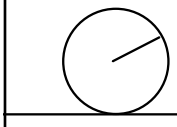
Modeling using sinusoidal functions



r = 1 unit

1 revolution in 60 seconds

Remember:

we want 1 degree or radian to equal 1 unit of our x-axis;

we will have to change the x-axis in the "window" to properly see one cycle;

The London Eye



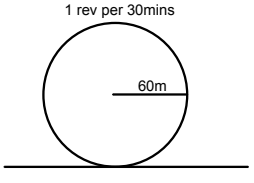



height = 120m

1 turn in 30 minutes

Write a function that models the height a passenger is from the ground given how long (in minutes) they have been riding.

h(t) =

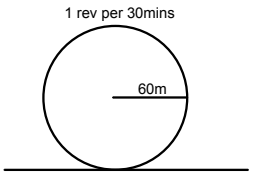


a=

b=

c=

d=



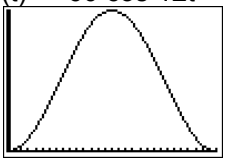
a= 60

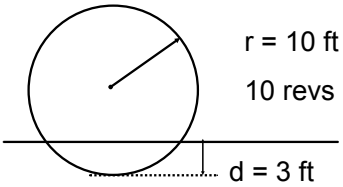
b= 12

c= 0

d= 60

h(t) = -60 cos 12t + 60





r = 10 ft

10 revs per minute

d = 3 ft

a =

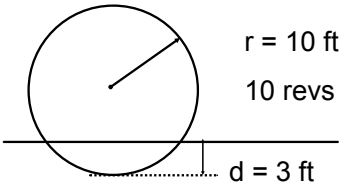
b =

c =

d =

time (seconds)

on the calculator make a line for the principal axis.



r = 10 ft

10 revs per minute

d = 3 ft

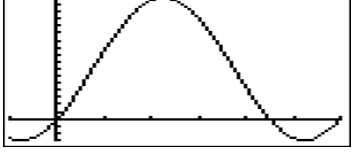
a = 10

b = 60

c =-.76

d = 7

h(t) = -10 cos 60(t + .76) + 7



on the calculator make a line for the principal axis.

Suppose you are at the beach at 2 pm and notice it is a high tide of 1.5m. You loiter and sun-bathe until 8 pm when it is low tide with a depth of 1.1m. Assuming the water depth varies sinusoidally, write an equation that models the depth of water by hours from 12:00 noon.

The depth of water (m) at a wharf is modeled by the equation $d(t) = 0.2 \sin 30t + 1.3$, where t is number of hours from midnight.

Sketch d(t) for $0 \leq t \leq 24$.

Find when the water will have a depth of 1.4m.

Find the times of the next low tides

Using this tide-table for the Willamette River, at Portland, sketch the curve and write an equation that models the depth of the river in minutes from midnight. Assume the depth varies sinusoidally.

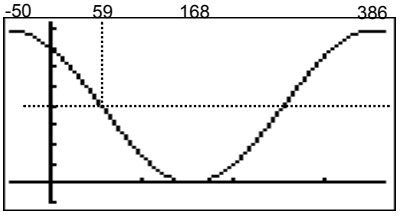
Ht 3" L 2:48 am

Ht 98" H 6:26 am

Ht 3" L 2:48 am

Ht 98" H 6:26 am

p = 436 mins, b = 360/436



a = 47.5

c = -50 or 59

d = 50.5

$d(t) = 47.5 \cos 0.826(x + 50) + 47.5$

$d(t) = -47.5 \sin 0.826(x - 59) + 47.5$

The angle of elevation of the sun varies sinusoidally with the time of day. Let t be the number of hours that has elapsed since midnight last night. If the sun reaches it's highest at 12:22 pm with an angle of elevation of 60^{o}. The period is, of course, 24 hours. Sketch the curve and write the equation that models the height of the sun above the horizon in degrees by hours from midnight. (22 minutes = 0.37 hours)

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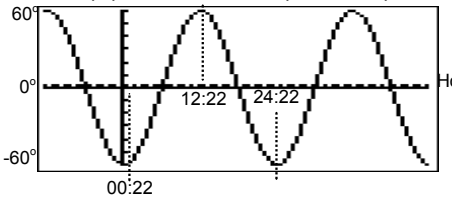
$e(h) = -60 \cos 15(h - 0.37)$



a = 60

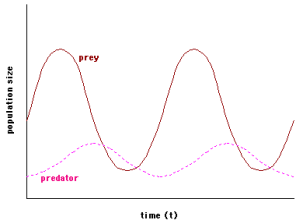
b = 15

c = +0.37

d = 0

Predator-Prey Population Curves

Often the balance between predator and prey populations can be modeled using a sinusoidal function.



Huffaker, C. B. 1958. Experimental studies on predation: dispersion factors and predator-prey oscillations. Hilgardia **27**(14):343-383

A population of foxes minimized at 200 animals at 2.9 years after record-keeping started. The population peaked at 800 animals 2.2 years later.

Sketch the graph of this sinusoid.

Write an equation to model the population w.r.t. years.

Predict the population seven years after record keeping began.

When did the population first drop below 300 animals?

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Sketch the graph of this sinusoid.

Write an equation to model the population w.r.t. years.

Predict the population seven years after record keeping began. 227 foxes

When did the population first drop below 300 animals? 2.3 years

a = 300

b = 81.8

c = 0.7

d = 500

$p(t) = 300 \cos 81.81(x - 0.7) + 500$