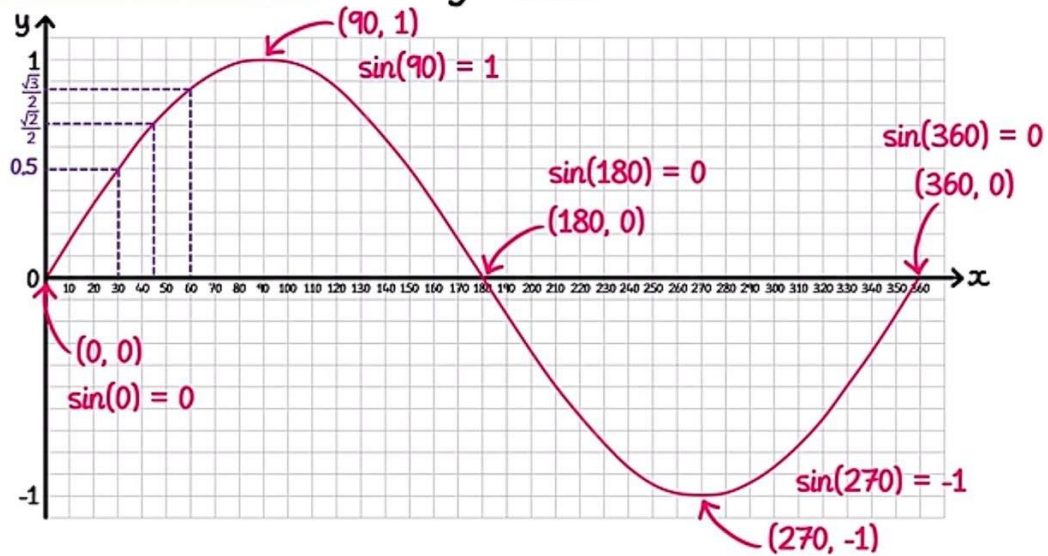


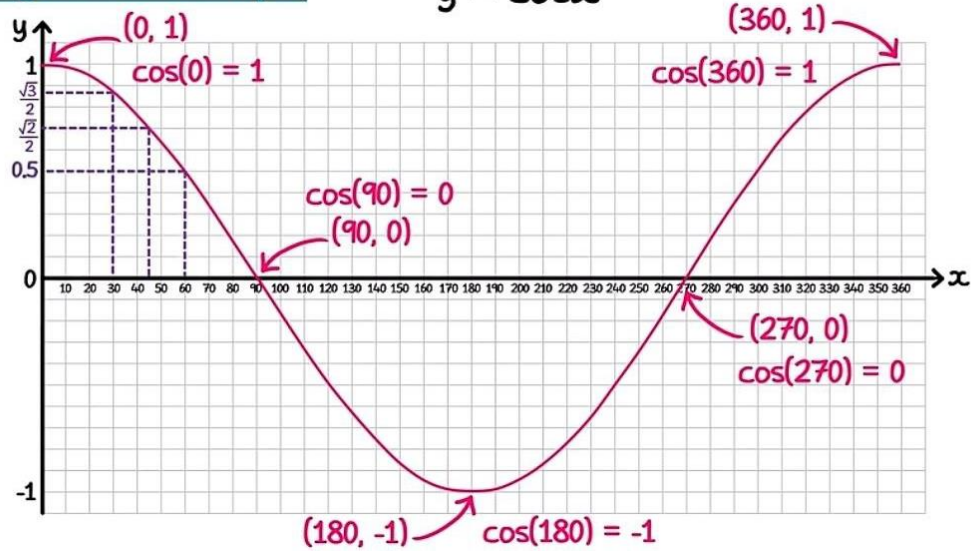
Trigonometric Graphs

$$y = \sin x^\circ$$

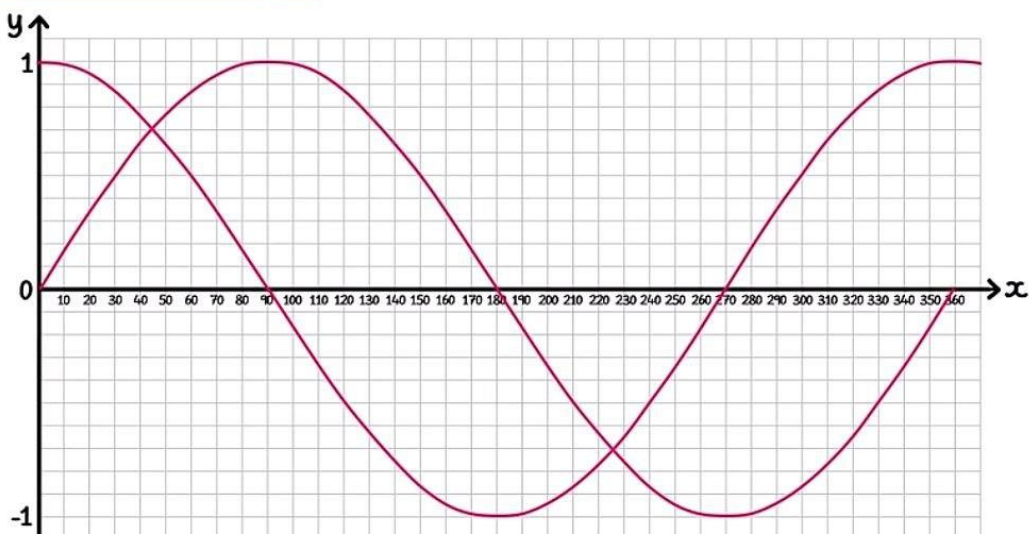


Trigonometric Graphs

$$y = \cos x^\circ$$



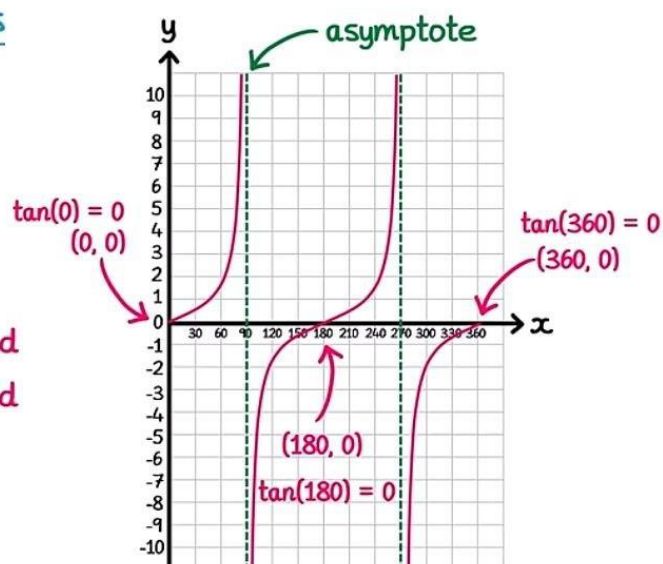
Trigonometric Graphs



Trigonometric Graphs

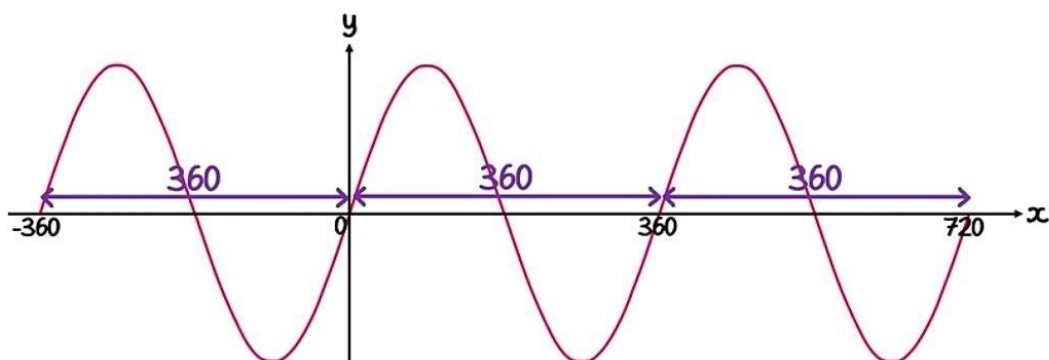
$$y = \tan x^\circ$$

$\tan(90)$ is undefined
 $\tan(270)$ is undefined



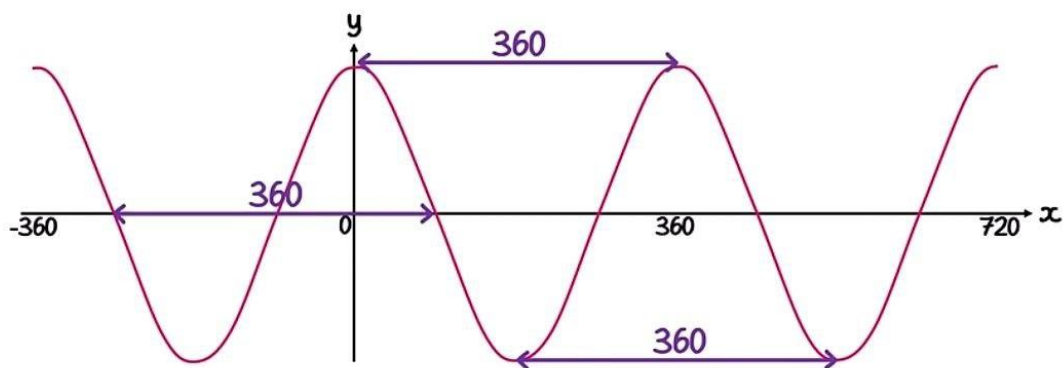
Trigonometric Graphs

Periodic Period = 360°



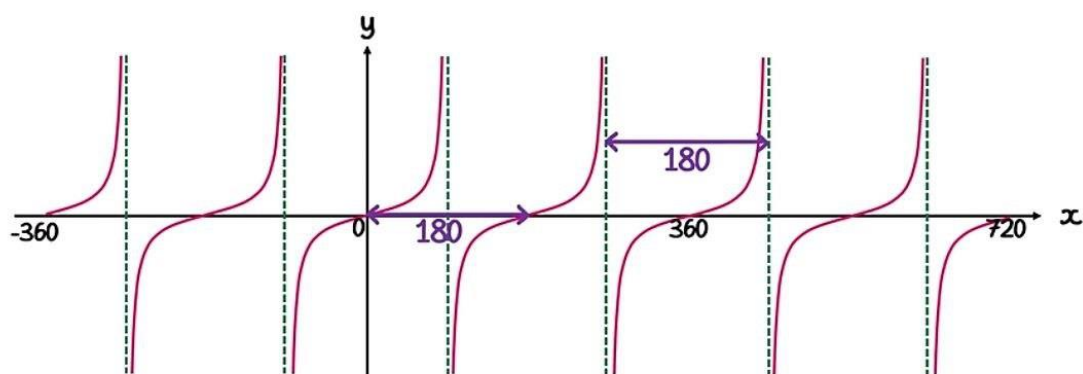
Trigonometric Graphs

Period = 360°

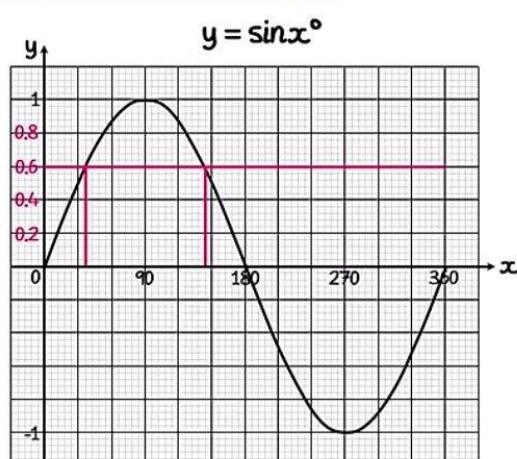


Trigonometric Graphs

Period = 180°



Trigonometric Graphs

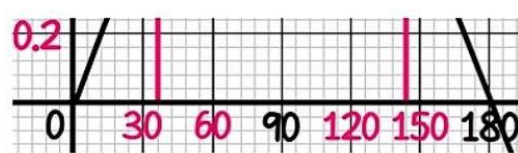


Use the graph to find estimates

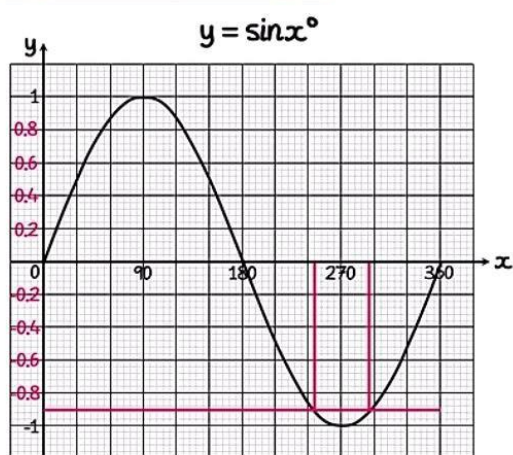
for the solutions of

$$\sin x^\circ = 0.6 \quad \text{for } 0 \leq x \leq 360$$

Answer: $x = 36^\circ$ and $x = 144^\circ$



Trigonometric Graphs



Use the graph to find estimates

for the solutions of

