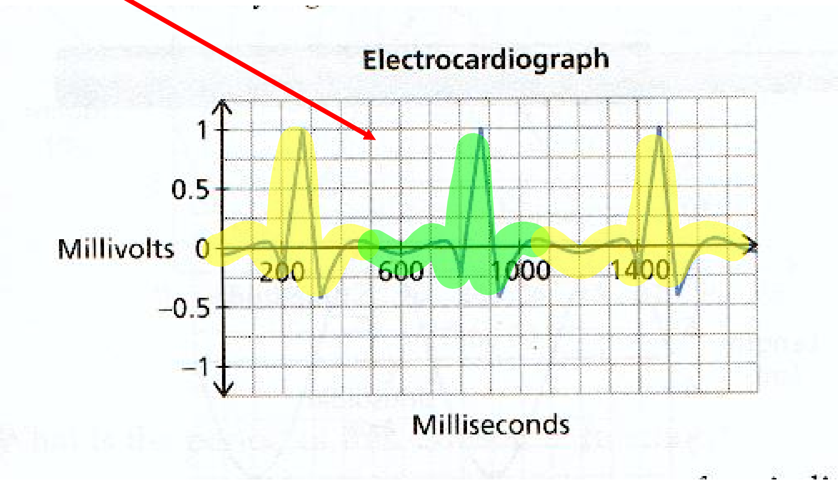
Sinusoidal Relations

Periodic Function: A function for which the dependent variable takes on the same set of values over and over again as the independent variable changes.

(A function that repeats)

Example of periodic behavior

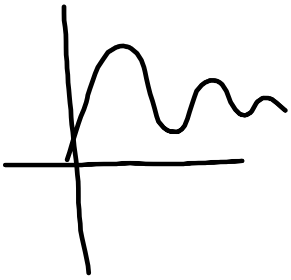


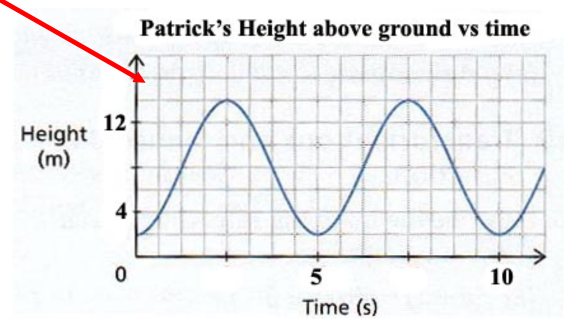
Sinusoidal Function: A periodic function that looks like waves, where any portion of the curve can be translated onto another portion of the curve.

(Repeats and looks like waves)

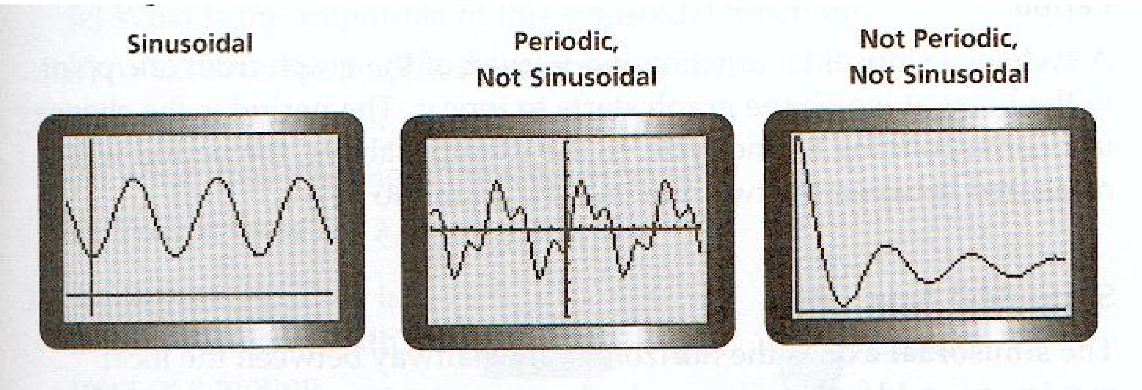
Example of sinusoidal behavior

Neither





These illustrations should summarize periodic and sinusoidal...

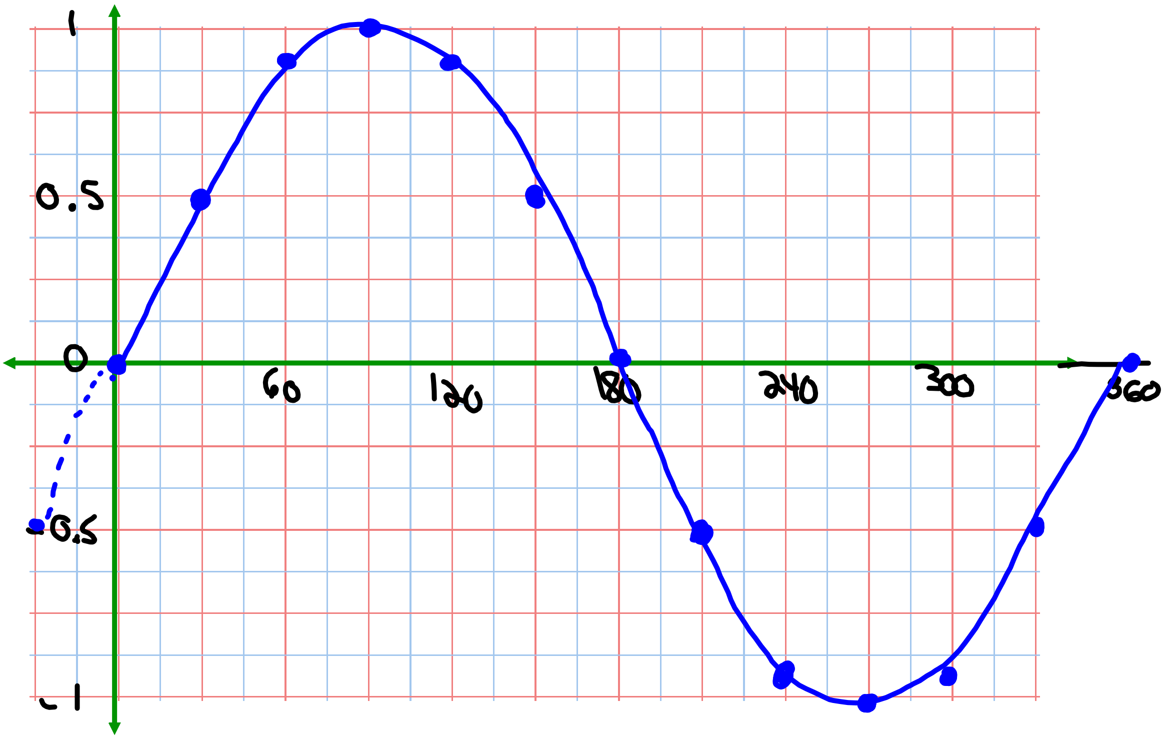


Let's examine the graph of $y = \sin\theta$

$y = \sin x$

θ	$0°$	$30°$	$60°$	$90°$	$120°$	$150°$	$180°$	$210°$	$240°$	$270°$	$300°$	$330°$	$360°$
y	0	0.5	0.9	1	0.9	0.5	0	-0.5	-0.9	-1	-0.9	-0.5	0

Now plot the above points...

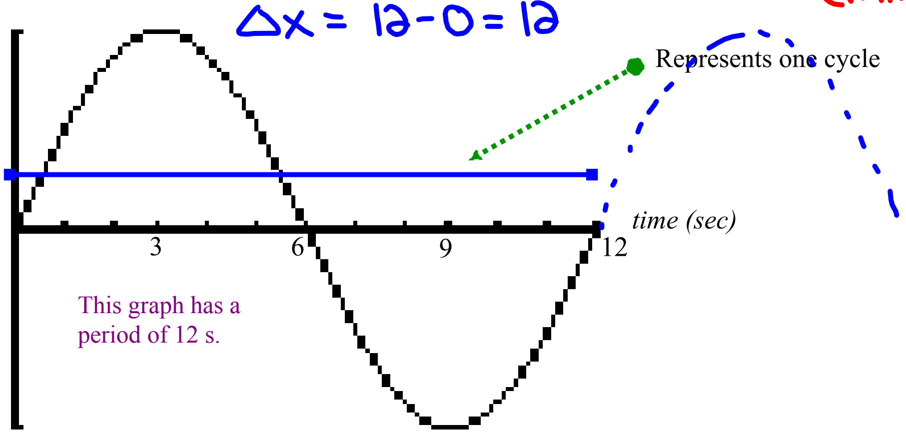


Vocabulary of Sinusoidal Functions

I. Period:

The change in x corresponding to one cycle. (max → max) (min → min)

$\Delta x = 12 - 0 = 12$



This graph has a period of 12 s.

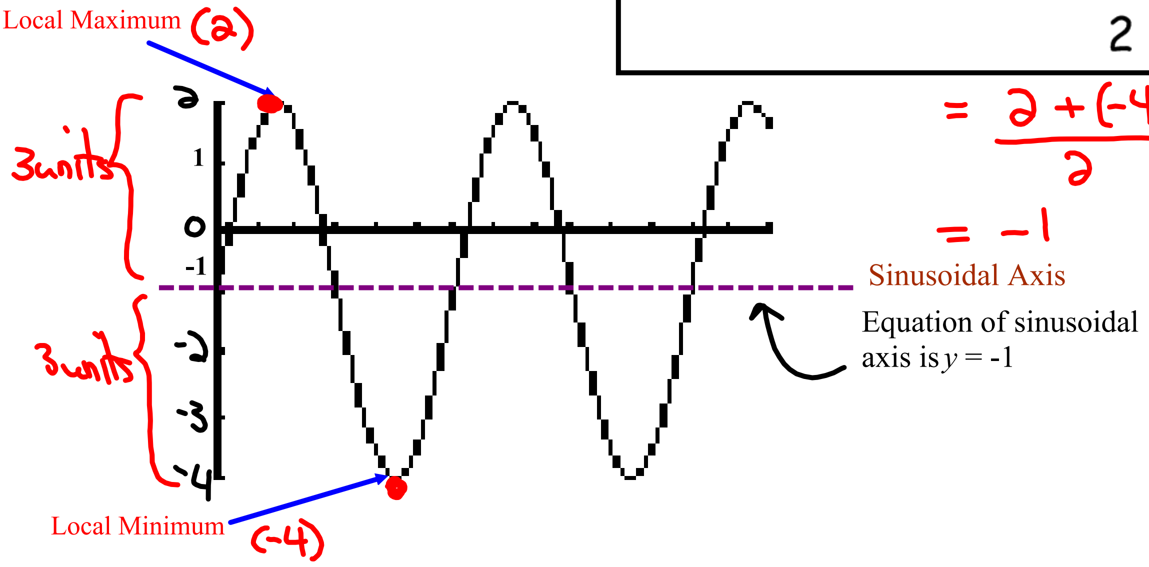
II. Sinusoidal Axis:

y = The horizontal line halfway between the local maximum and local minimum.
(highest point) (lowest)

$$\boxed{\text{Sinusoidal Axis} = \frac{\text{Max} + \text{Min}}{2}}$$

$$= \frac{2 + (-4)}{2}$$

$$= -1$$



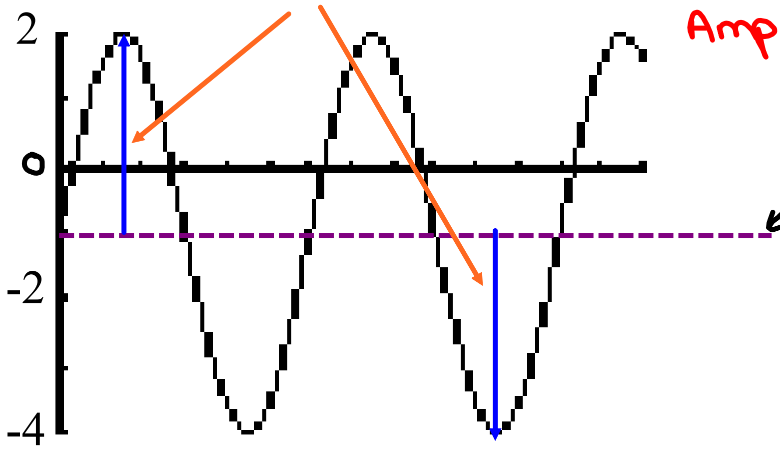
Equation of sinusoidal axis is $y = -1$

III. Amplitude:

The vertical distance from the sinusoidal axis to a local maximum or local minimum. (Amplitude is always (+))

$y = -2\sin[3(x+30°)]-1$

Amp = 2

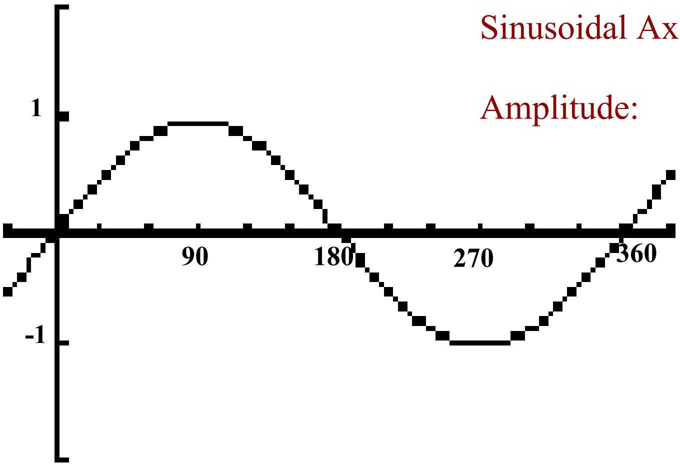


Amplitude would equal 3

sinusoidal axis: $\boxed{y = -1}$

Summarize...

Here is the graph of $y = \sin\theta$



Period :

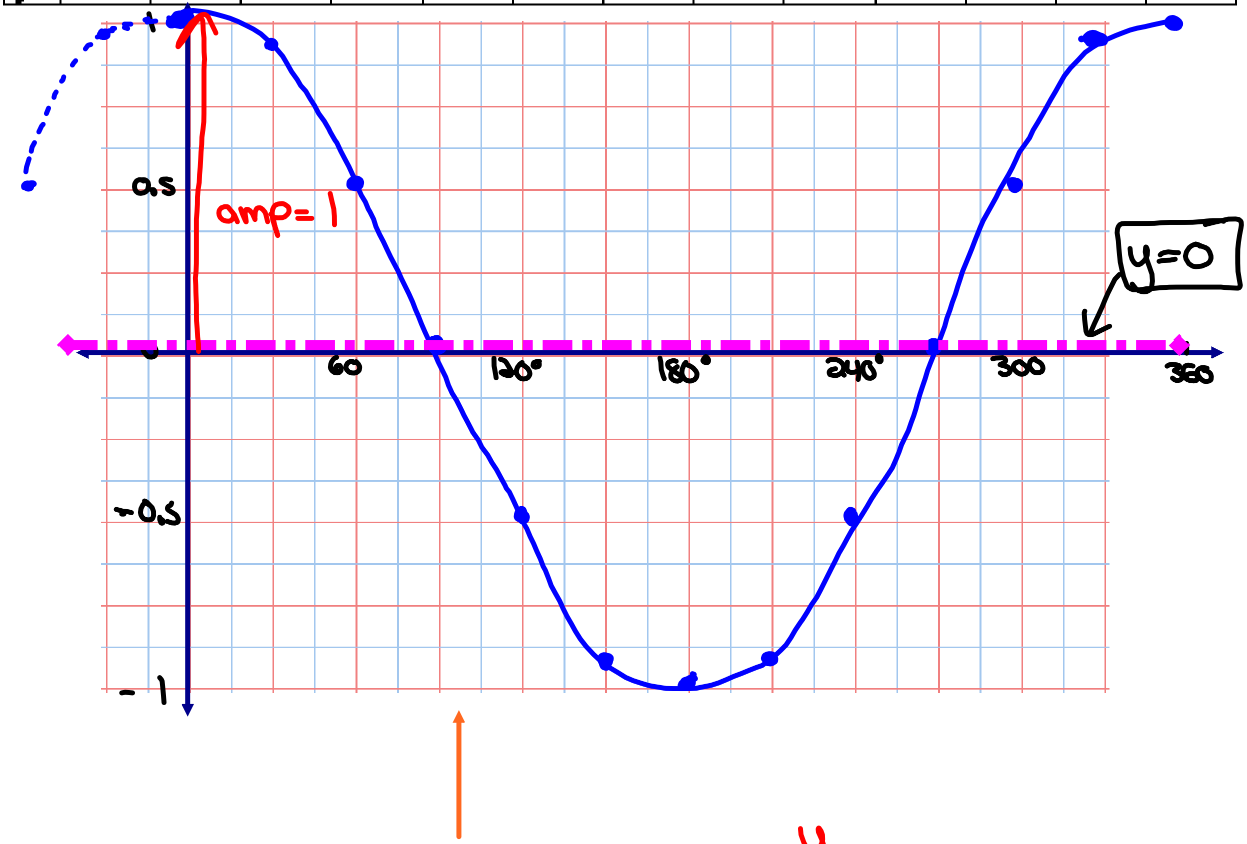
Sinusoidal Axis:

Amplitude:

What about $y = \cos\theta$?

