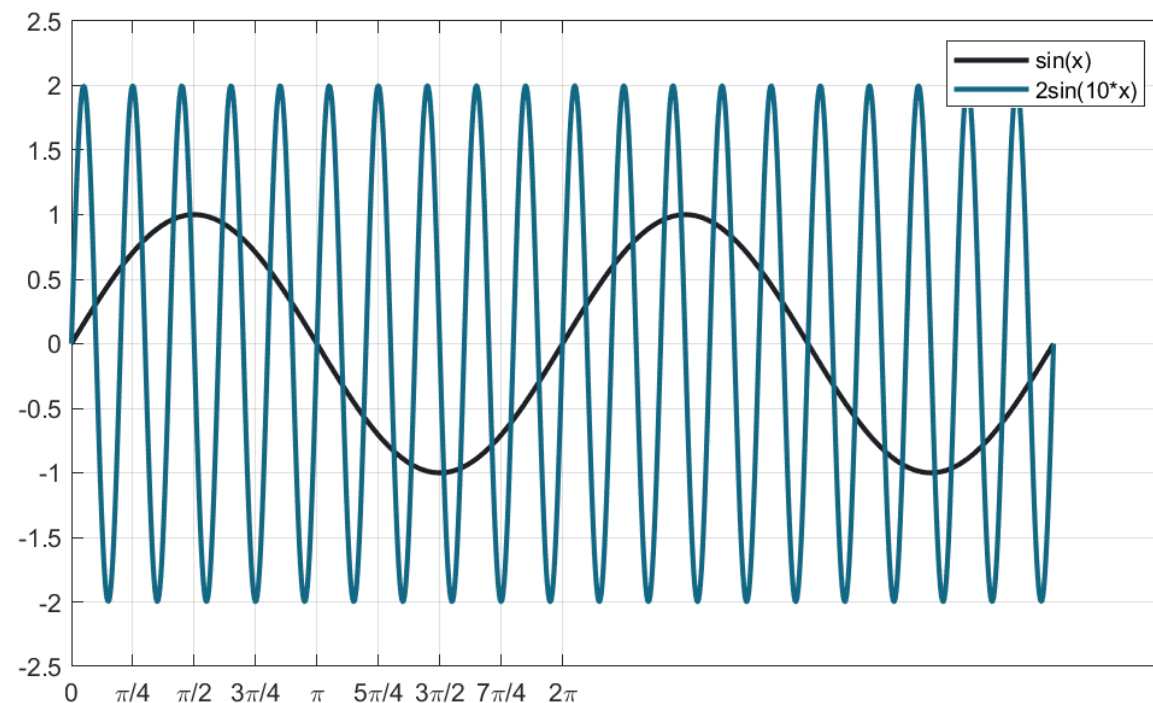
# AMPLITUDE AND PERIOD

$$f(x) = a \sin bx$$

Let  $a = 2$ ,  $b = 10$

$x$	$\sin x$	$2 \sin 10x$
0		
$\pi/4$		
$\pi/2$		
$3\pi/4$		
$\pi$		
$5\pi/4$		
$3\pi/2$		
$7\pi/4$		
$2\pi$		

Graph of  $\sin 10x$



$$\text{period} = \frac{2\pi}{b}$$



## EXERCISE

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The average temperature (in °F) at Mould Bay, Canada, can be approximated by the function

$$f(x) = 34 \sin \left[ \frac{\pi}{6} (x - 4.3) \right]$$

where  $x$  is the month and  $x = 1$  corresponds to January,  $x = 2$  to February, and so on.

Using this model:

- What is the maximum temperature predicted?
- What is the period of the temperature cycle?
- What is the average temperature in May?

Solution



## EXERCISE

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The light from the moon, in lux, on the night of the day  $t^{th}$  of 2016, is

$$L(t) = 0.25 - \sin\left(\frac{2\pi(t - 2)}{28.5}\right)$$

What is the period of the light from the moon?

Solution



## EXERCISE

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The solar constant  $S$  is the amount of energy per unit area that reaches Earth's atmosphere from the sun. It is equal to 1367 watts per  $m^2$  but varies slightly throughout the seasons. This fluctuation  $\Delta S$  in  $S$  can be calculated using the formula

$$\Delta S = 0.034S \sin \left[ \frac{2\pi(82.5 - N)}{365.25} \right]$$

In this formula,  $N$  is the day number covering a four-year period, where  $N = 1$  corresponds to January 1 of a leap year and  $N = 1461$  corresponds to December 31 of the fourth year.

- Calculate  $\Delta S$  for  $N = 80$ , which is the spring equinox in the first year.
- Calculate  $\Delta S$  for  $N = 1268$ , which is the summer solstice in the fourth year.
- What is the maximum value of  $\Delta S$ ?
- Find a value for  $N$  where  $\Delta S$  is equal to 0.





# SEATWORK