$$\sin x^\circ = 0.6 \quad \text{for } 0 \leq x \leq 360$$

Answer: $x = 36^\circ$ and $x = 144^\circ$

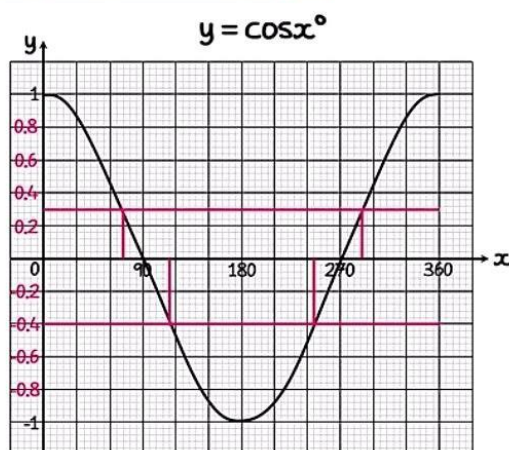
Use the graph to find estimates

for the solutions of

$$\sin x^\circ = -0.9 \quad \text{for } 0 \leq x \leq 360$$

Answer: $x = 246^\circ$ and $x = 294^\circ$

Trigonometric Graphs



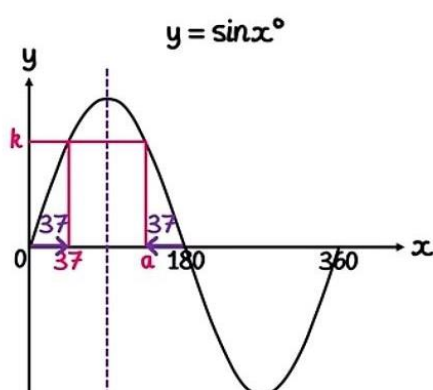
Use the graph to find estimates for the solutions of
 $\cos x^\circ = 0.3$ for $0 \leq x \leq 360$

Answer: $x = 72^\circ$ and $x = 288^\circ$

Use the graph to find estimates for the solutions of
 $\cos x^\circ = -0.4$ for $0 \leq x \leq 360$

Answer: $x = 114^\circ$ and $x = 246^\circ$

Trigonometric Graphs



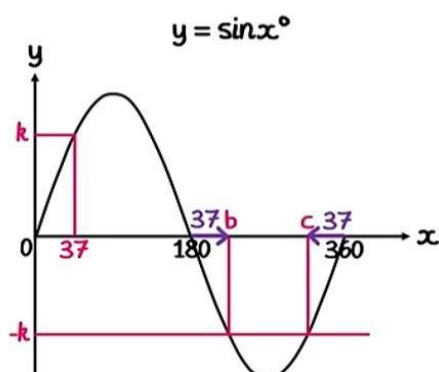
$\sin(a) = k$ where $90 \leq a \leq 360$

Find the value of a

Answer: $a = 180 - 37$

$a = 143^\circ$

Trigonometric Graphs



$\sin(a) = k$ where $90 \leq a \leq 360$

Find the value of a

Answer: $a = 180 - 37$

$a = 143^\circ$

$\sin(b) = -k$ where $180 \leq b \leq 360$
 $\sin(c) = -k$ where $180 \leq c \leq 360$