Complete the table of values and sketch below

θ	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
y	1	0.9	0.5	0	-0.5	-0.9	-1	-0.9	-0.5	0	0.5	0.9	1



Is this a sinusoidal function? Yes

What about the period, sinusoidal axis, and amplitude?

$P = 360°$

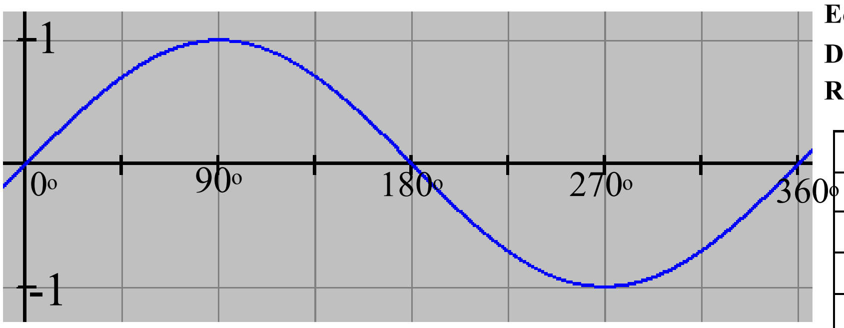
$$\text{sin axis} = \frac{1+(-1)}{2} = \frac{0}{2} = 0$$

$$\boxed{y=0}$$

$\text{Amp} = 1$

Basic Trig Graphs

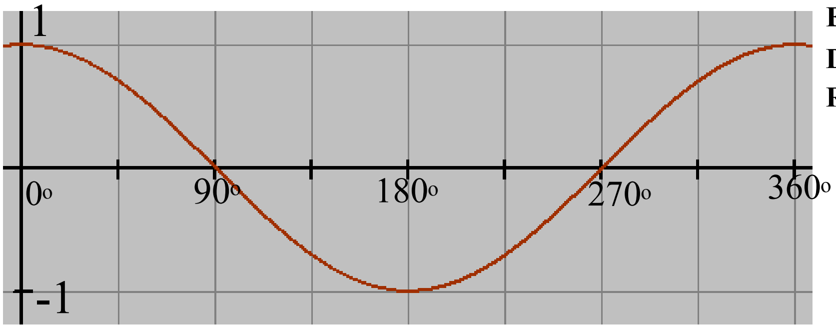
$y = \sin \theta$



Period = 360°
Amplitude = 1
Eq'n of Sinusoidal Axis: y = 0
Domain: $\{\theta \in R\}$
Range: $\{-1 \leq y \leq 1\}$

θ	y
0°	0
90°	1
180°	0
270°	–1
360°	0

$y = \cos \theta$



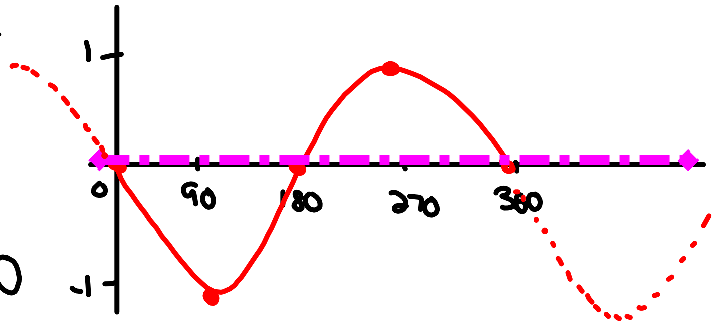
Period = 360°
Amplitude = 1
Eq'n of Sinusoidal Axis: y = 0
Domain: $\{\theta \in R\}$
Range: $\{-1 \leq y \leq 1\}$

θ	y
0°	1
90°	0
180°	–1
270°	0
360°	1

Homework

$y = -\sin\theta$ (Reflected in x-axis)

θ	y
0°	0
90°	-1
180°	0
270°	1
360°	0

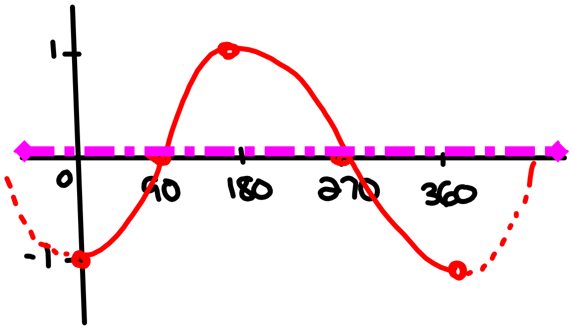


'Period': 360°
Amp: 1
equation of sin axis: $y=0$

D: $\{\theta \mid \theta \in R\}$
R: $\{y \mid -1 \leq y \leq 1, y \in R\}$

$y = -\cos\theta$

θ	y
0°	-1
90°	0
180°	1
270°	0
360°	-1



'Period': 360°
Amp: 1
equation of sin axis: $y=0$

D: $\{\theta \mid \theta \in R\}$
R: $\{y \mid -1 \leq y \leq 1, y \in R\}$

Transformations of the Sinusoidal Function

Recall... $y=-2(x-3)^2+4$ (Quadratic)

reflection in the x-axis (vertical)

vertical stretch by a factor of 2

$a=-2$

horizontal translation

$h=3$

(right 3)

vertical translation

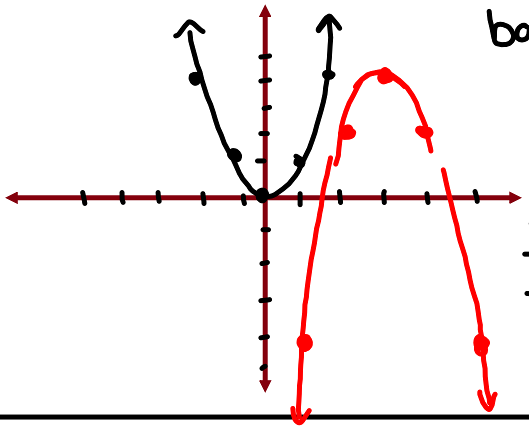
$k=4$

(up 4)

(h,k)

Vertex ⇒ (3,4)

Sketch ⇒



base : $y=x^2$

$y=-2(x-3)^2+4$

x	y
-2	4
-1	1
0	0
1	1
2	4

x	y
1	-4
2	2
3	4
4	2
5	-4

Now, let's look at a sinusoidal function...

$$y=-2\sin[3(\theta-60^\circ)]-1$$

Reflection

Amplitude (v. stretch)

$a=-2$

amp = 2

Horizontal Stretch

$b=3$

Phase Shift (h. translation)

$h=60°$

Vertical Translation

$k=-1$

Equations in Standard Form

$$y = a\sin[b(x-c)]+d \quad \text{or} \quad y = a\cos[b(x-h)]+k$$

a = ***Amplitude*** → influences how tall the sine curve is.(always positive)

$b = \frac{360°}{P}$ → influences how often the pattern repeats. $\left(P = \frac{360°}{b}\right)$

Period

c = ***Horizontal Translation*** → Influences how far to the left or the right that the graph will shift. (Phase Shift)

- If C is positive → Shift Left
- If C is negative → Shift Right

} Inside Brackets

d = ***Vertical Translation*** → influences how far up and down the graph will shift.

- If d is positive → Shift Up
- If d is negative → Shift Down
- equal to the sinusoidal axis:
  ↳ equation of sinusoidal axis: $y=d$

Example:

$$2y\boxed{+5} = -6\sin\left(\tfrac{1}{3}x-30°\right)-3$$ (Subtract 5 from both sides)

$$\frac{2y}{2} = \frac{-6}{2}\sin\left(\tfrac{1}{3}x-30°\right)-\frac{8}{2}$$ (Divide by 2)

$$y = -3\sin\left(\tfrac{1}{3}x-30°\right)-4$$ (Factor out a $\frac{1}{3}$)

$$y = \underline{\underline{-3}}\sin\left[\boxed{\tfrac{1}{3}}\left(x-\underline{\underline{90°}}\right)\right]\underline{\underline{-4}}$$

$a = -3$ $b = \frac{1}{3}$ $h = 90°$ $K = -4$

$\text{Amp} = 3$ $P = \frac{360°}{1/3} = 1080°$ equation of sinusoidal axis: $y = -4$

Homework

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ex: $2y-5\overset{+5}{} = -4\cos[3x-90°]-7\overset{+5}{}$

$$\frac{2y}{2} = \frac{-4}{2}\cos[3x-90°] - \frac{2}{2}$$

$$y = -2\cos[3x-90°]-1$$

$$y = \underline{\underline{-2}}\cos[\underline{\underline{3}}(x-\underline{\underline{30°}})]\underline{\underline{-1}}$$

a = -2 (Amp = 2) Vertically stretched by a factor of 2 and reflected in x-axis

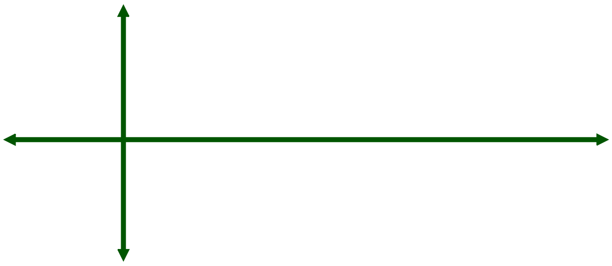
b = 3 horizontally stretched by a factor of $\frac{1}{3}$

h = 30° translated 30° right

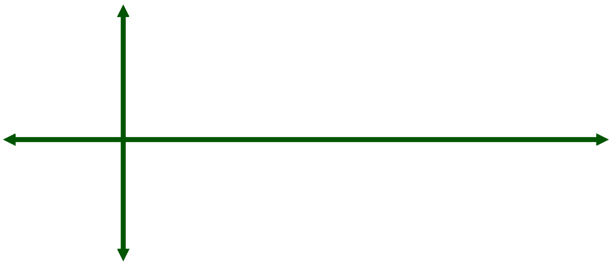
K = -1 " 1 unit down

EXAMPLES: Sketch each of the following...

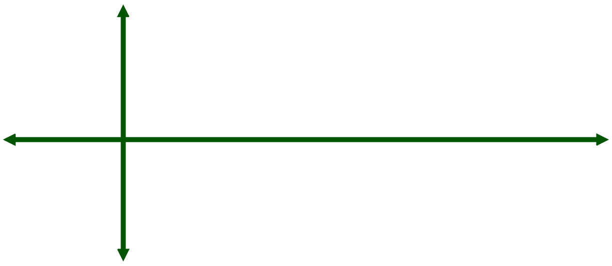
a) $y = 2\sin\theta$



b) $y = \sin 2\theta$



c) $y = -2\cos\theta$



Sketching Sinusoidal Functions using Transformations

Development of a standard form for sinusoidal functions...

Standard Form ⟶ $f(\theta) = a\sin k(\theta - c) + d$

1. Reflection: If a < 0 the graph will be reflected in the *x*-axis.
2. Amplitude: The amplitude of the graph will be equal to | a | .
3. Period: The period of the graph will be equal to $\frac{360^\circ}{k}$
4. Horizontal Phase Shift: The graph will shift "c" units to the right. (Think Opposite)
5. Vertical Translation: The graph will shift "d" units up.

Mapping Notation: $(x, y) \rightarrow \left(\frac{1}{k}\theta + c, ay + d\right)$

Transformations of Sinusoidal Functions

Example: $f(\theta) = -2\sin 3(\theta + 30^\circ) - 2$

Domain	
Range	
Reflection	
Amplitude	
Horizontal Phase Shift	
Vertical Translation	
Period	

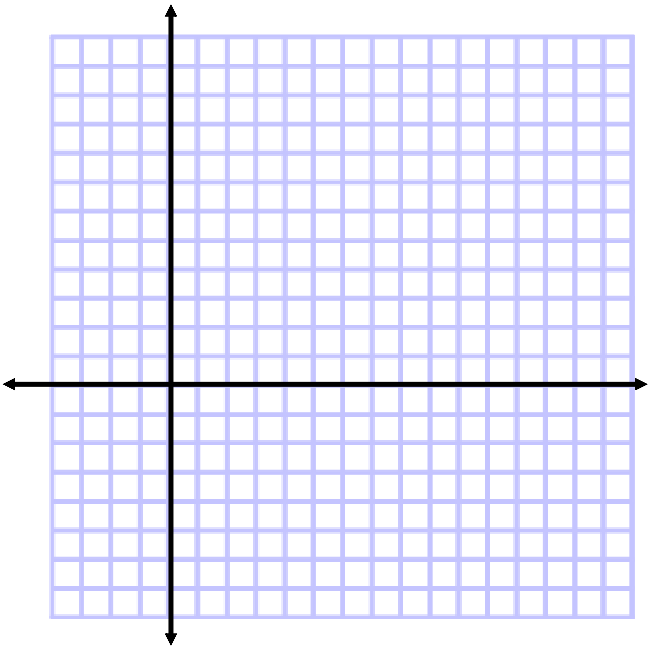
EXAMPLE #1

Now let's sketch a graph of $f(\theta) = -2\sin 3(\theta + 30°) - 2$

" THINK: RST "

Sketching using transformations:

- *Apply the reflections and stretches first*
- *Apply phase shift and vertical translation second*



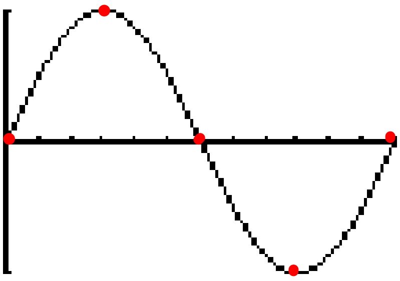
DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

