Precalculus

Lesson 8.5: Simple Harmonic Motion and combining Waves

Mrs. Snow, Instructor

Repetitive motion as seen in the rising and falling of the tide, the changing of the seasons year after year, or sunrise and sunset are all examples of periodic behavior. Trigonometric functions are ideally suited for modeling periodic behavior.

cycle: one complete vibration or motion of an object is a cycle

amplitude: $|a|$ the distance from the object's rest position to its point of greatest displacement

period: $T = \frac{2\pi}{\omega}$; time required to complete one complete cycle

frequency: $f = \frac{\omega}{2\pi}$ number of cycles per unit of time

reciprocals!!

simple harmonic motion: an object is considered to be in simple harmonic motion if the displacement **d** of an object at time **t** can be modeled by:

$$d = a\, sin\omega t \quad or \quad d = a\cos\omega t$$

Thoughts: consider the equation that models harmonic motion at time 0, the starting point.

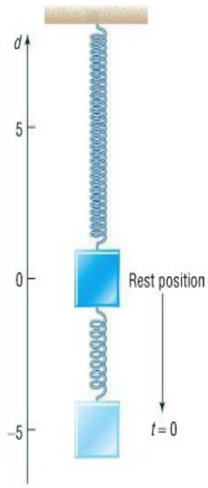
$$solve\ for\ displacement:$$
$$d = a\, sin\omega t \quad at\ t = 0,$$

$$d = a\cos\omega t \quad at\ time = 0$$

So, one equation works for situations where there is no displacement at initial conditions and the other equations is applicable for initial conditions that have a displacement.

Build a Model for an Object in Harmonic Motion: a vibrating spring

Suppose that an object attached to a coiled spring is pulled down a distance of 5 inches from its rest position and then released. If the time for one oscillation is 3 seconds, develop a model that relates the displacement d of the object from its rest position after time t (in seconds). Assume no friction.



Suppose that the displacement d (in meters) of an object at time t (in seconds) satisfies the equation $d = 10\sin(5t)$

a) Describe the motion of the object
b) What is the maximum displacement from its resting position
c) What is the time required of an oscillation?
d) What is the frequency?

A Ferris wheel Problem

A person is seated on a Ferris wheel of radius 100 ft that makes one rotation every 30 s. The center of the wheel is 105 ft above the ground. Find and graph a function to represent the person's height above the ground at any time t of a 2-minute ride. Assume uniform speed from the beginning to the end of the ride and that the person is at the level of the center of the wheel and headed up when the ride begins.
(hint: Make a table of time vs. height, graph and build an equation based on the graph.)