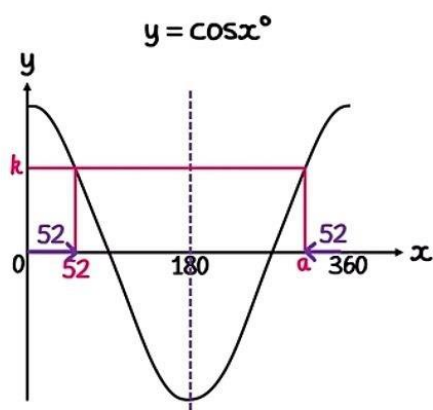
$b < c$

Find the values of b and c

Answers: $b = 180 + 37$ $c = 360 - 37$

$b = 217^\circ$ $c = 323^\circ$

Trigonometric Graphs

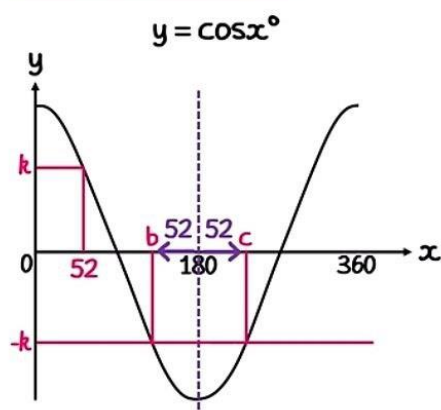


$\cos(a) = k$ where $270 \leq a \leq 360$

Find the value of a

Answer: $a = 360 - 52$

Trigonometric Graphs



$\cos(a) = k$ where $270 \leq a \leq 360$

Find the value of a

Answer: $a = 360 - 52$

$a = 308^\circ$

$\cos(b) = -k$ where $90 \leq b \leq 270$

$\cos(c) = -k$ where $90 \leq c \leq 270$

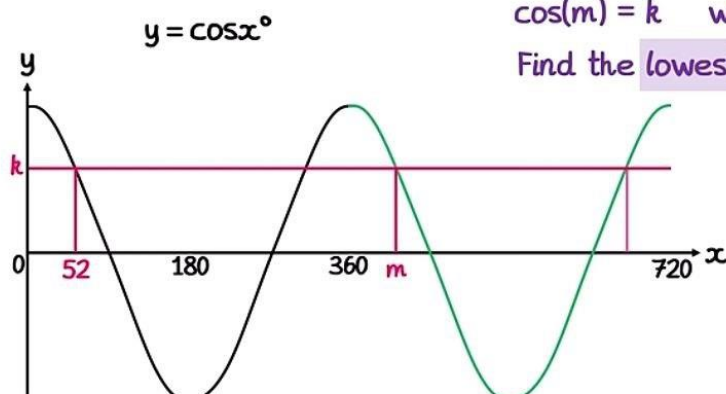
$b < c$

Find the values of b and c

Answers: $b = 180 - 52$ $c = 180 + 52$

$b = 128^\circ$ $c = 232^\circ$

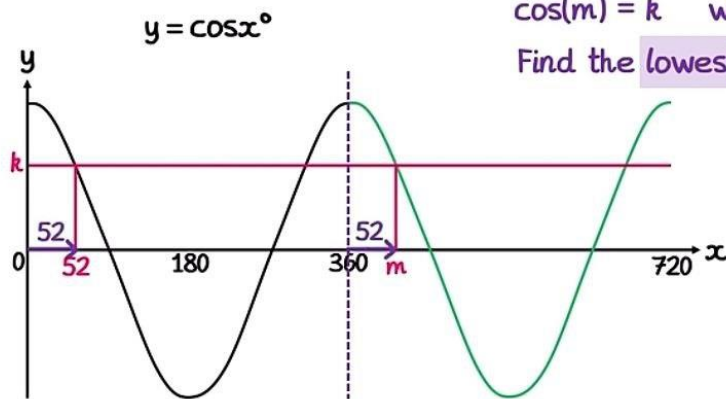
Trigonometric Graphs



$\cos(m) = k$ where $360 \leq m \leq 720$

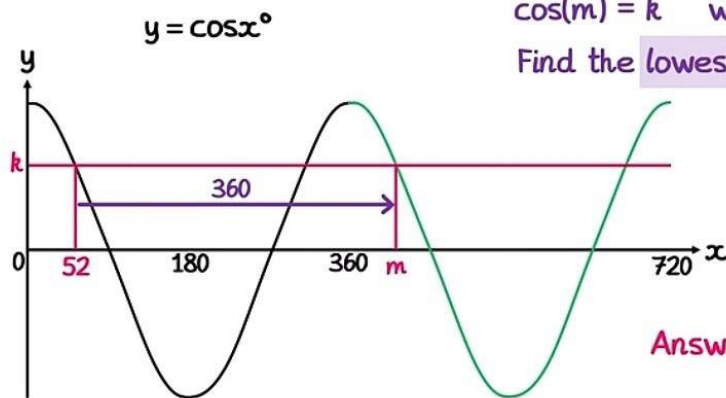
Find the lowest possible value of m

Trigonometric Graphs



$\cos(m) = k$ where $360 \leq m \leq 720$
Find the lowest possible value of m

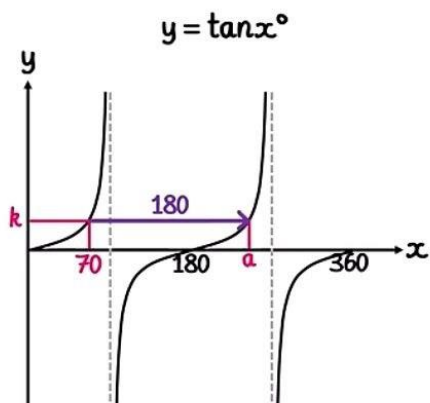
Trigonometric Graphs



$\cos(m) = k$ where $360 \leq m \leq 720$
Find the lowest possible value of m

Answer : $m = 360 + 52$
 $m = 412^\circ$

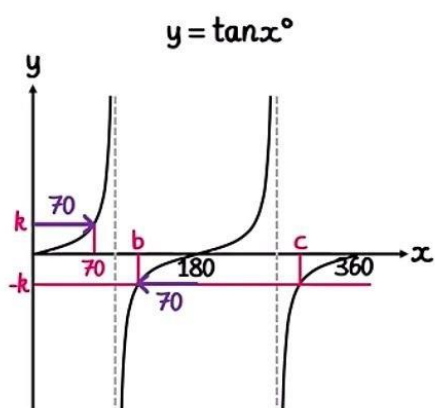
Trigonometric Graphs



$\tan(a) = k$ where $180 \leq a \leq 360$
Find the value of a

Answer : $a = 70 + 180$
 $a = 250^\circ$

Trigonometric Graphs



$$\tan(a) = k \quad \text{where } 180 \leq a \leq 360$$

Find the value of a

$$\text{Answer : } a = 70 + 180$$

$$a = 250^\circ$$

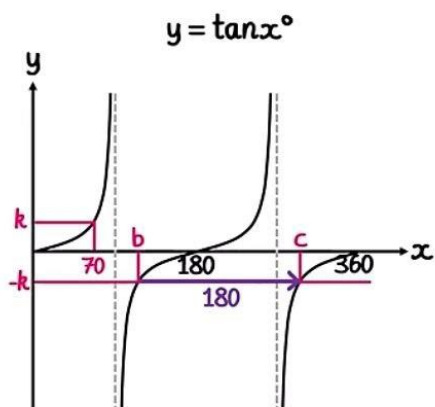
$$\begin{array}{l} \tan(b) = -k \\ \tan(c) = -k \end{array} \quad \text{where } \begin{array}{l} 90 \leq b \leq 180 \\ 270 \leq c \leq 360 \end{array}$$

Find the values of b and c

$$\text{Answers : } b = 180 - 70$$

$$b = 110^\circ$$

Trigonometric Graphs



$$\tan(a) = k \quad \text{where } 180 \leq a \leq 360$$

Find the value of a

$$\text{Answer : } a = 70 + 180$$

$$a = 250^\circ$$

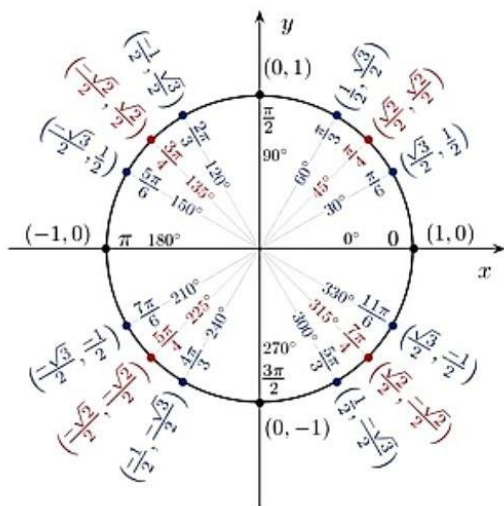
$$\begin{array}{l} \tan(b) = -k \\ \tan(c) = -k \end{array} \quad \text{where } \begin{array}{l} 90 \leq b \leq 180 \\ 270 \leq c \leq 360 \end{array}$$