Check our graph using a graphing calculator

This time we will graph the same function using a mapping:

$$f(\theta) = -2\sin 3(\theta + 30^\circ) - 2$$

$y = \sin\theta$

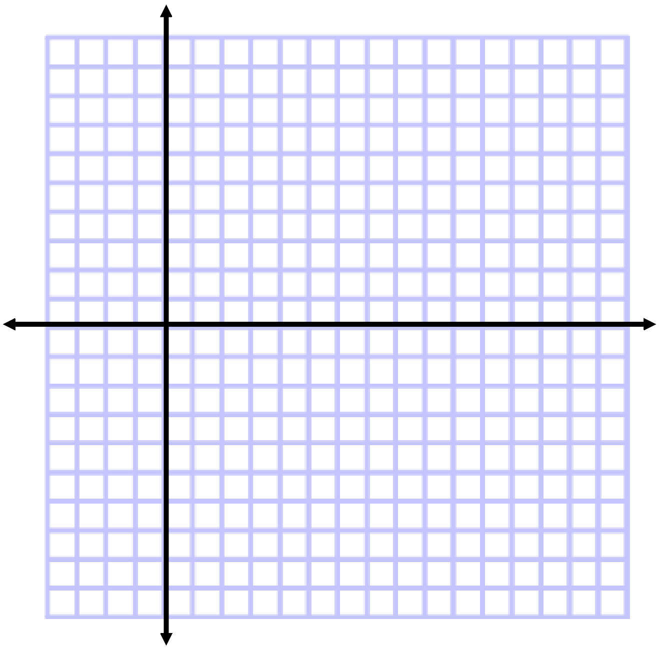


Mapping:

ϑ	y
0	
90	
180	
270	
360	

New points after mapping →

ϑ	y



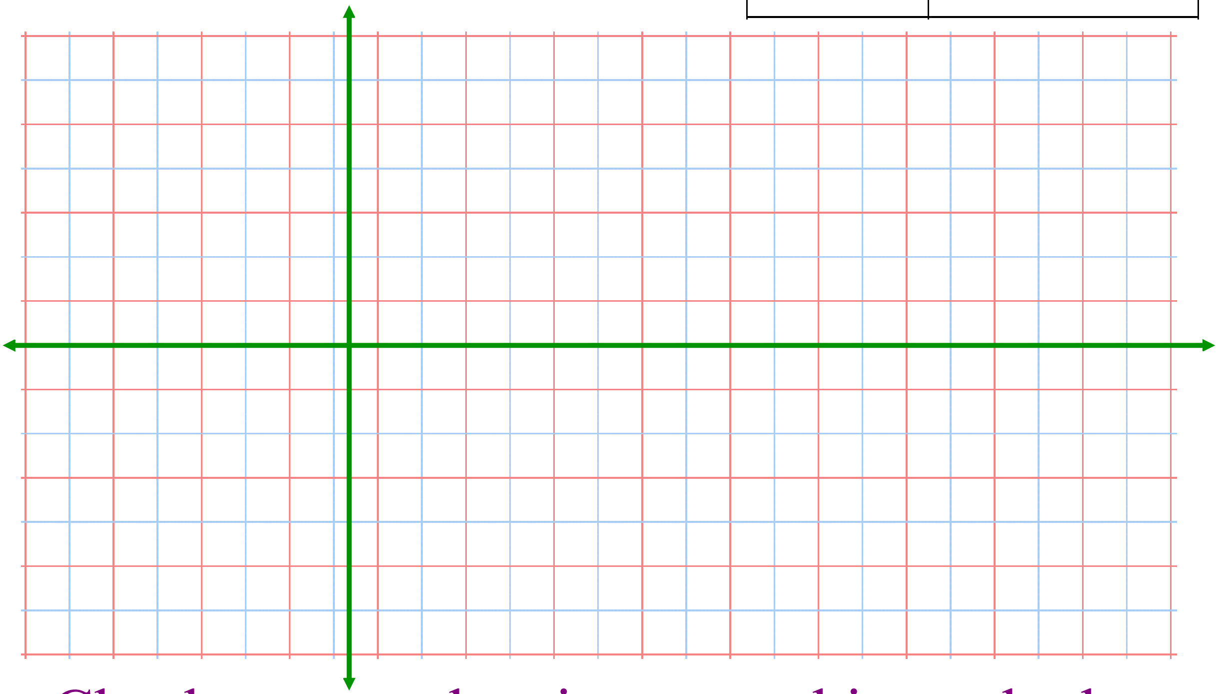
EXAMPLE #2

Now let's sketch a graph of $y = 3\cos\left[2(\theta - 135°)\right] + 2$

Sketching using transformations:

- *Apply the reflections and stretches first*
- *Apply phase shift and vertical translation second*

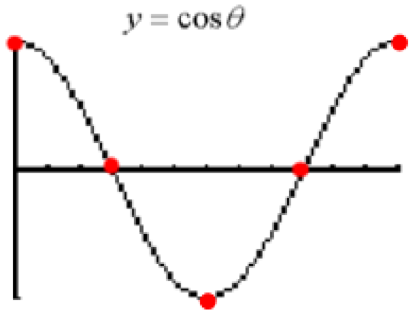
DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	



Check our graph using a graphing calculator

This time we will graph the same function using a mapping:

$$y = 3\cos\left[2(\theta - 135°)\right] + 2$$

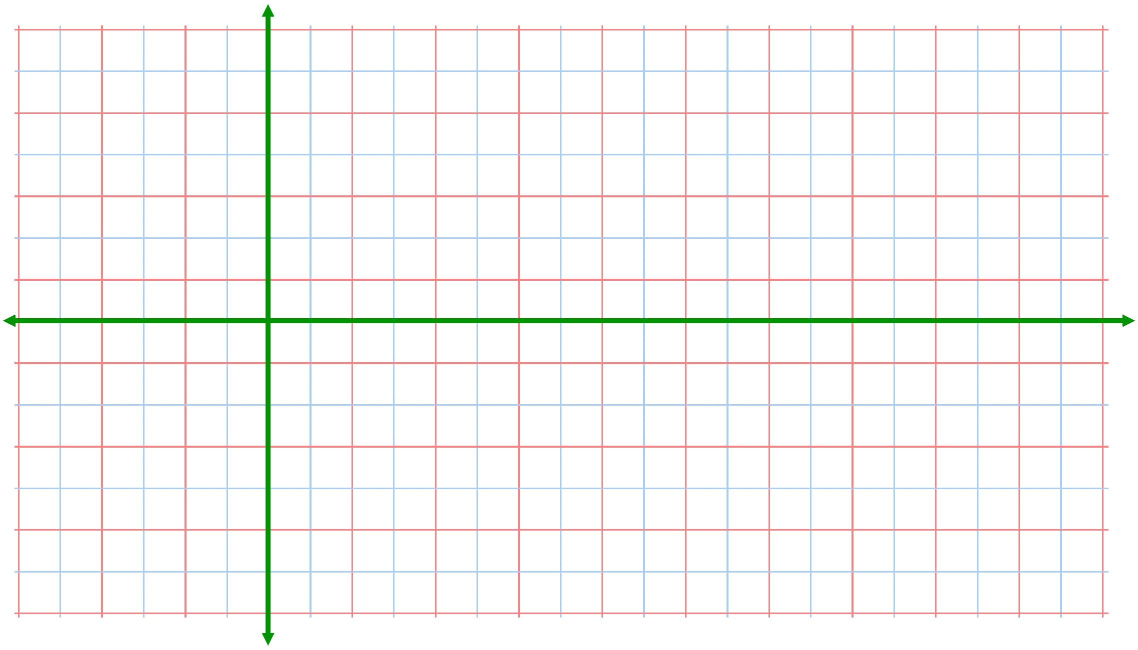


Mapping:

ϑ	y
0	
90	
180	
270	
360	

New points after mapping →

ϑ	y

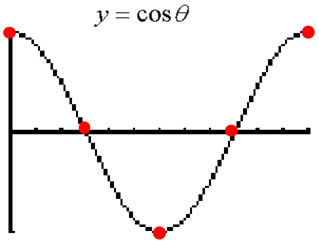


Hopefully you are not too puzzled for this one...

$$\frac{1}{2}(y+1)=3\cos\left(\frac{1}{2}\theta-90^\circ\right)+2$$

Remember...Put in standard form first!!

Remember what the graph of cosine looks like ??



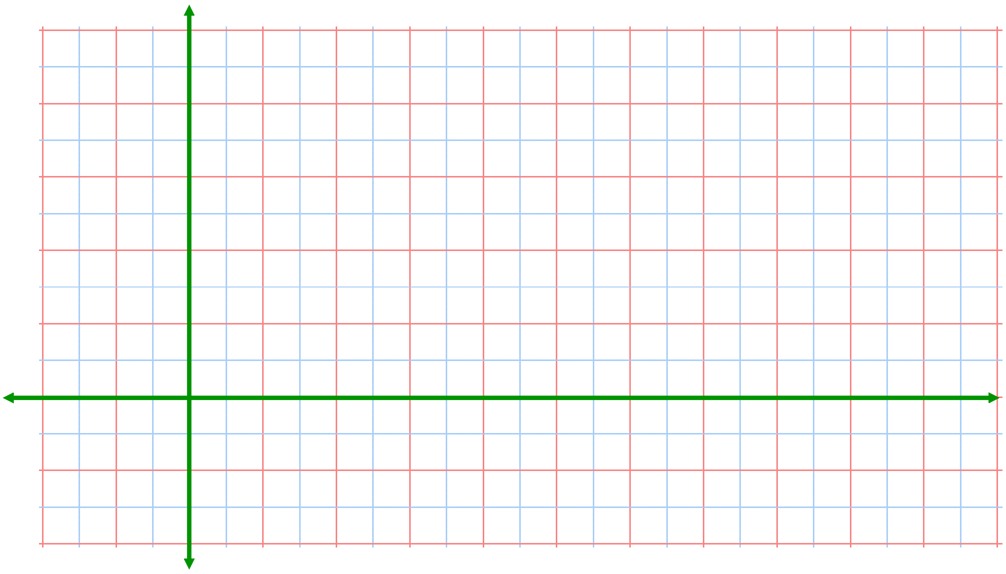
Mapping:

θ	y
0	
90	
180	
270	
360	

New points after mapping

θ	y

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	



Warm Up

Given the sinusoidal relation $f(\theta) = 5\cos(2\theta + 80°) - 2$

Complete the chart shown below:

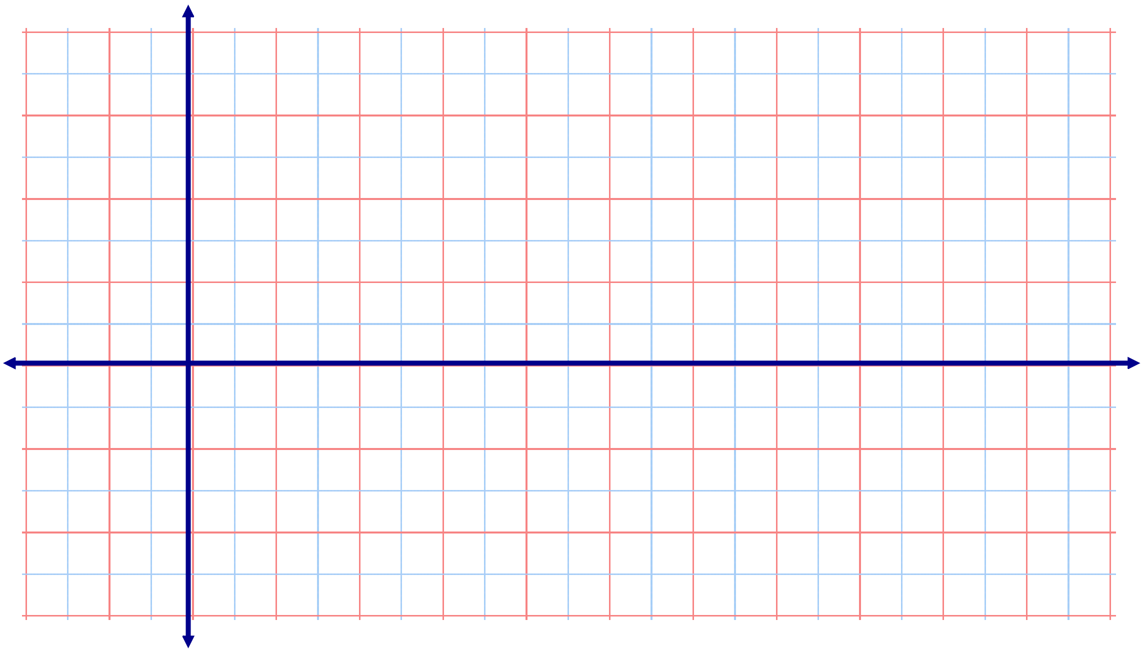
Mapping:

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

ϑ	y
0	
90	
180	
270	
360	

New points after mapping

ϑ	y



Review sketching the graph of a sinusoidal function:

For the equation: $f(\theta) = -2\cos(2\theta - 90°) + 3$

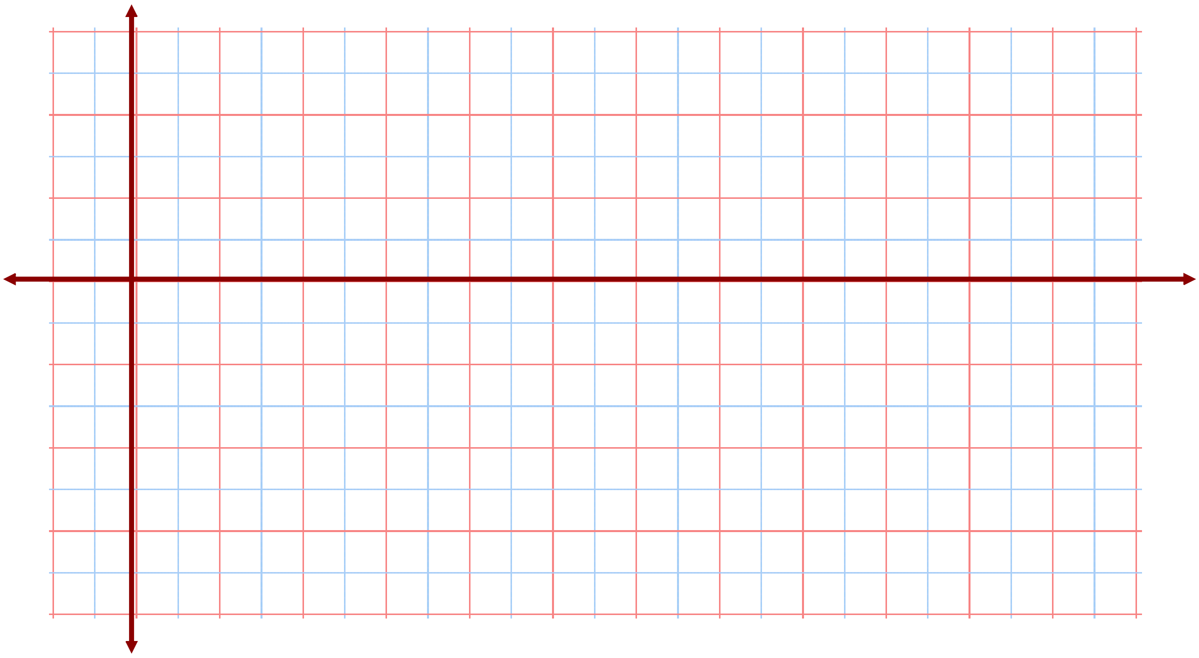
DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

Mapping:

ϑ	y
0	
90	
180	
270	
360	

New points after mapping →

ϑ	y



Given the function $y = -2\sin(2\theta - 30^\circ) + 3$

Remember...Put in standard form first!!

Complete the chart below and sketch the graph of this function.