Find the values of b and c

$$\text{Answers : } b = 180 - 70 \quad c = 110 + 180$$

$$b = 110^\circ \quad c = 290^\circ$$

Graphing Trigonometric Functions

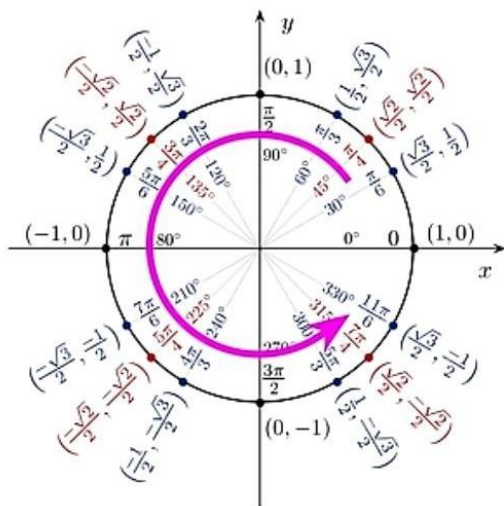


every point has
the coordinates
($\cos\theta$, $\sin\theta$)

$$y = \sin\theta$$

domain = possible inputs

range = possible sine values

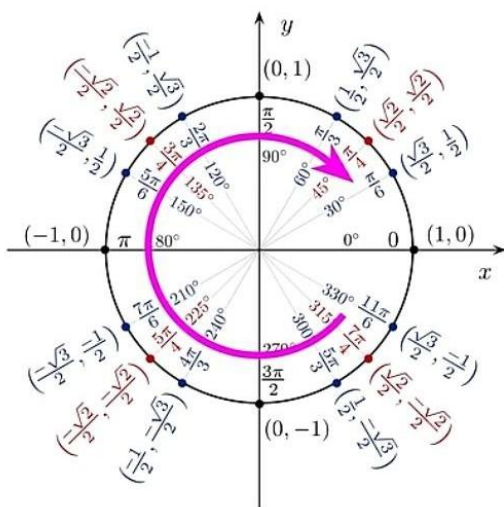


every point has
the coordinates
($\cos\theta$, $\sin\theta$)

$$y = \sin\theta$$

domain = all real numbers

range = possible sine values

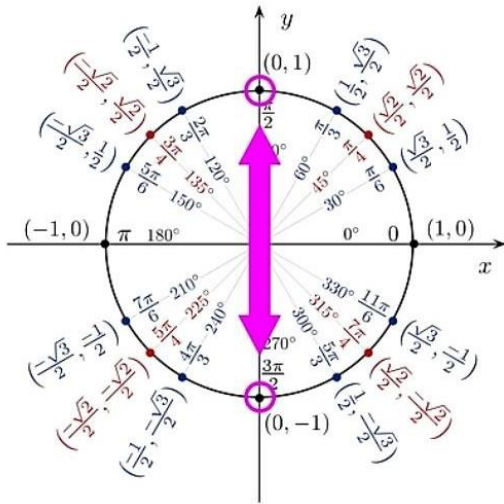


every point has
the coordinates
($\cos\theta$, $\sin\theta$)

$$y = \sin\theta$$

domain = all real numbers

range = possible sine values

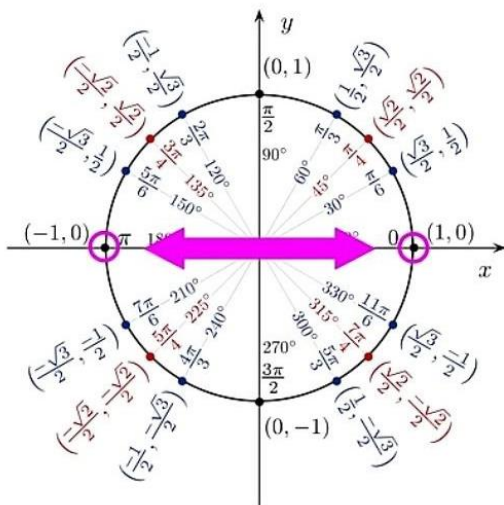


every point has
the coordinates
($\cos \theta$, $\sin \theta$)

$$y = \sin \theta$$

domain = all real numbers

$$\text{range} = -1 \leq y \leq 1$$

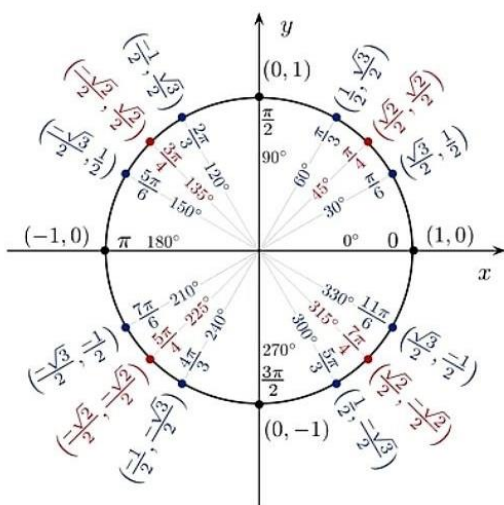


every point has
the coordinates
($\cos \theta$, $\sin \theta$)