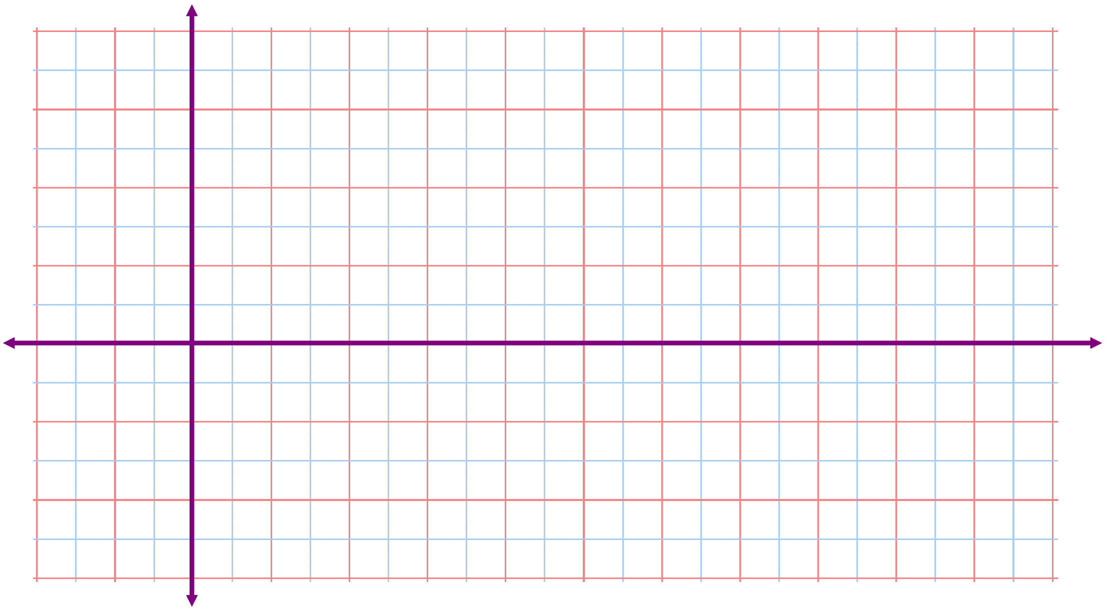
Mapping:

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

θ	y
0	
90	
180	
270	
360	

New points after mapping →

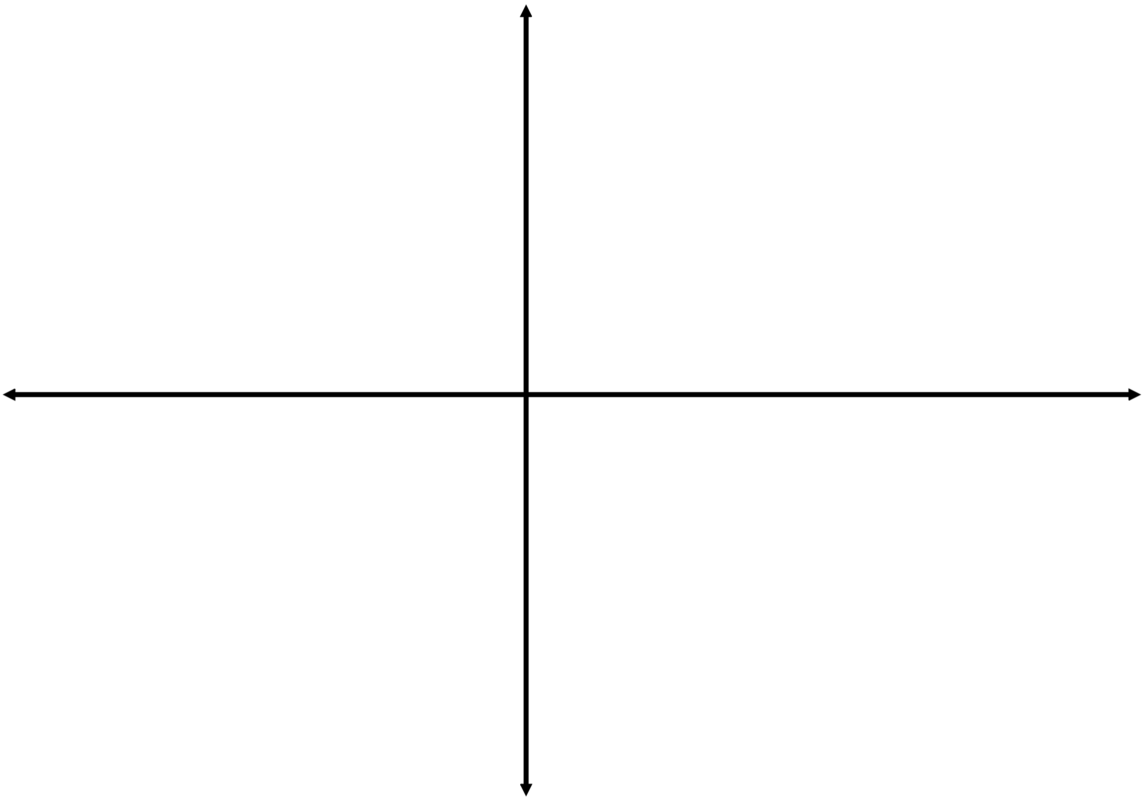
θ	y



Sketching Sinusoidal Functions in Radian Measure...

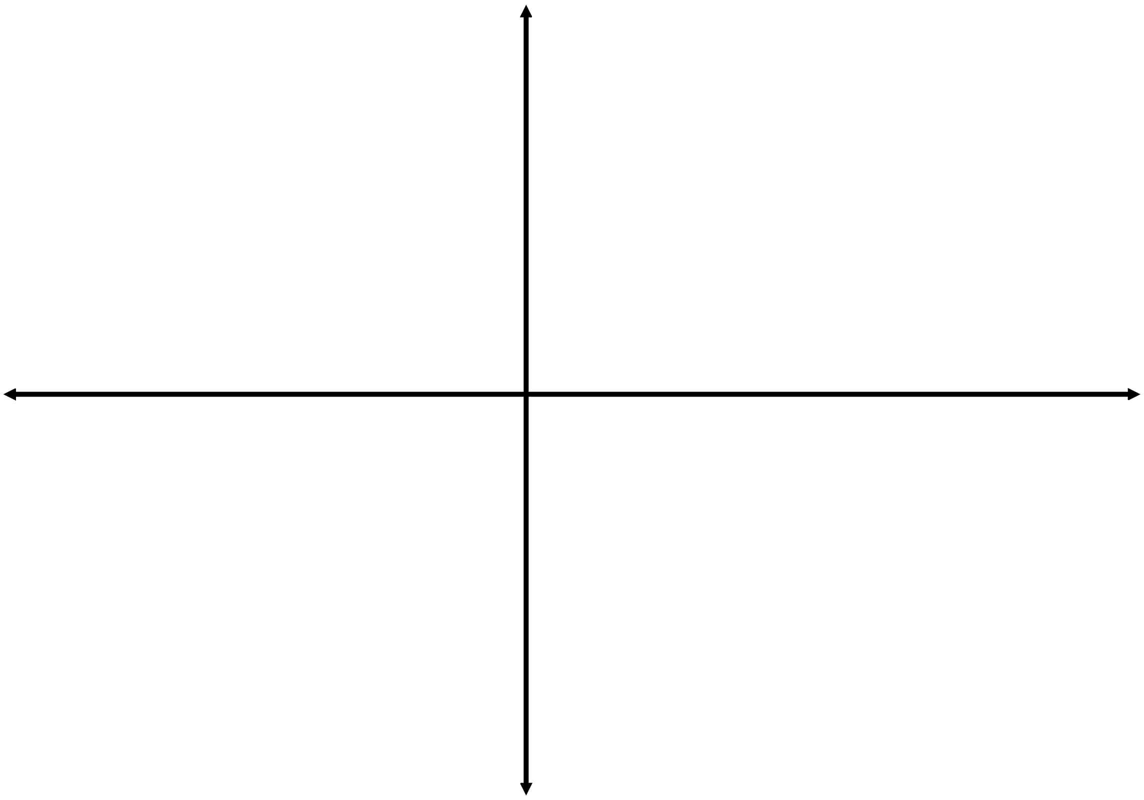
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

$$y = 2\sin\left(x - \frac{\pi}{4}\right) + 1$$



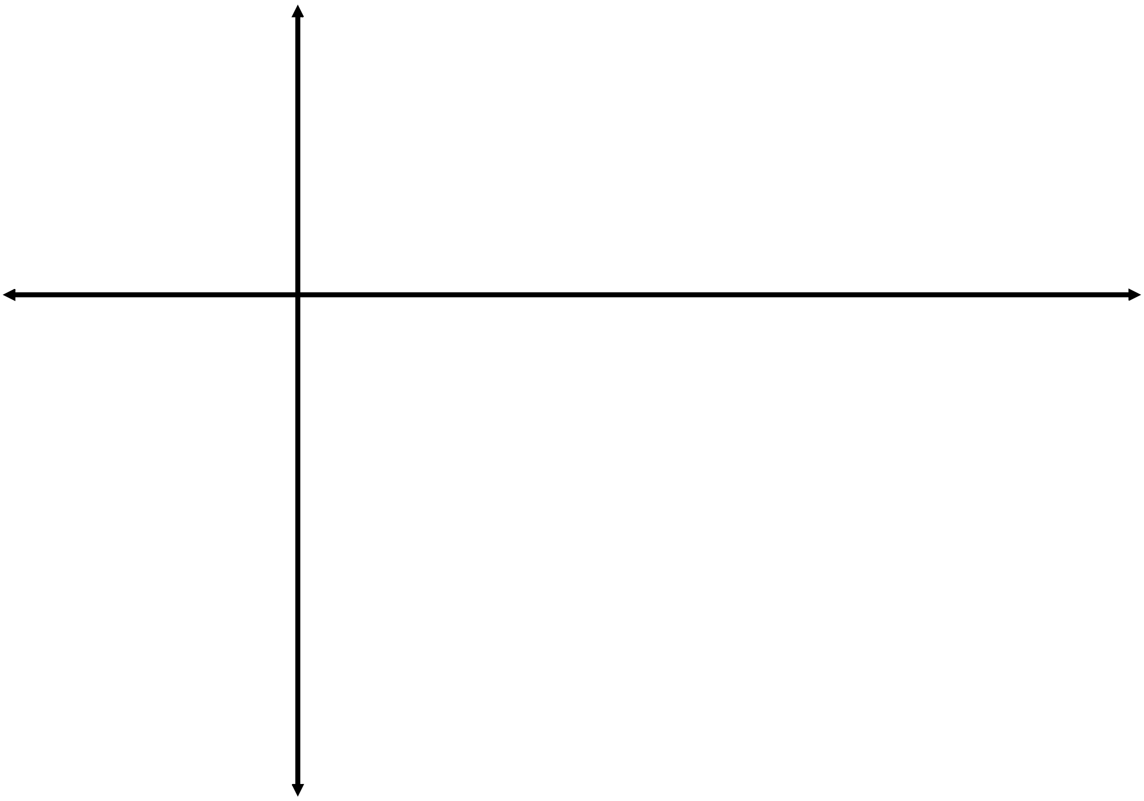
Ex. $y = \cos\left(2x - \frac{\pi}{3}\right) - 1$

AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	



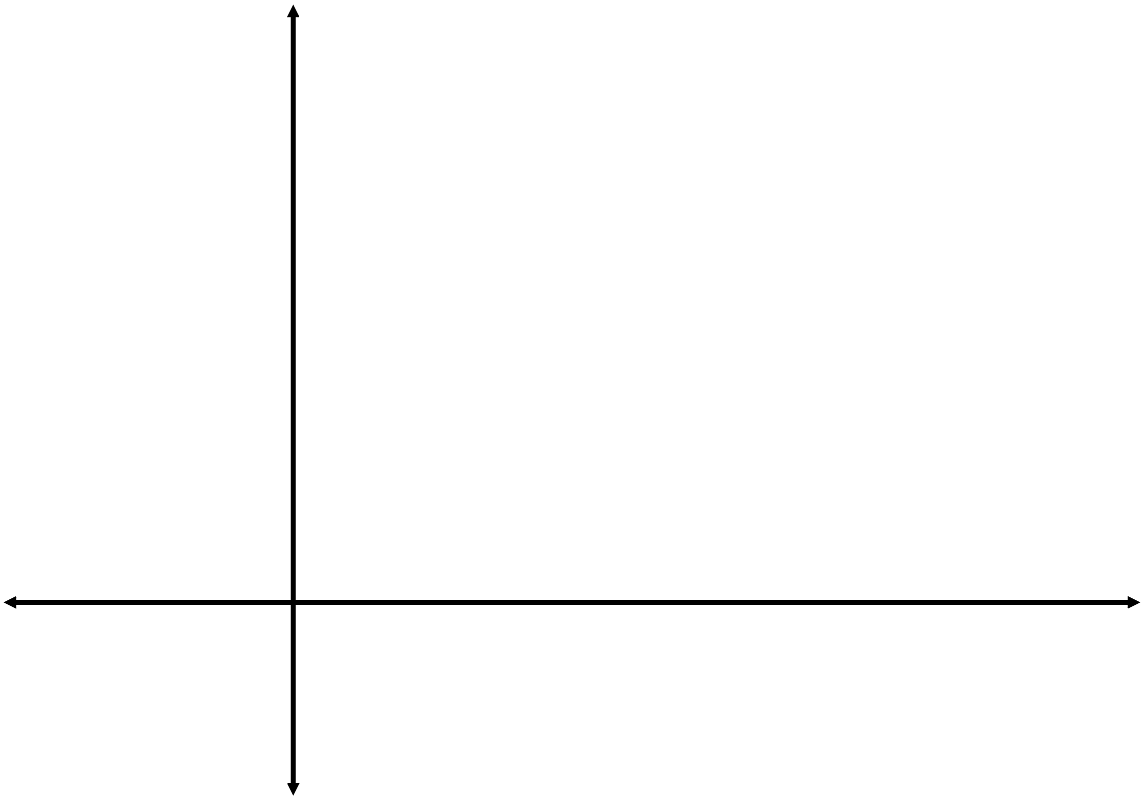
Example...

Graph the equation $y = -3\sin(2\theta + \pi) + 1$ using mapping notation.



One More Example...

Graph $y = \cos\left(3\theta + \frac{\pi}{2}\right) + 2$



Given the functio $f(\theta) = -4\sin(3\theta + 90°) - 1$

Remember...Put in
standard form first!!

Complete the chart below and sketch the graph of this function.

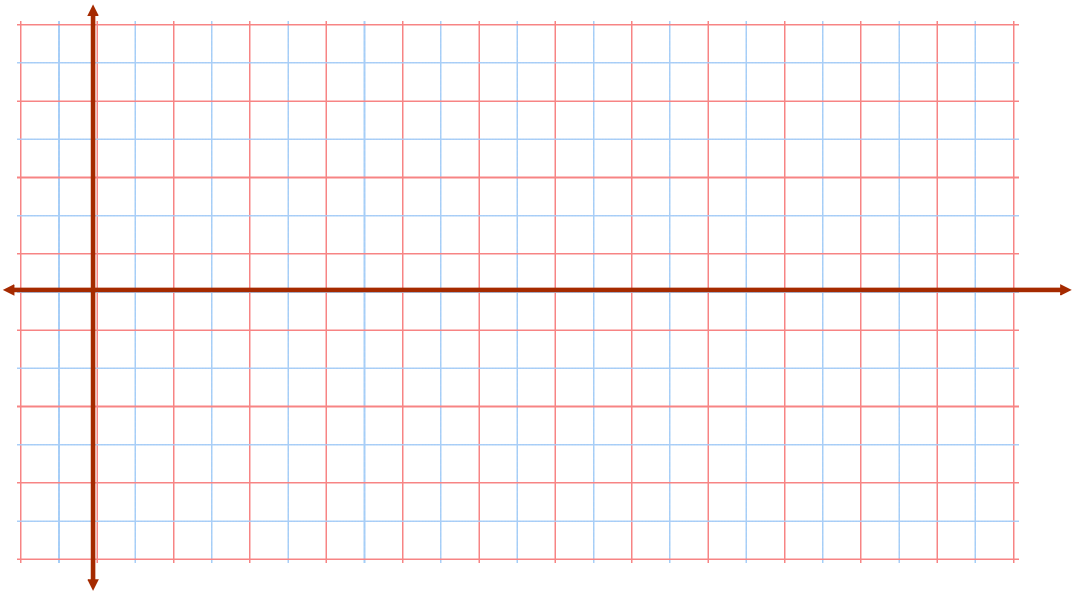
Mapping:

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

θ	y
0	
90	
180	
270	
360	

New points after mapping →

θ	y



Let's check with a graphing calculator

Homework

Worksheet - Sketching Trigonometric Functions.doc

Questions from the homework???