$$y = \cos \theta$$

domain = all real numbers

$$\text{range} = -1 \leq y \leq 1$$



$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

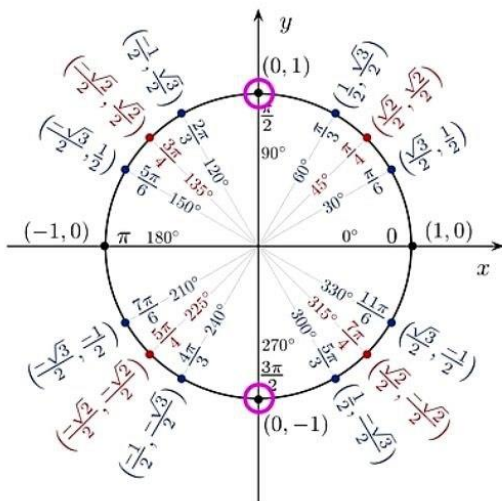
$$\cos \theta \rightarrow 0^{+/-}$$

$$\tan \theta \rightarrow +/- \infty$$

$$y = \tan \theta$$

range = all real numbers

Graphing Trigonometric Functions



$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

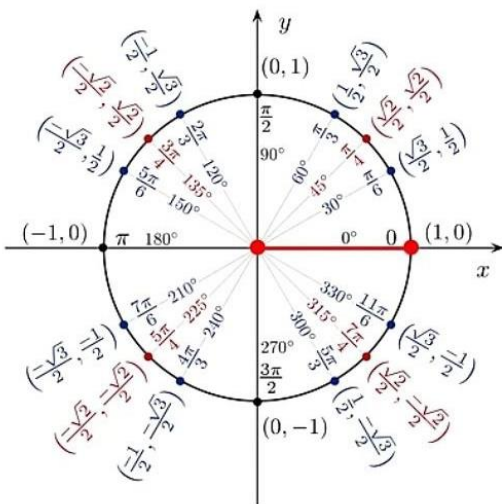
when $\cos \theta = 0$

$\tan \theta = \text{undefined}$

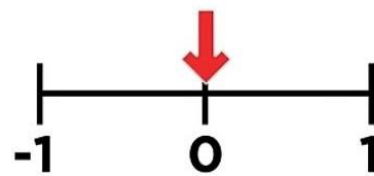
$$y = \tan \theta$$

range = all real numbers

domain = all real numbers
except $\pi/2 + \pi n$

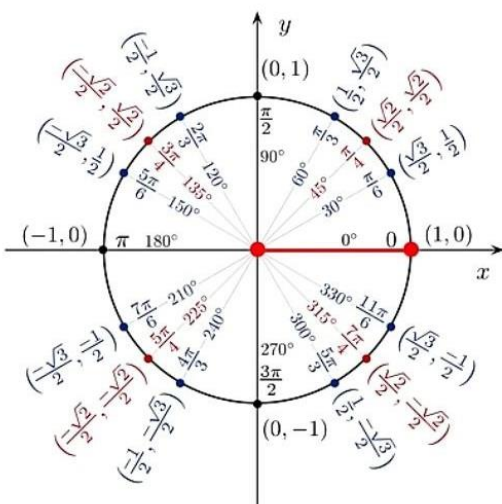


trig functions
are periodic

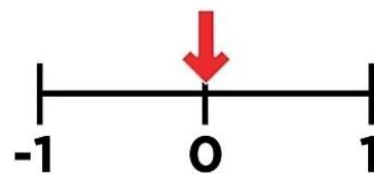


$\sin \theta$

period = 2π



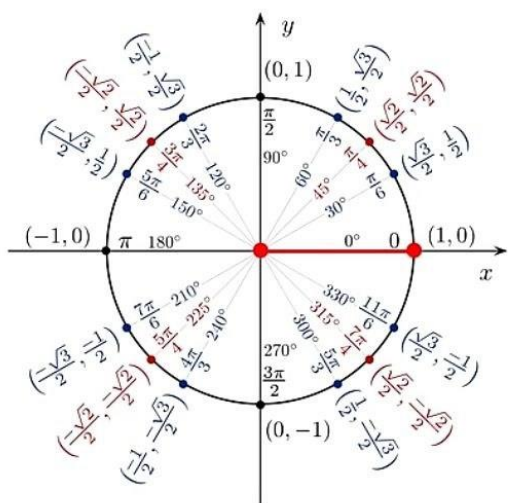
trig functions
are periodic



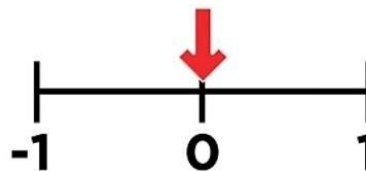
$\sin \theta$

$$\sin x = \sin (x + 2\pi)$$

Graphing Trigonometric Functions

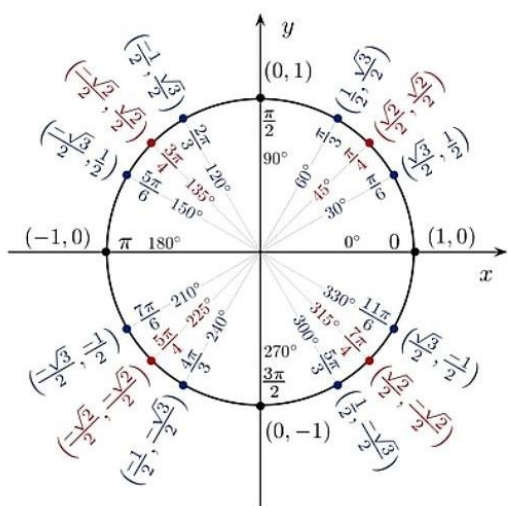


trig functions
are **periodic**



$\sin \theta$

$$\cos x = \cos (x + 2\pi)$$

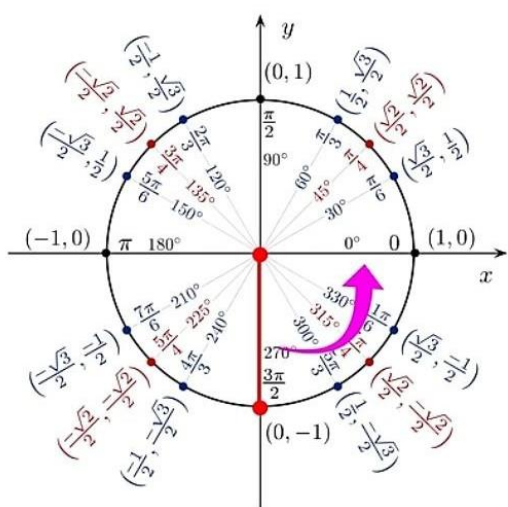


let's graph:

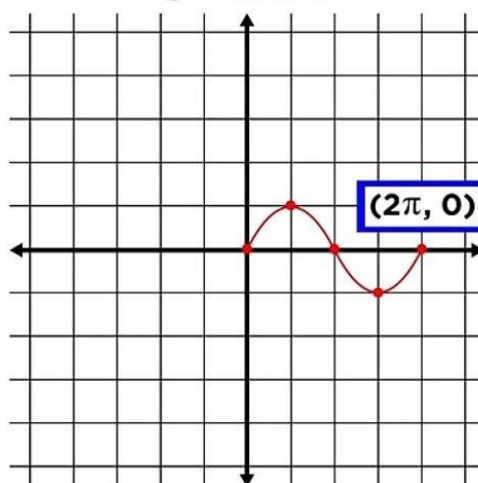
$$y = \sin x$$

and

$$y = \cos x$$

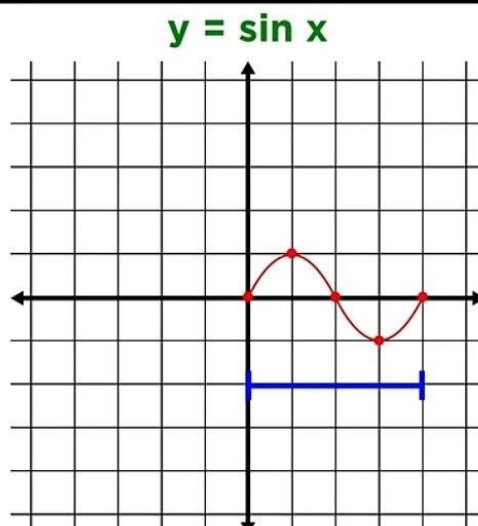


$y = \sin x$



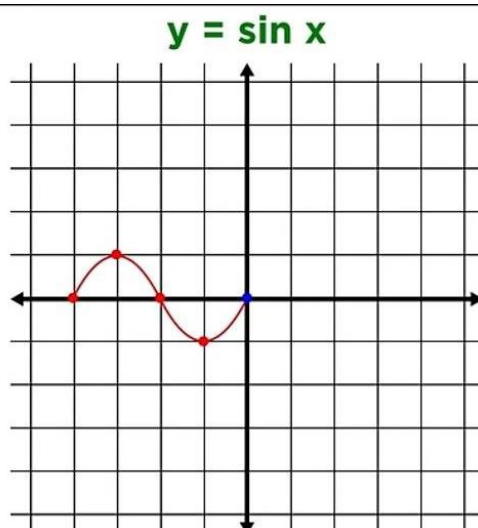
Graphing Trigonometric Functions

this represents
one period
of the function



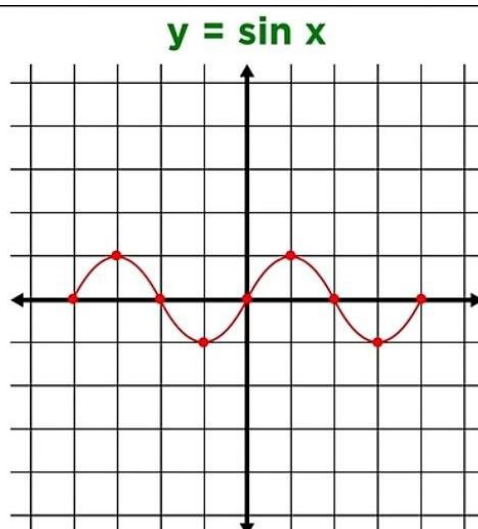
this represents
one period
of the function