Worksheet Solns - Sketching Sinusoidal Relations.doc

Warm Up

Sketch the equation: $\frac{y+5}{3} = \cos(2\theta + 90°) + 6$

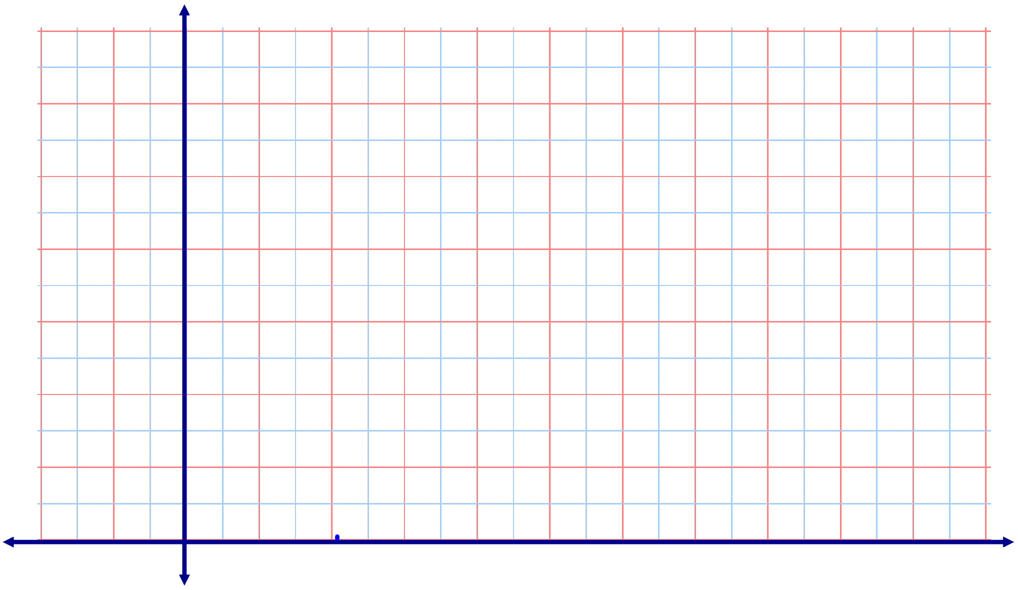
Mapping:

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

θ	y
0	
90	
180	
270	
360	

New points after mapping →

θ	y



Extra Practice...

Worksheet # 1 - 8

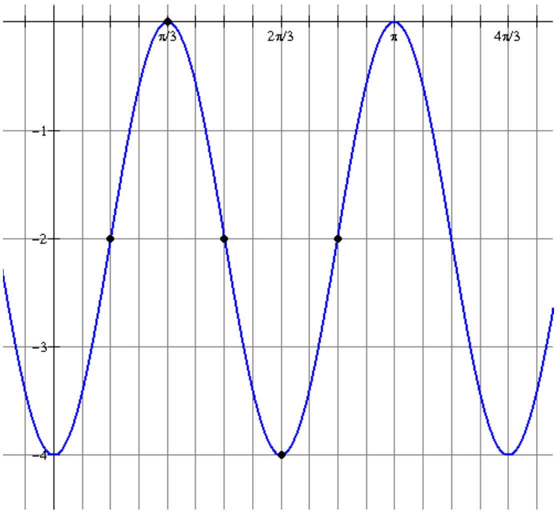
Worksheet - Sketching Sinusoidal Relations

Homework...

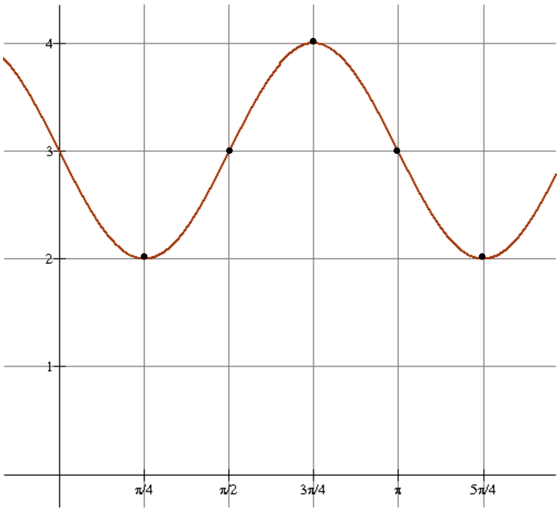
Worksheet - Sketching in radian measure.doc

Solutions to the Worksheet...

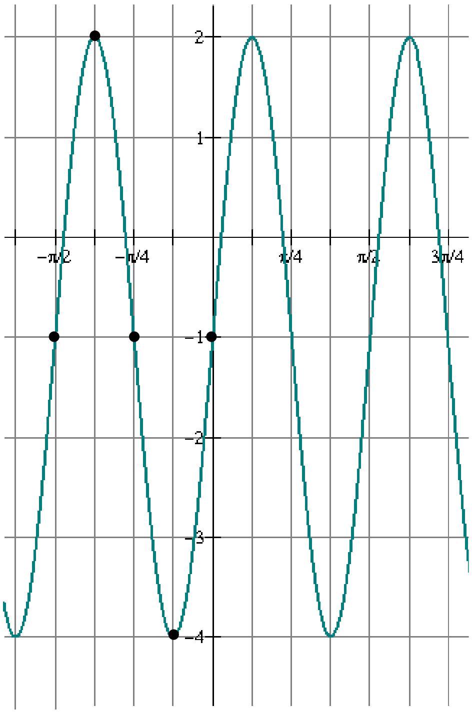
1. a) $y = 2\sin\left[3\left(\theta - \frac{\pi}{6}\right)\right] - 2$



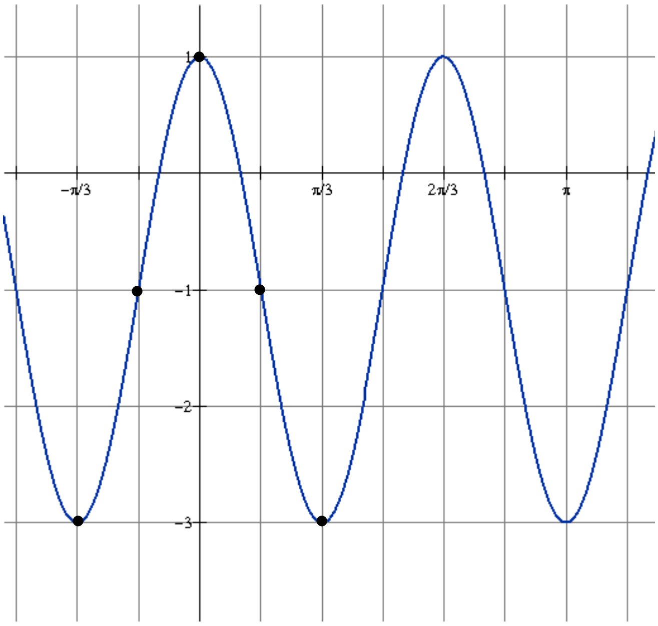
b) $y = -\cos 2\left(x - \frac{\pi}{4}\right) + 3$



c) $y = 3\sin 4\left(x + \frac{\pi}{2}\right) - 1$



d) $y = -2\cos 3\left(\theta + \frac{\pi}{3}\right) - 1$



2. a) b $y = -2\sin 3\left(\theta + \frac{\pi}{3}\right) + 2$

$y = -2\cos 3\left(\theta + \frac{\pi}{6}\right) + 2$

$y = 2\sin 3\theta + 2$

$y = 2\cos 3\left(\theta - \frac{\pi}{6}\right) + 2$

$y = -3\cos 4\theta - 2$

$y = 3\sin 4\left(\theta - \frac{\pi}{8}\right) - 2$

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

$y = -3\sin 4\left(\theta - \frac{3\pi}{8}\right) - 2$

Developing Trigonometric Functions from Properties...

Develop a trigonometric function that fits the following description...

- **Models a sine function**
- **Period is 120°**
- **Graph is reflected in x-axis**
- **Wave has a range of -8** $\leq y \leq 2$
- **Graph has a phase shift of 60° right**
- **Graph has a vertical translation of 3 units down**

...Now we must learn how to identify all of the above information from a graph.

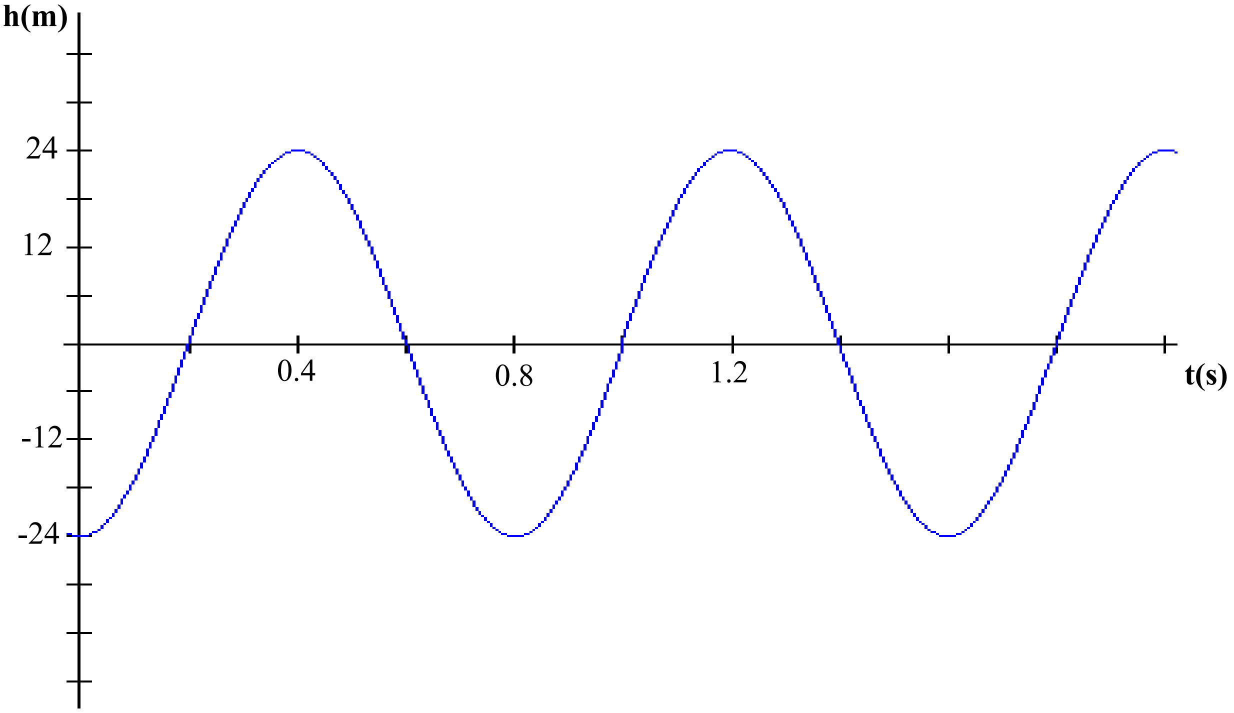
Developing the Equation of a Sinusoidal Function

STEPS: 1) Identify & label the sinusoidal axis.

2) Determine the amplitude, period & vertical translation.

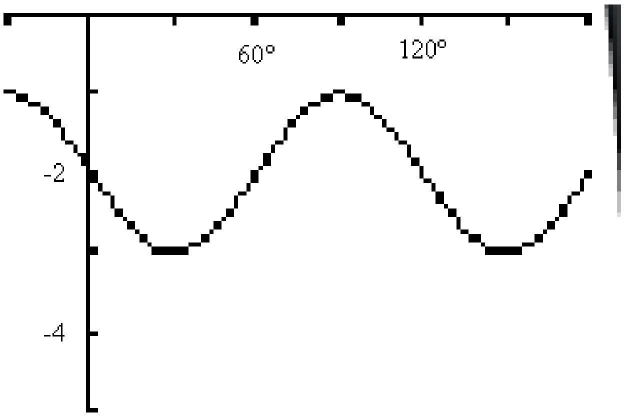
3) Pick a trig function & determine the corresponding phase shift.

- the choices are: positive sine,
  positive cosine, negative sine,
  negative cosine

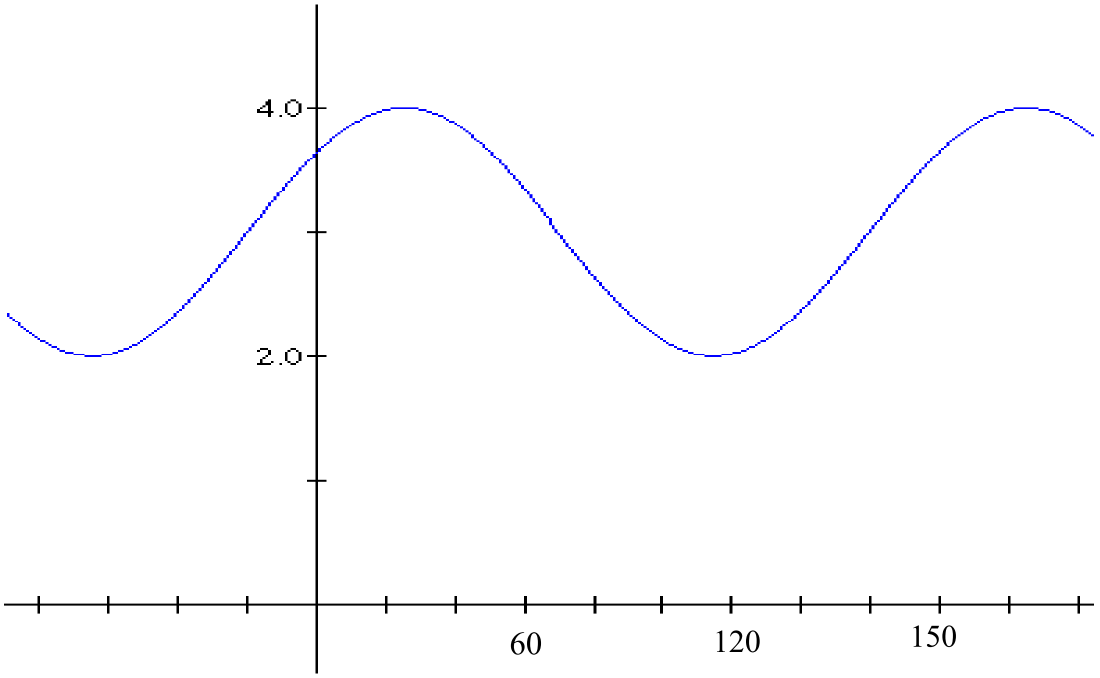


Finding an Equation from a Graph:

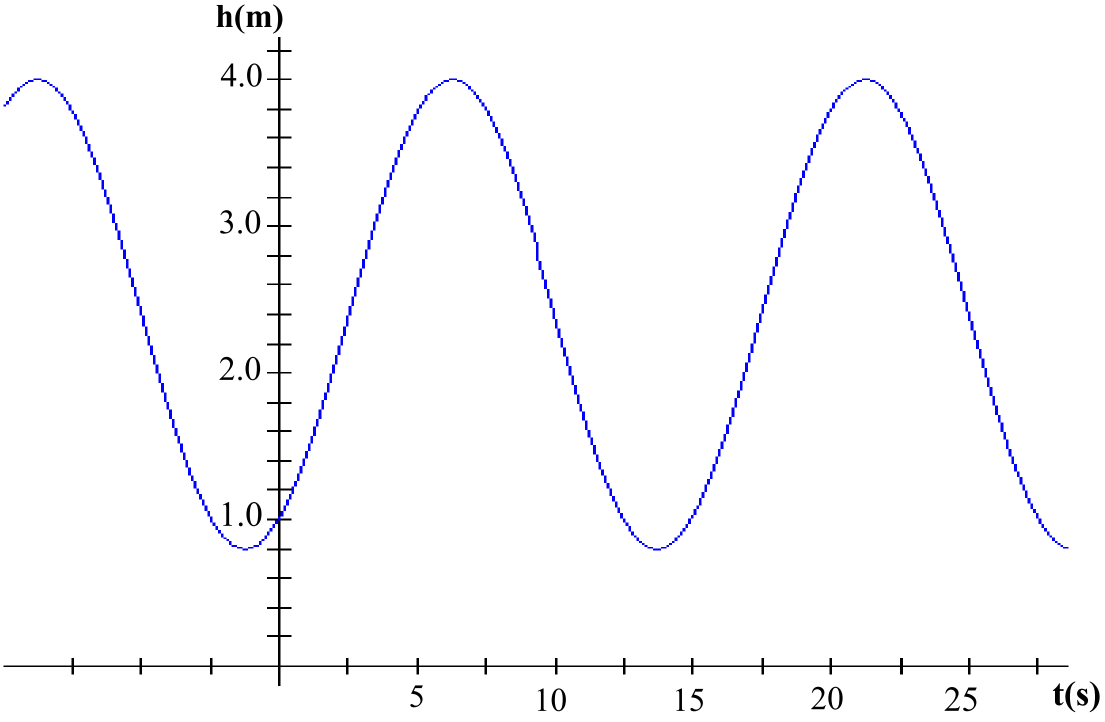
What is the equation that describes this graph?



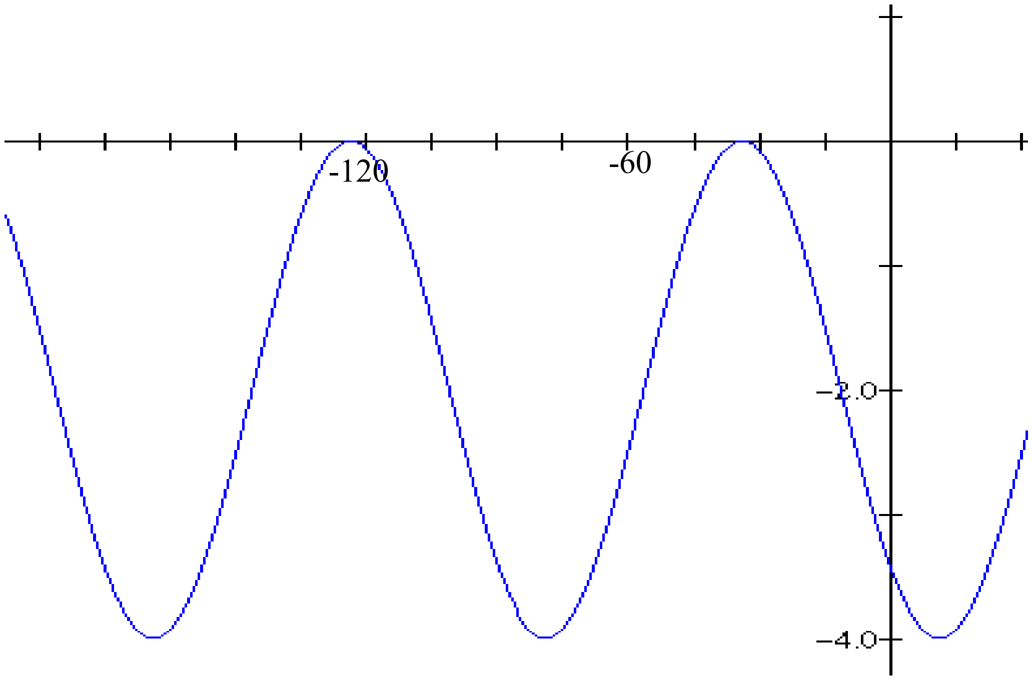
Determine a sine and a cosine equation for this graph



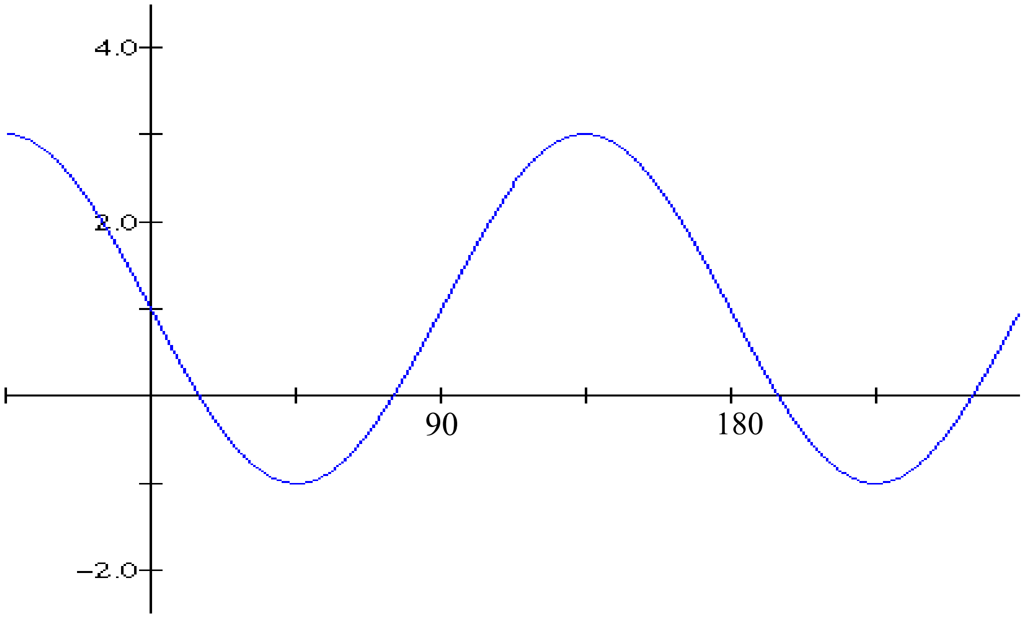
What about those not centered around the x-axis?
Find both a sine and cosine equation to describe the graph.



Write both a sine and cosine equation to describe the following graph:

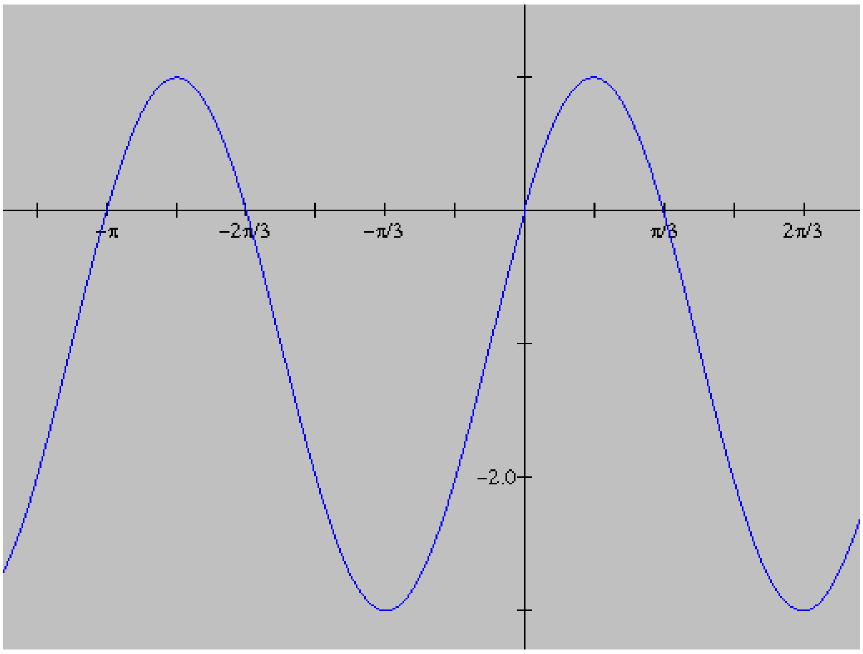


Find four equations that match the graph:

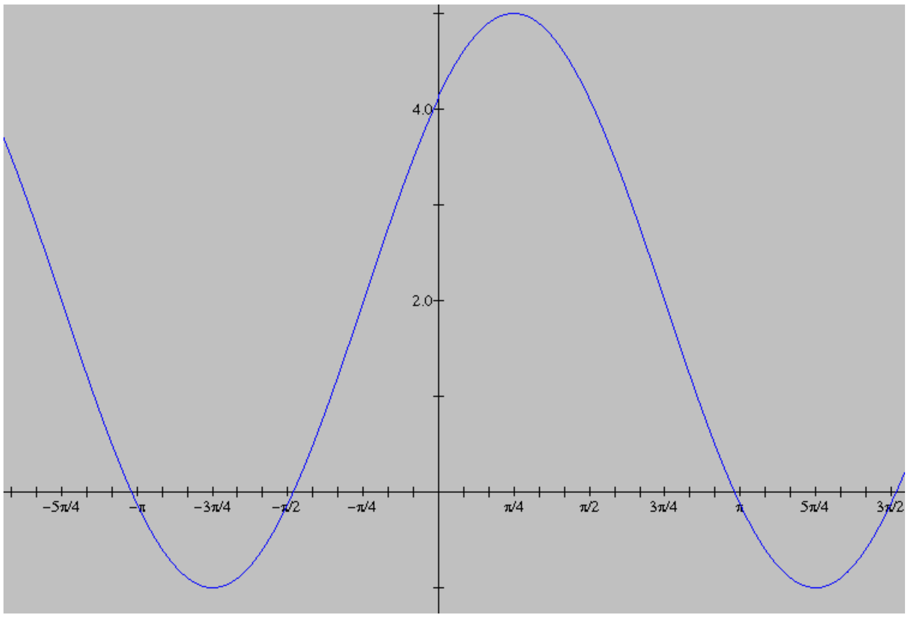


Check with a calculator...

Find a Sine and Cosine Equation From the Graph:



Find a Sine and Cosine Equation From the Graph:



EXTRA PRACTICE...

Worksheet - Finding the Equation.doc

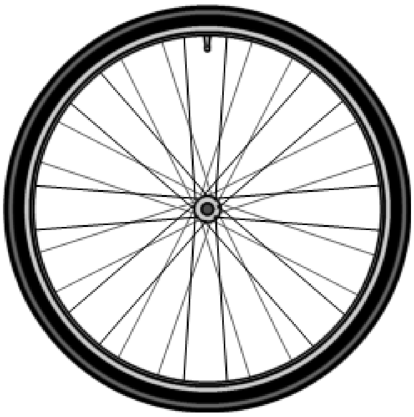
Applications of Sinusoidal Relations

Strategy: (1) Translate ALL key pieces of information from the problem.
(2) Draw a sketch with ALL key points identified.
(3) Develop an equation that models the problem.
(4) Answer the question(s) being asked.

CHECK??? Do the numbers make sense?

EXAMPLE...

Johnny is driving his bike when a tack becomes stuck in his tire. The tire has a radius of 32 cm and makes one complete rotation every 500 ms. How high will the tack be above the ground 12.38 seconds after becoming lodged in his tire????

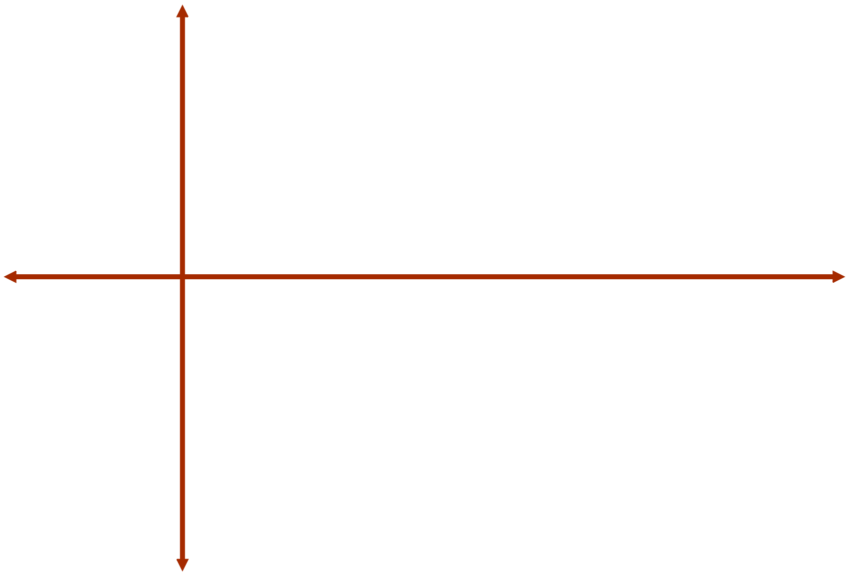


Applications of Sinusoidal Functions

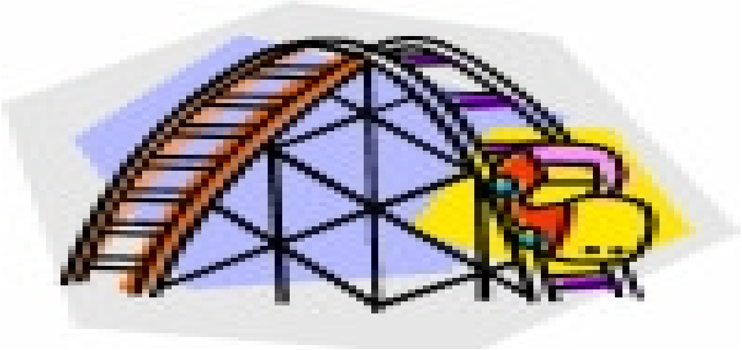
Example: A Ferris Wheel with a radius of 20 m rotates every 40 s. Passengers get on a seat that is 1 m above ground level. How high above the ground would a passenger be situated 3 minutes and 17 seconds after starting this ride?

Ocean Tides

The alternating half-daily cycles of the rise and fall of the ocean are called tides. Tides in one section of the Bay of Fundy caused the water level to rise 6.5m above mean sea-level and to drop 6.5m below. The tide completes one cycle every 6 h. Assume the height of water with respect to mean sea-level to be modelled by a sinusoidal relationship. If it is high tide at 8:00 AM, determine where the water level would be at 1:47 PM.