for the next
period all the
values **repeat**



this represents
one period
of the function

for the next
period all the
values **repeat**

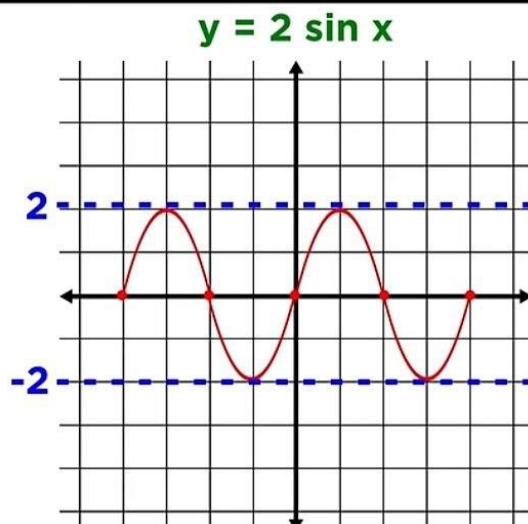


Graphing Trigonometric Functions

transformations

vertical stretch

$$y = a \sin x$$

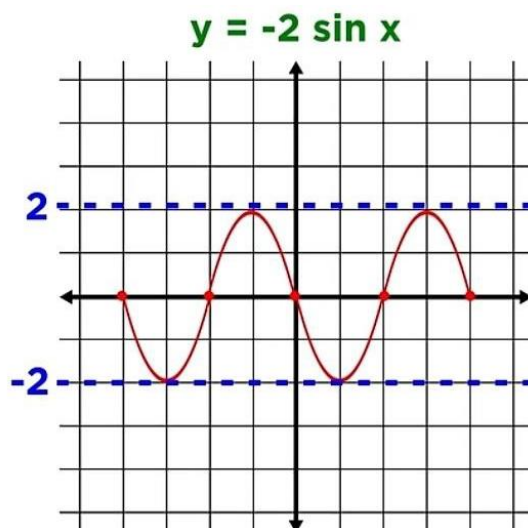


transformations

vertical stretch

$$y = a \sin x$$

amplitude = $|a|$



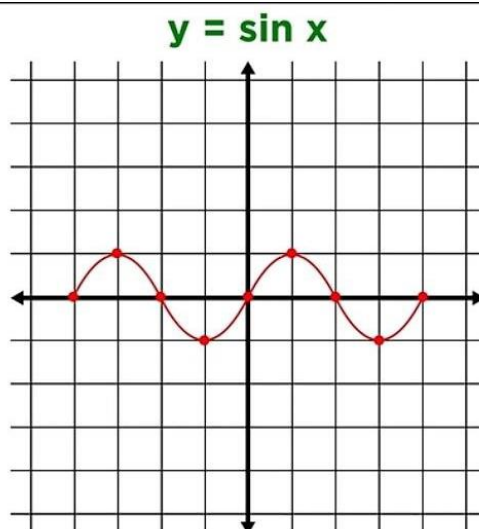
transformations

vertical stretch

$$y = a \sin x$$

horizontal stretch

$$y = \sin bx$$



Graphing Trigonometric Functions

transformations

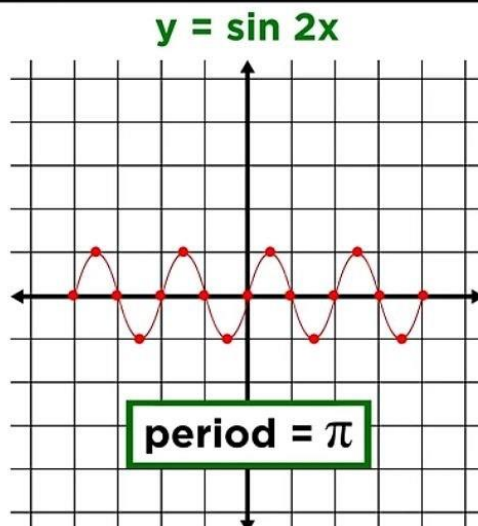
vertical stretch

$$y = a \sin x$$

horizontal stretch

$$y = \sin bx$$

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



transformations

vertical stretch

$$y = a \sin x$$

horizontal stretch

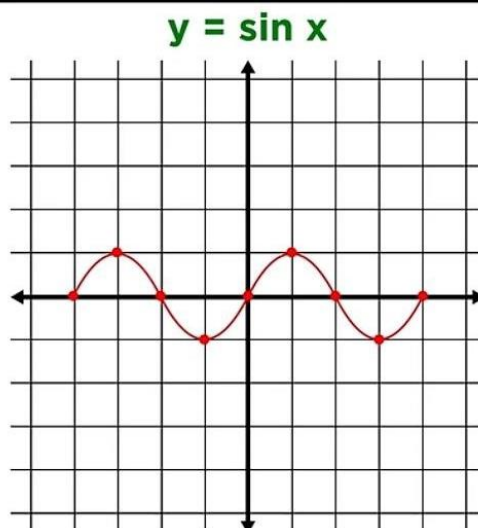
$$y = \sin bx$$

vertical shift

$$y = \sin x + k$$

horizontal shift

$$y = \sin (x + h)$$



transformations

vertical stretch

$$y = a \sin x$$

horizontal stretch

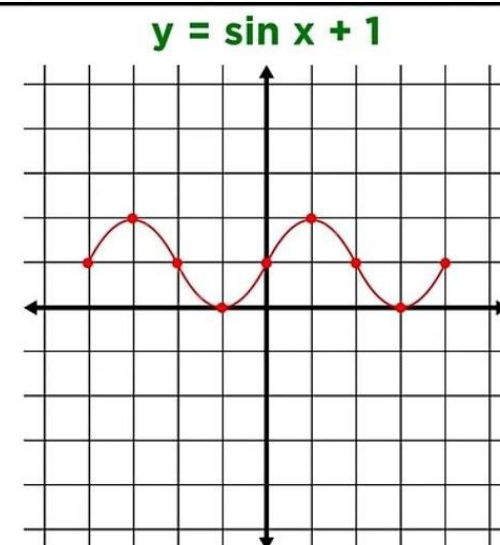
$$y = \sin bx$$

vertical shift

$$y = \sin x + k$$

horizontal shift

$$y = \sin (x + h)$$



Graphing Trigonometric Functions

transformations

vertical stretch

$$y = a \sin x$$

horizontal stretch

$$y = \sin bx$$

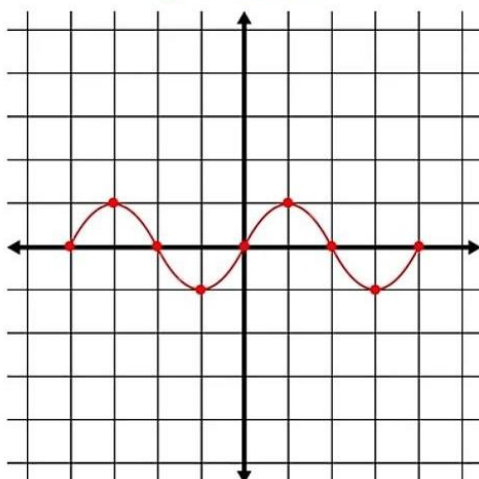
vertical shift

$$y = \sin x + k$$

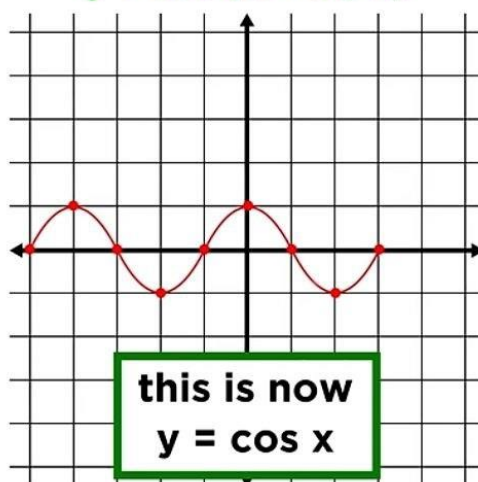
horizontal shift

$$y = \sin (x + h)$$

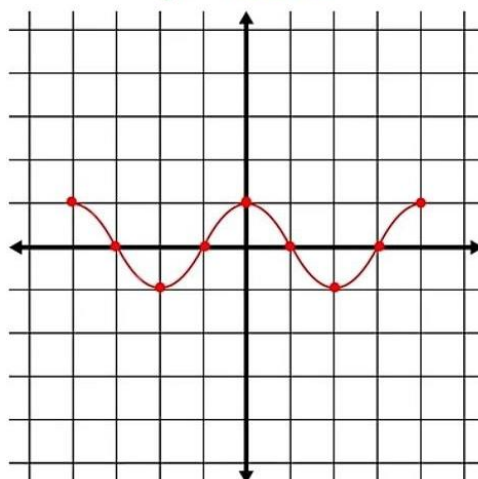
$$y = \sin x$$



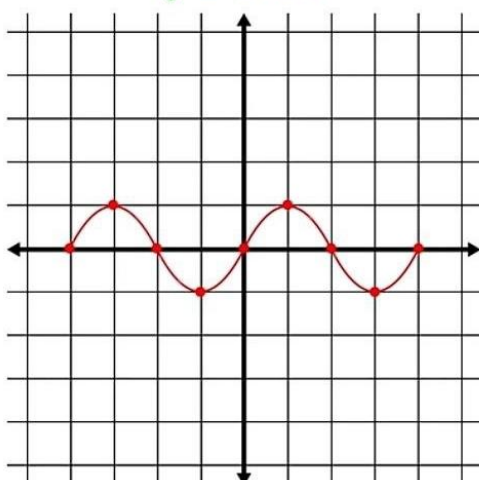
$$y = \sin (x + \pi/2)$$



$$y = \cos x$$



$$y = \sin x$$

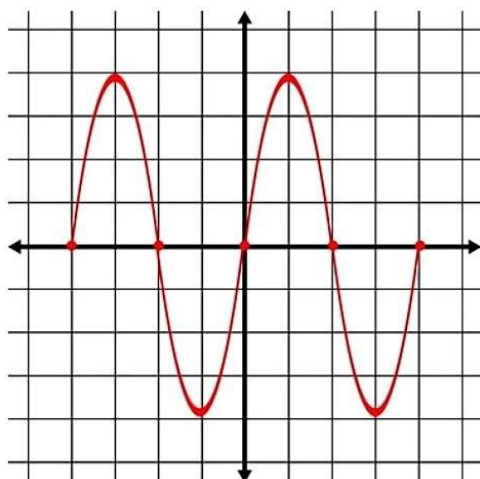


Let's graph:

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

Graphing Trigonometric Functions

$$y = 4 \sin x$$

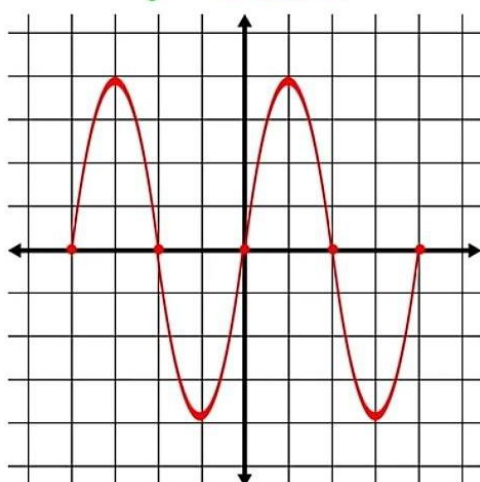


Let's graph:

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

$$\text{amplitude} = 4$$

$$y = 4 \sin x$$



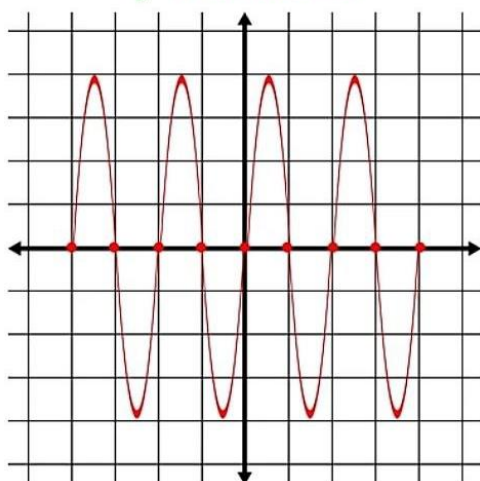
Let's graph:

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

$$\text{amplitude} = 4$$

$$\text{period} = 2\pi/2$$

$$y = 4 \sin 2x$$



Let's graph:

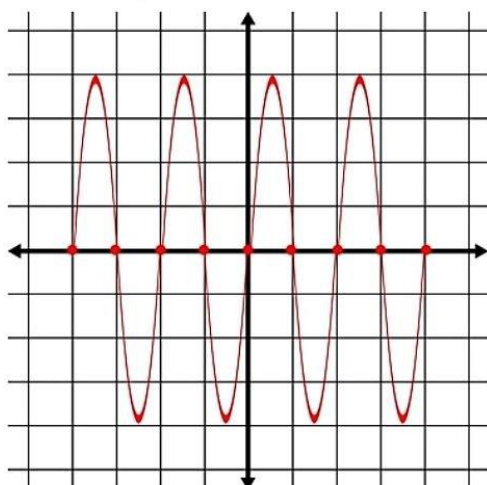
$$y = 4 \sin (2x - 2\pi/3)$$

$$\text{amplitude} = 4$$

$$\text{period} = \pi$$

Graphing Trigonometric Functions

$$y = 4 \sin 2x$$



Let's graph:

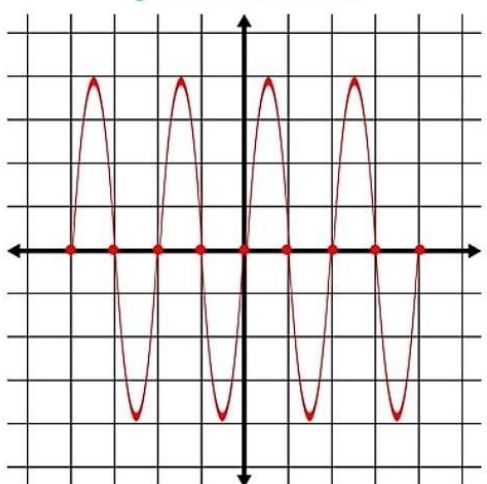
$$y = 4 \sin (2x - 2\pi/3)$$

amplitude = 4

period = π

phase shift = $2\pi/3$

$$y = 4 \sin 2x$$



Let's graph:

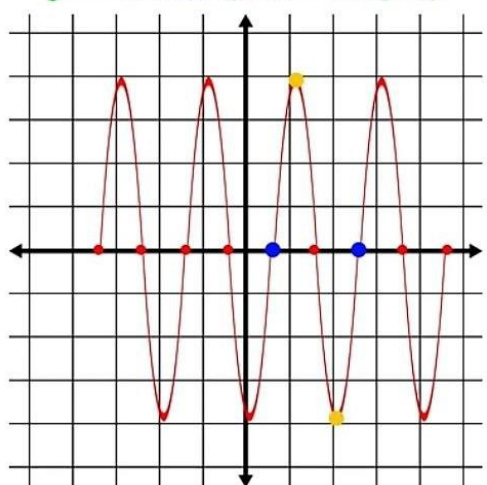
$$y = 4 \sin (2x - 2\pi/3)$$

amplitude = 4

period = π

phase shift = $\frac{2\pi/3}{2}$

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



Let's graph:

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

amplitude = 4

period = π

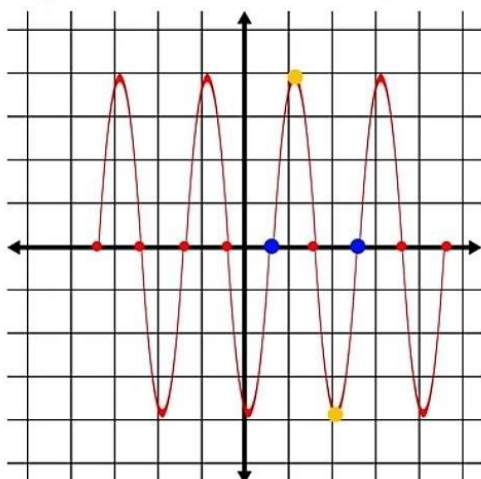
phase shift = $\pi/3$

period:

$\pi/3 \rightarrow 4\pi/3$

Graphing Trigonometric Functions

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



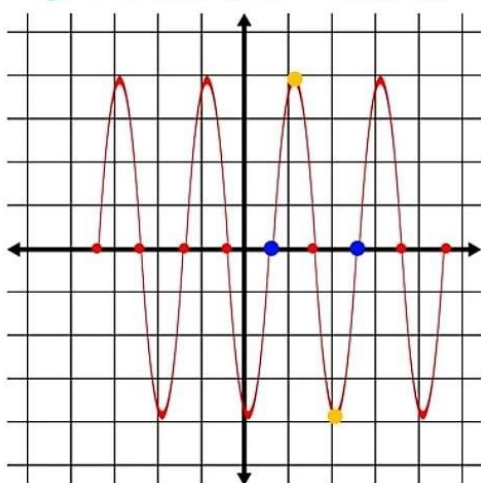
Let's graph:

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

$$\text{period} = \pi$$

- Point 1: $\pi/3$
- Point 2:
- Point 3:
- Point 4:
- Point 5: $4\pi/3$

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



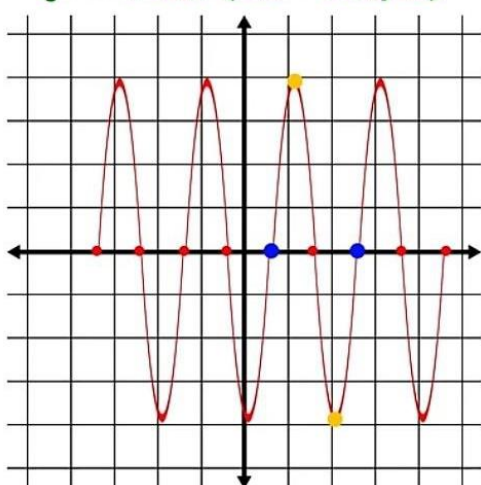
Let's graph:

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

$$\text{period} = 4(\pi/4)$$

- Point 1: $\pi/3$
- Point 2: $\pi/3 + \pi/4$
- Point 3: $\pi/3 + 2\pi/4$
- Point 4: $\pi/3 + 3\pi/4$
- Point 5: $4\pi/3$

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



Let's graph:

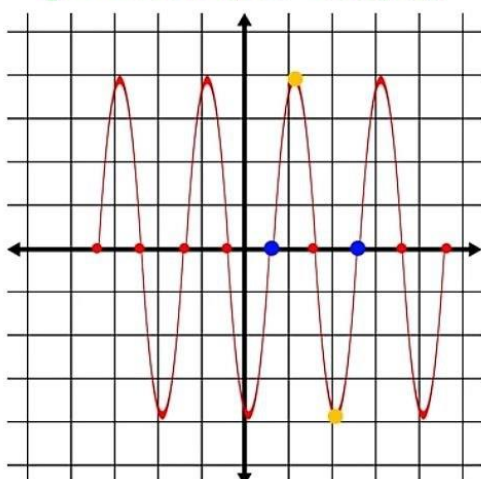
$$y = 4 \sin (2x - 2\pi/3)$$

$$\text{period} = 4(\pi/4)$$

- Point 1: $\pi/3$
- Point 2: $4\pi/12 + 3\pi/12$
- Point 3: $4\pi/12 + 6\pi/12$
- Point 4: $4\pi/12 + 9\pi/12$
- Point 5: $4\pi/3$