Roller Coaster

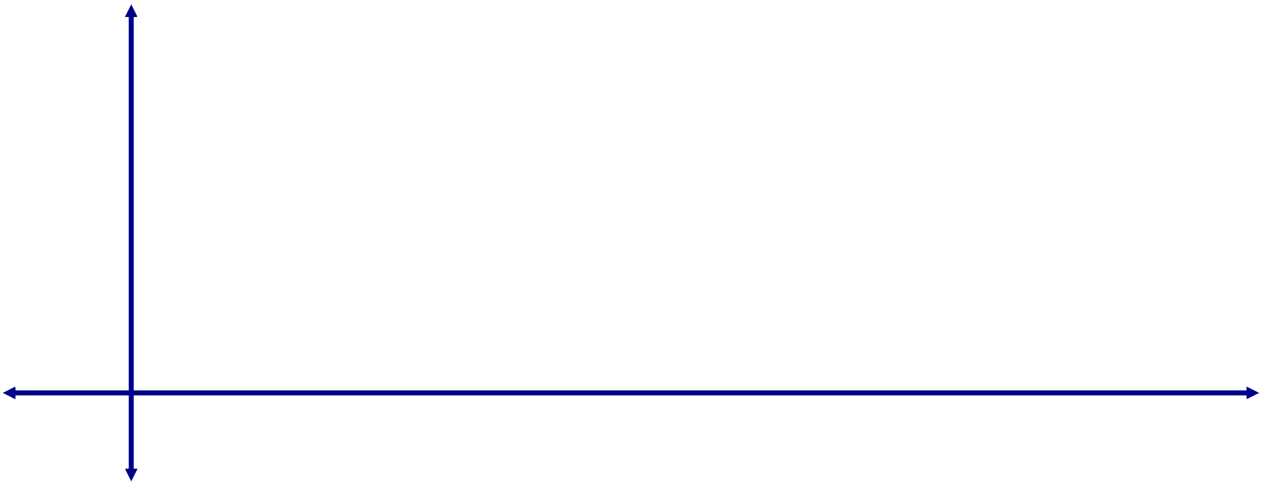


John climbs on a roller coaster at Six Flags Amusement Park. An observer starts a stopwatch and observes that John is at a maximum height of 12 m at t = 13.2 s. At t = 14.6 s, John reaches a minimum height of 4 m.

a) Sketch a graph of the function.

b) Find an equation that expresses John's height in terms of time.

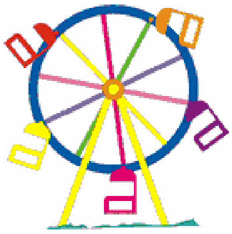
c) How high is John above the ground at t = 20.8 s?



Now, your turn...

Ferris Wheel

A carnival Ferris wheel with a radius of 14 m makes one complete revolution every 16 seconds. The bottom of the wheel is 1.5 m above the ground. If a person gets on the wheel at its lowest point, determine how high above the ground that person will be after 1 minute and 7 seconds?



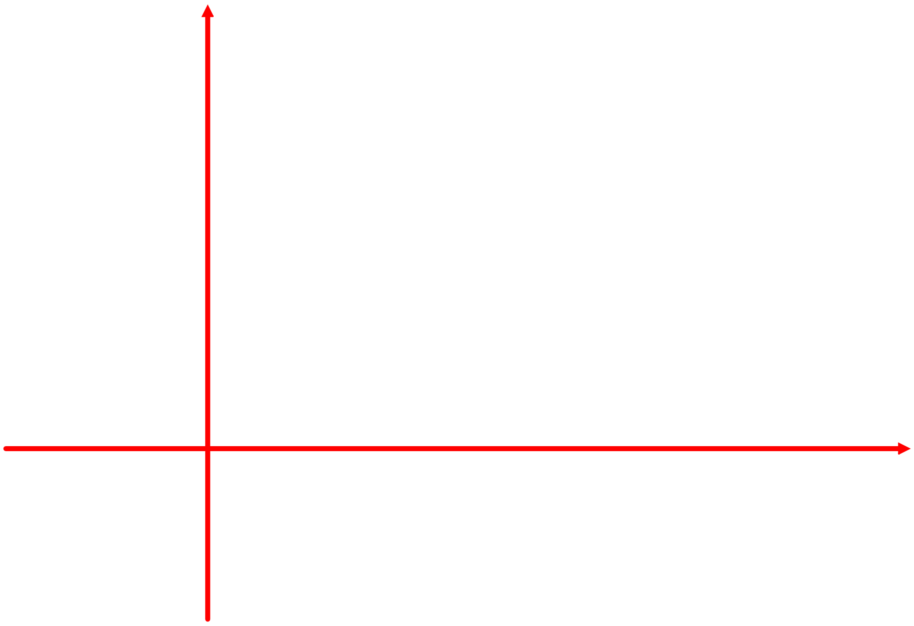
Spring Problem

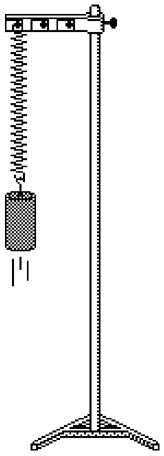
A weight attached to a long spring is being bounced up and down by an electric motor. As it bounces, its distance from the floor varies periodically with time. You start a stopwatch. When the stopwatch reads 0.3 seconds, the weight reaches its first high point 60 cm above the ground. The next low point, 40 cm above the ground, occurs at 1.9 seconds.

a) Sketch a graph of the function.

b) Write an equation expressing the distance above the ground in terms of the numbers of seconds the stopwatch reads.

c) How high is the mass above the ground after 17.2 seconds?



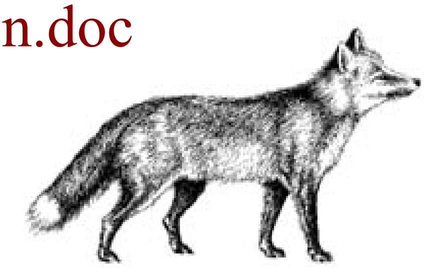


Biology!!

Naturalists find that the populations of some animals varies periodically with time. Records started being taken at t = 0 years. A minimum number, 200 foxes, occurred when t = 2.9 years. The next maximum, 800 foxes, occurred at t = 5.1 years.

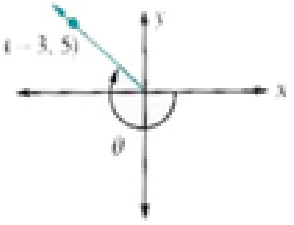
Give two different times at which the fox population is 625.

Bonus Soln - Fox Population.doc



Warm Up

1. Determine the measure of the rotation angle shown in the diagram below.



[A] – 239° [B] 121°

[C] – 233° [D] -217°

2. Determine the range of the trigonometric function $\frac{1}{5}(y+2)=\sin(2\theta+60^{\circ})$

[A] $1 \le y \le 3$ [B] [C] [D] $-7 \le y \le 3$ $-3 \le y \le 7$ $-5 \le y \le 5$

3. The graph of y = cos x is transformed to a new image according to the mapping rule $(x, y) \rightarrow \left(\frac{2}{3}x+30^{\circ}, 5y-2\right)$
What is the period of this transformation?

[A] 240° [B] 540° [C] 72° [D] 1.5°

4. Given that $\csc x=-1.4945$ and , $0^{\circ} \le x \le 360^{\circ}$ then all possible values of x are…
[A] 222° & 318° [B] -42° & 318° [C] 42° & 138° [D]138° & 222°

Applications of Sinusoidal Functions: Worksheet

Let's look at the detailed solutions...

Worksheet Solns - Applications of Sinusoidal Relations.doc

Check-Up...

Tarzan is swinging back and forth on his grapevine. As he swings, he goes back and forth across the riverbank, going alternately over land and water. Jane decides to model mathematically his motion and starts her stopwatch. Let t be the number of seconds the stopwatch reads and let y be the number of meters Tarzan is from the riverbank. Assume that y varies sinusoidally with t, and that y is positive when Tarzan is over water and negative when he is over land. Jane finds that when t = 2.8 seconds, Tarzan is at one end of his swing, 23 feet from the riverbank, over the water. She finds when t = 6.3 seconds he reaches the other end of his swing and is situated 17 feet from the riverbank, however this time over land.

(a) Where was Tarzan when Jane started the stopwatch?

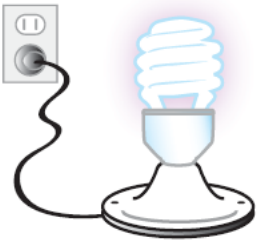
(b) Provide three instances when Tarzan was located at a position 14 feet from the riverbank, over the water.

Solve a Trigonometric Equation in Radians

Determine the general solutions for the trigonometric equation $16 = 6\cos\frac{\pi}{6}x + 14$. Express your answers to the nearest hundredth.

Model Electric Power

The electricity coming from power plants into your house is alternating current (AC). This means that the direction of current flowing in a circuit is constantly switching back and forth. In Canada, the current makes 60 complete cycles each second.



The voltage can be modelled as a function of time using the sine function $V = 170 \sin 120\pi t$.

a) What is the period of the current in Canada?

b) Graph the voltage function over two cycles. Explain what the scales on the axes represent.

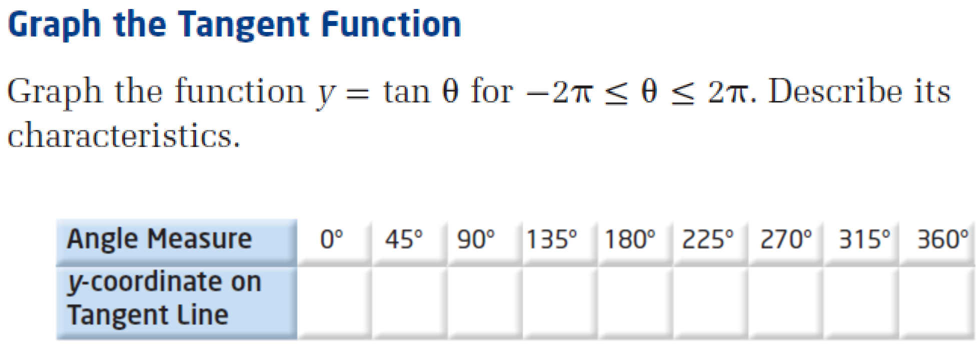
c) Suppose you want to switch on a heat lamp for an outdoor patio. If the heat lamp requires 110 V to start up, determine the time required for the voltage to first reach 110 V.

Did You Know?

The number of cycles per second of a periodic phenomenon is called the frequency. The hertz (Hz) is the SI unit of frequency. In Canada, the frequency standard for AC is 60 Hz.

Voltages are expressed as root mean square (RMS) voltage. RMS is the square root of the mean of the squares of the values. The RMS voltage is given by $\frac{\text{peak voltage}}{\sqrt{2}}$. What is the RMS voltage for Canada?

What about graphs of other trigonometric functions ???



Graph the Tangent Function

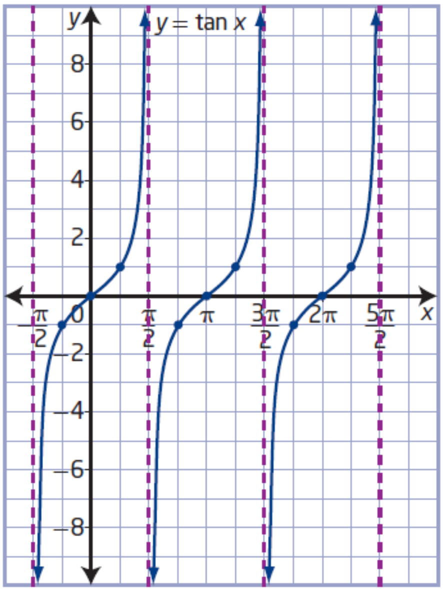
Graph the function $y = \tan \theta$ for $-2\pi \leq \theta \leq 2\pi$. Describe its characteristics.

Angle Measure	0°	45°	90°	135°	180°	225°	270°	315°	360°
***y*-coordinate on Tangent Line**									

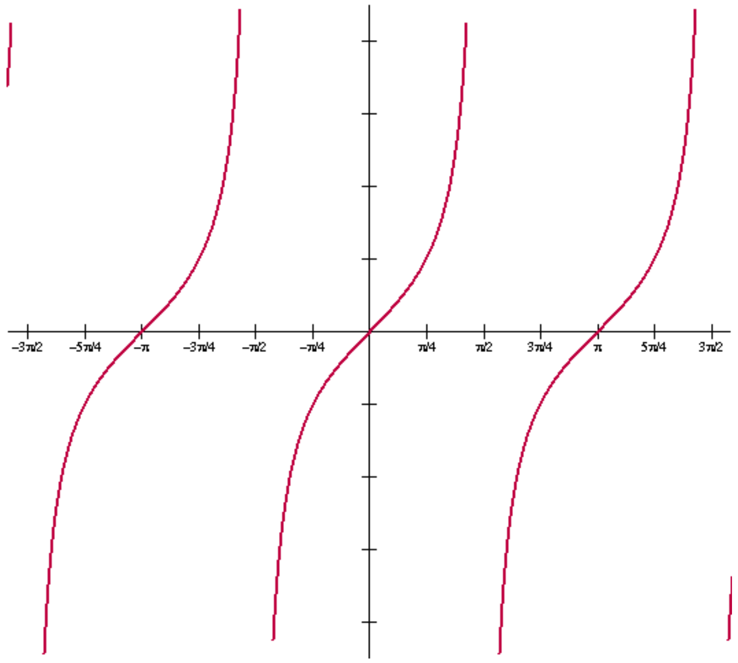
Key Ideas

- You can use asymptotes and three points to sketch one cycle of a tangent function. To graph $y = \tan x$, draw one asymptote; draw the points where $y = -1$, $y = 0$, and $y = 1$; and then draw another asymptote.
- The tangent function $y = \tan x$ has the following characteristics:
  - The period is π.
  - The graph has no maximum or minimum values.
  - The range is $\{y \mid y \in \mathrm{R}\}$.
  - Vertical asymptotes occur at $x = \frac{\pi}{2} + n\pi$, $n \in \mathrm{I}$.
  - The domain is $\left\{x \mid x \neq \frac{\pi}{2} + n\pi, x \in \mathrm{R}, n \in \mathrm{I}\right\}$.
  - The x-intercepts occur at $x = n\pi$, $n \in \mathrm{I}$.
  - The y-intercept is 0.

How can you determine the location of the asymptotes for the function $y = \tan x$?



y = tan θ



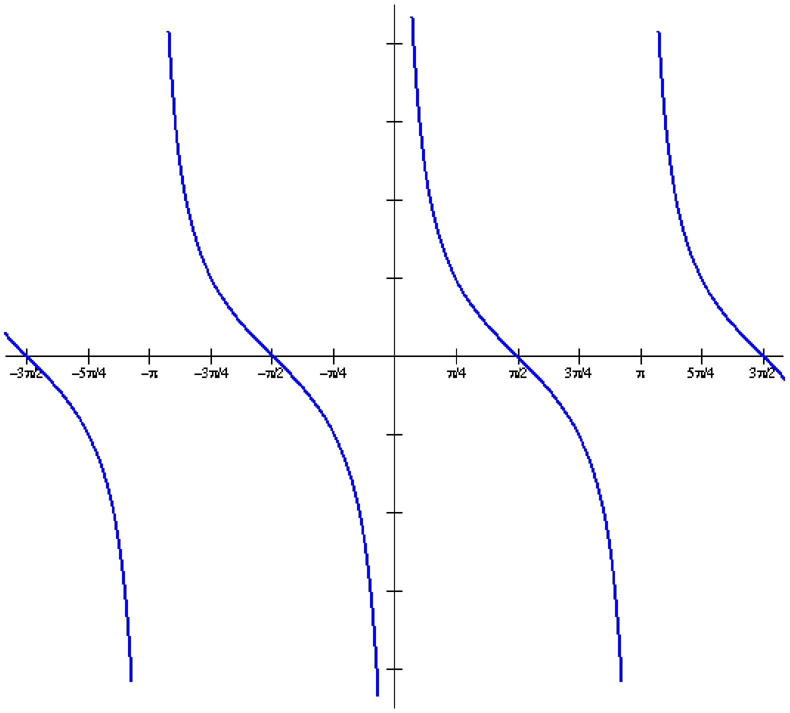
What would the graph of **cot θ** look like?

REMEMBER:

$$\tan x = \frac{1}{\cot x}$$

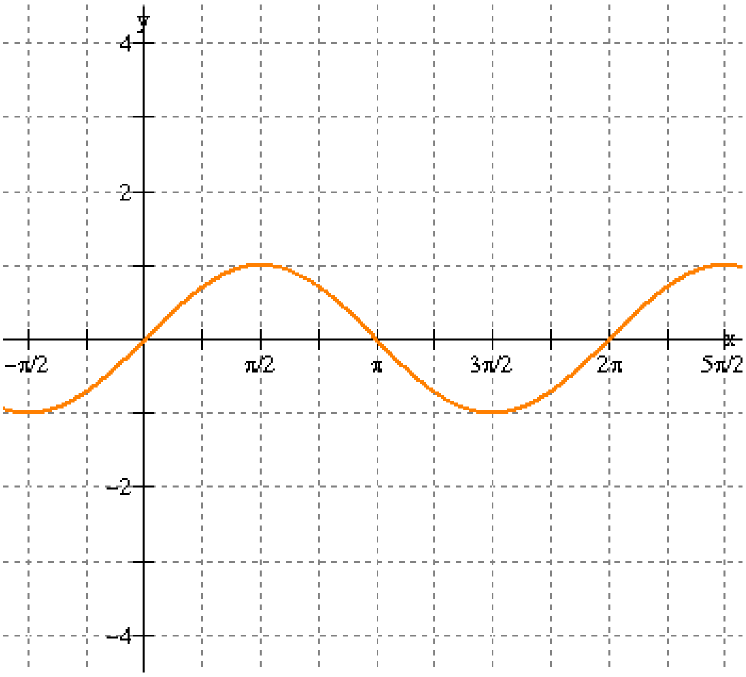
where tan x = 0,
cot x is undefined

y = cot θ



Graphs of Other Trigonometric Functions

$y = \sin\theta$



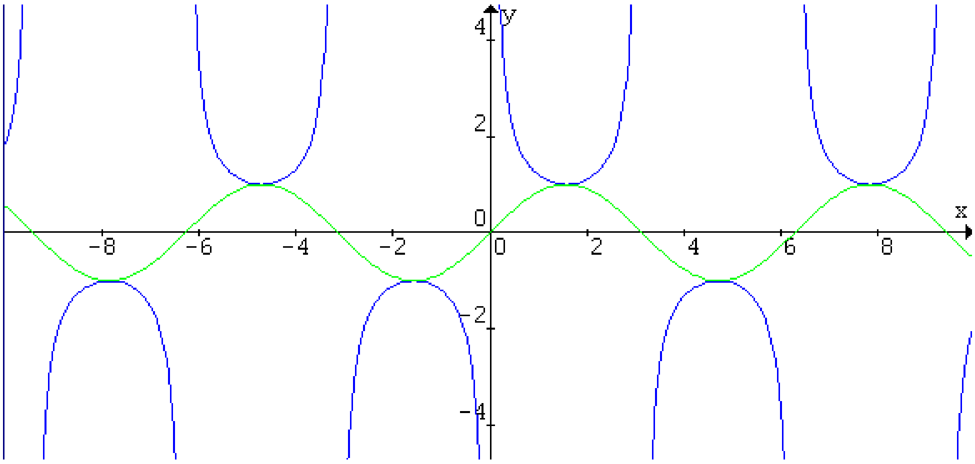
What would the graph of **csc θ** look like?

REMEMBER:

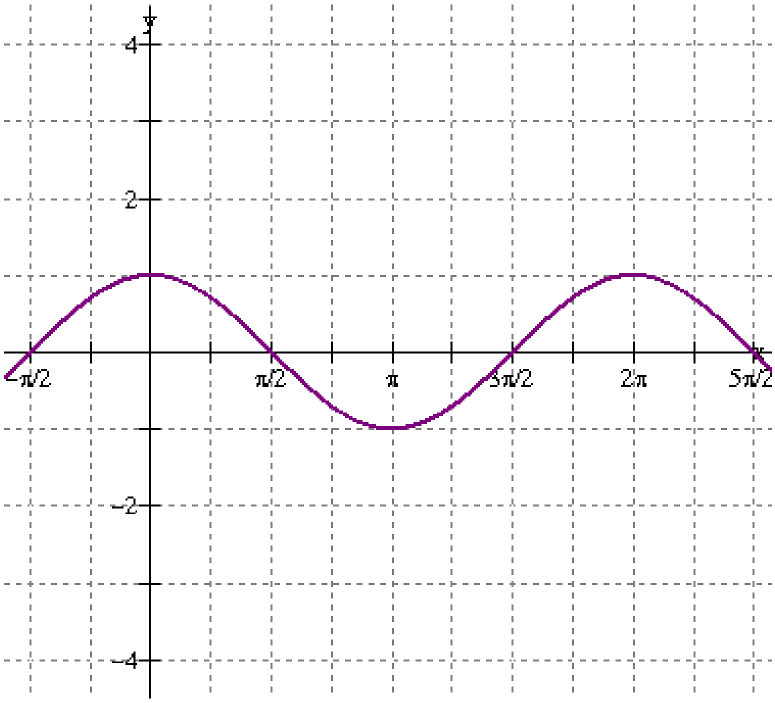
$$\csc\theta = \frac{1}{\sin\theta}$$

where sin x = 0,
csc x is undefined

$y = \sin x$ $y = \csc x$



y = cos θ



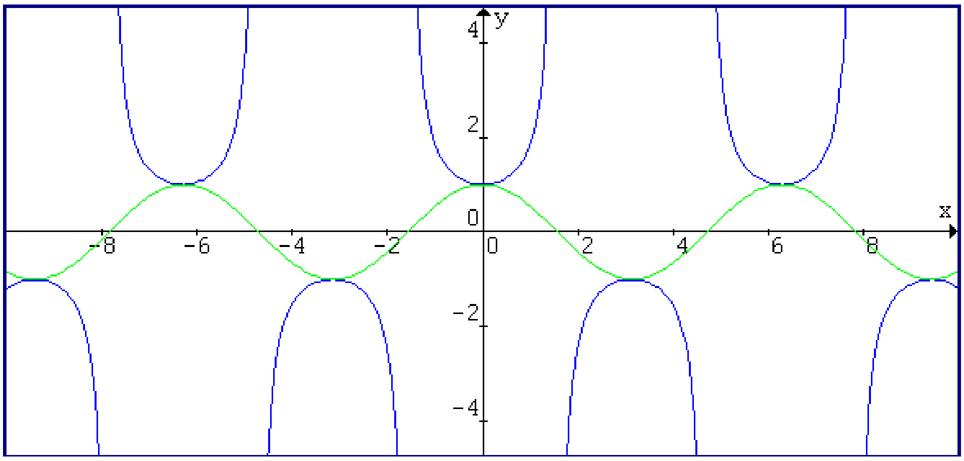
What would the graph of **sec θ** look like?

REMEMBER:

$$\sec\theta = \frac{1}{\cos\theta}$$

where cos x = 0,
sec x is undefined

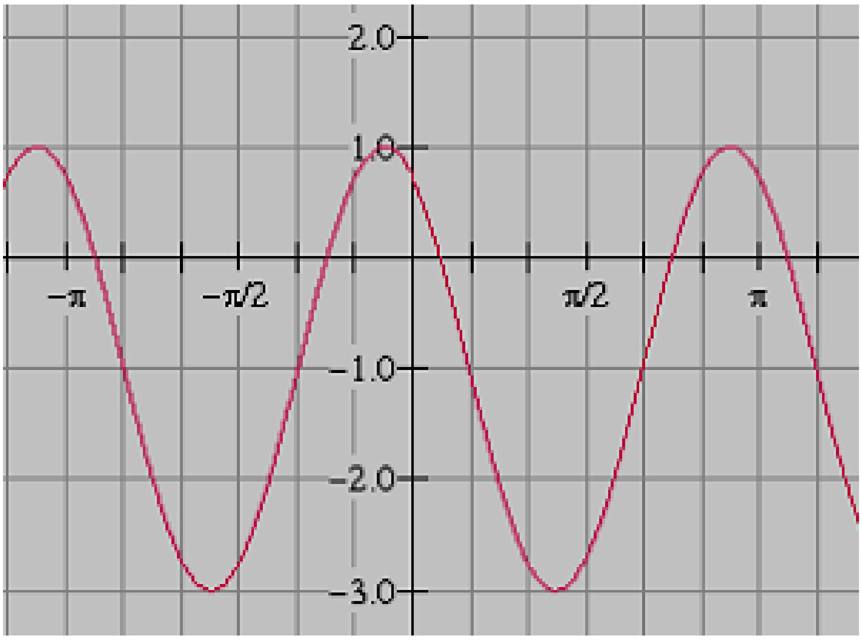
y = cos x y = sec x



REVIEW - Sketching Trigonometric Functions

- sinusoidal functions
  - properties: domain/range, amplitude, period, phase shift,
    vertical translation, eq'n of sinusoidal axis,
    mapping notation.
  - sketching equation in standard form.
- finding the function (both a sine/cosine) given a graph
- solving trigonometric equations where period is not 360
- applications of sinusoidal functions.
  - sketch
  - develop a function
  - use function to answer question
- sketches of all SIX trigonometric ratios

Write both a cosine and sine function to describe the graph shown



Complete the chart shown below and sketch one full cycle of this function

$$-\frac{1}{2}(y+2) = \sin\left(3\theta + \frac{\pi}{8}\right) - 2$$

DOMAIN	
RANGE	
AMPLITUDE	
PERIOD	
PHASE SHIFT	
VERTICAL TRANSLATION	
EQUATION OF SINUSOIDAL AXIS	

The Canadian National Historic Windpower Centre, at Etzikom, Alberta, has various styles of windmills on display. The tip of the blade of one windmill reaches its minimum height of 8 m above the ground at a time of 2 s. Its maximum height is 22 m above the ground. The tip of the blade rotates 12 times per minute.

a) Write a sine or a cosine function to model the rotation of the tip of the blade.

b) What is the height of the tip of the blade after 4 s?

c) For how long is the tip of the blade above a height of 17 m in the first 10 s?

PRACTICE TIME...

Review - Practice Test for Sinusoidal Functions.doc

Practice Test Solutions

Part A: Multiple Choice

1. A
2. D
3. A
4. C
5. B
6. D
7. A
8. D
9. B
10. A
11. A (second hand)
12. C
13. A
14. C
15. D
16. D
17. B
18. D
19. A
20. A

Part B: Open Response

1. $-\frac{5}{4}$

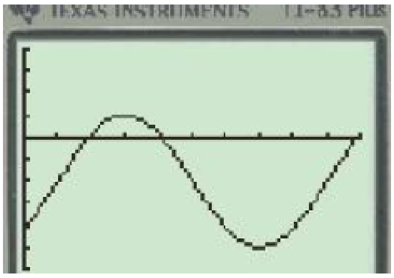
2. (i)

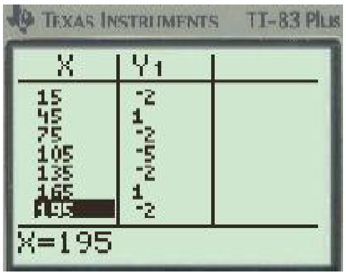
$$y = 3\sin\frac{3}{2}(x - 160°) - 6$$

$$y = 3\cos\frac{3}{2}(x + 20°) - 6$$

(ii) $(x, y) \rightarrow \left(\frac{2}{3}x + 160°, 3y - 6\right)$

3.





X	Y1
15	-2
45	1
75	-2
105	-5
135	-2
165	1
195	-2

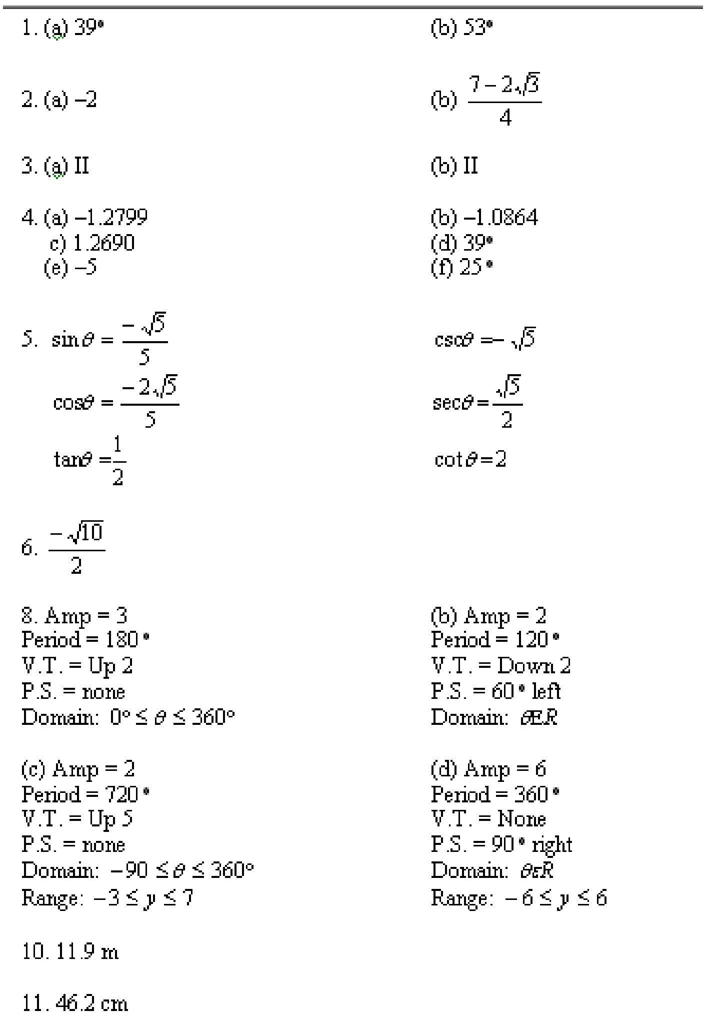
X=195

4. 10.28 m

MORE PRACTICE???

Review - Trigonometric Functions.doc

SOLUTIONS



1. (a) 39° (b) 53°

2. (a) −2 (b) $\frac{7-2\sqrt{3}}{4}$

3. (a) II (b) II

4. (a) −1.2799 (b) −1.0864
c) 1.2690 (d) 39°
(e) −5 (f) 25°

5. $\sin\theta = \frac{-\sqrt{5}}{5}$ $\csc\theta = -\sqrt{5}$
$\cos\theta = \frac{-2\sqrt{5}}{5}$ $\sec\theta = \frac{\sqrt{5}}{2}$
$\tan\theta = \frac{1}{2}$ $\cot\theta = 2$

6. $\frac{-\sqrt{10}}{2}$

8. Amp = 3
Period = 180°
V.T. = Up 2
P.S. = none
Domain: $0° \le \theta \le 360°$

(b) Amp = 2
Period = 120°
V.T. = Down 2
P.S. = 60° left
Domain: θER

(c) Amp = 2
Period = 720°
V.T. = Up 5
P.S. = none
Domain: $-90 \le \theta \le 360°$
Range: $-3 \le y \le 7$

(d) Amp = 6
Period = 360°
V.T. = None
P.S. = 90° right
Domain: $\theta \varepsilon R$
Range: $-6 \le y \le 6$

10. 11.9 m

11. 46.2 cm

Attachments

worksheet-sketching in radian measure.doc

Worksheet - Finding the Equation.doc

Worksheet - Sketching Trigonometric Functions.doc

Worksheet Solns - Sketching Sinusoidal Relations.doc

Worksheet - Sketching Sinusoidal relations (sept06).pdf

Bonus Soln - Fox Population.doc

Worksheet Solns - Applications of Sinusoidal Relations.doc

Review - Practice Test for Sinusoidal Functions.doc

Review - Trigonometric Functions(3)(4).doc