Graphing Trigonometric Functions

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



Let's graph:

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

$$\text{period} = 4(\pi/4)$$

- Point 1: $\pi/3$
- Point 2: $7\pi/12$
- Point 3: $5\pi/6$
- Point 4: $13\pi/12$
- Point 5: $4\pi/3$

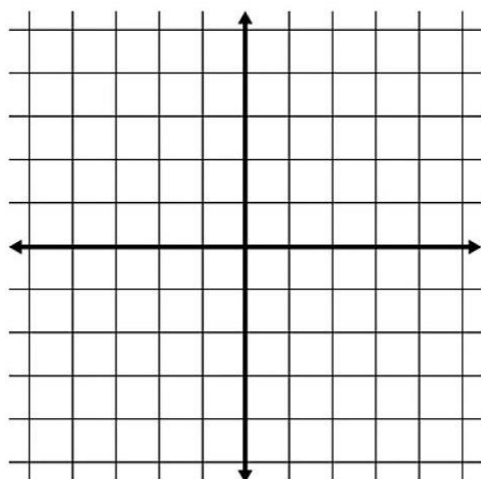
Let's take a quick look at:

$\tan x$

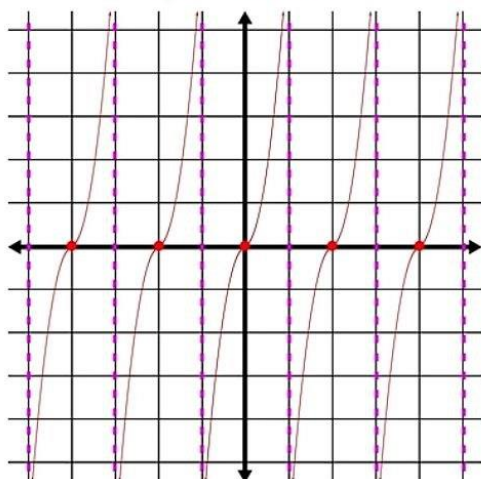
$\cot x$

$\csc x$

$\sec x$



$$y = \tan x$$



$$\tan x = \frac{\sin x}{\cos x}$$

range: $(-\infty, \infty)$

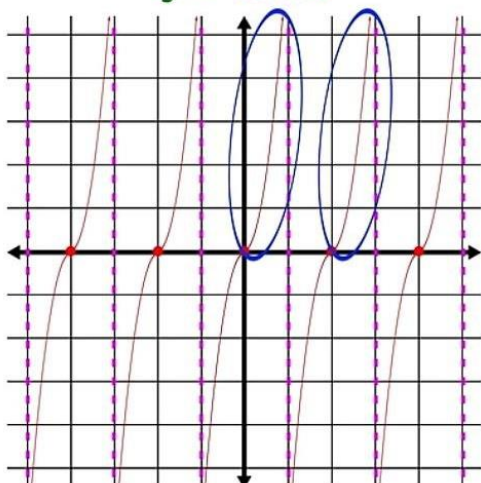
$\cos x \rightarrow 0^{+/-}$

$\tan x \rightarrow +/- \infty$

$\cos x = 0 \rightarrow \tan x = \text{undefined}$

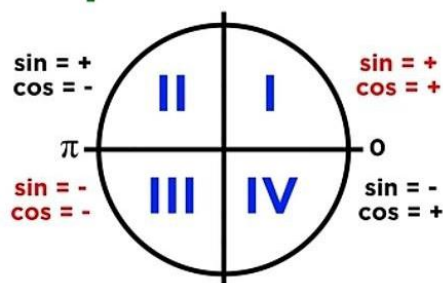
Graphing Trigonometric Functions

$$y = \tan x$$

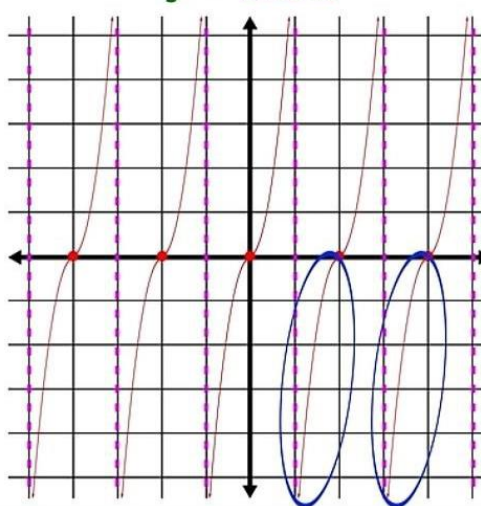


$$\tan x = \frac{\sin x}{\cos x}$$

$$\text{period} = \pi$$

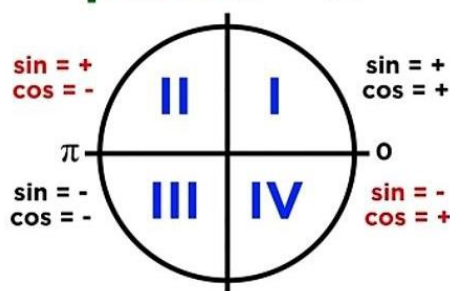


$$y = \tan x$$

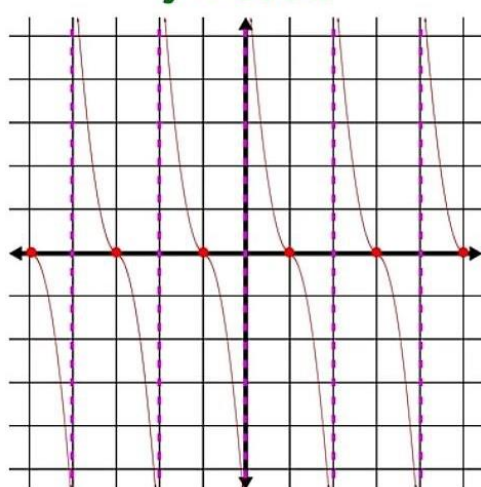


$$\tan x = \frac{\sin x}{\cos x}$$

$$\text{period} = \pi$$



$$y = \cot x$$



$$\cot x = \frac{\cos x}{\sin x}$$

$$\sin x / \cos x = \text{undefined}$$

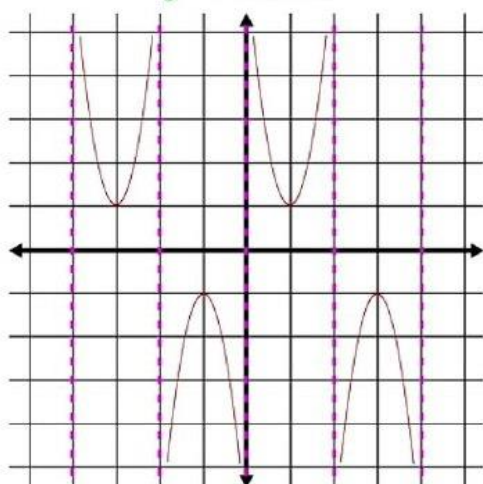
$$\cos x / \sin x = 0$$

$$\sin x / \cos x = 0$$

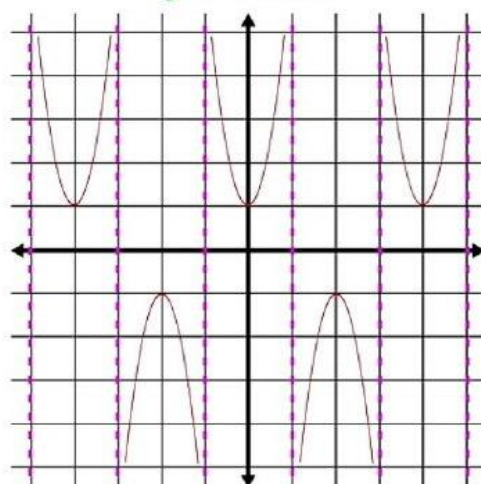
$$\cos x / \sin x = \text{undefined}$$

Graphing Trigonometric Functions

$$y = \csc x$$



$$y = \sec x$$



What is the equation for a sine function with an amplitude of three and a period of four π ?

$$y = 3 \sin(x/2)$$

What is the equation for a cosine function with an amplitude of two and a period of π that has been shifted five units down?

$$y = 2 \cos(2x) - 5$$