

Section 1.2 – Mathematical Models and Periodic Functions

**Objective:** Given a real-world situation in which there are two variable quantities, sketch a reasonable graph showing how these variables are related to each other.

Functions that could represent relationships in the real world are called mathematical models.

People who apply mathematics to make predictions about things in the real world want to be able to calculate values of a dependent variable for given values of the independent variable.

Sketch a reasonable graph for each situation.

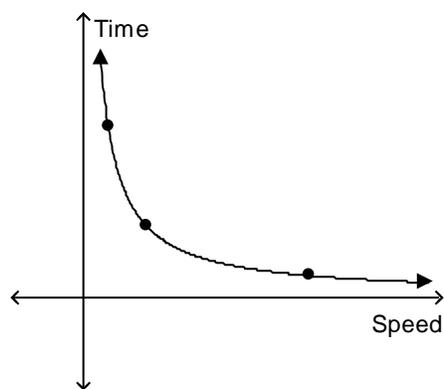
Example 1: The time it takes you to get home from a football game is related to how fast you drive.

The time to get home depends on the speed you are traveling.

So, time is on the vertical axis and speed is on the horizontal axis.

To determine the graph, think about what happens to the time as your speed varies. The faster you go, the less time it will take you to get home. The slower you go, the longer it will take you to get home.

Graph a few points and connect them with a curve.



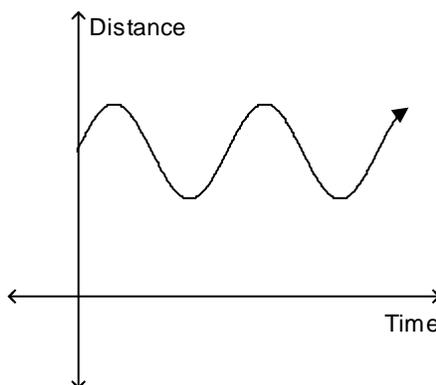
What if your speed is zero?

That means you are stopped and you will never get home. So the graph does not touch the vertical axis.

Since it always takes you some amount of time no matter how fast you drive, the graph never touches the horizontal axis.

Remember from Algebra II that a line that a graph gets closer and closer to, but never touches as  $x$  or  $y$  gets very large is called an asymptote. Both the Time and Speed axes above are asymptotes.

Example 2: As a windmill turns, the distance between the tip of a blade and the ground depends on time.

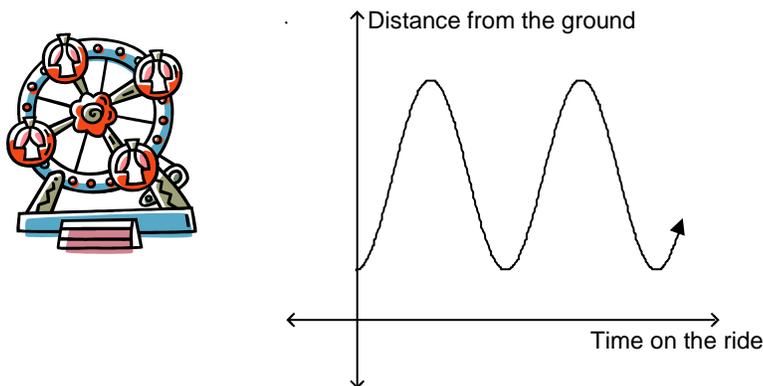


Why doesn't the graph ever touch the horizontal axis?

Functions whose graphs behave like the graph in Example 2 are called periodic functions. The dependent variable has values that repeat themselves as the independent variable changes. As you will soon learn, trigonometric functions have graphs that are periodic.

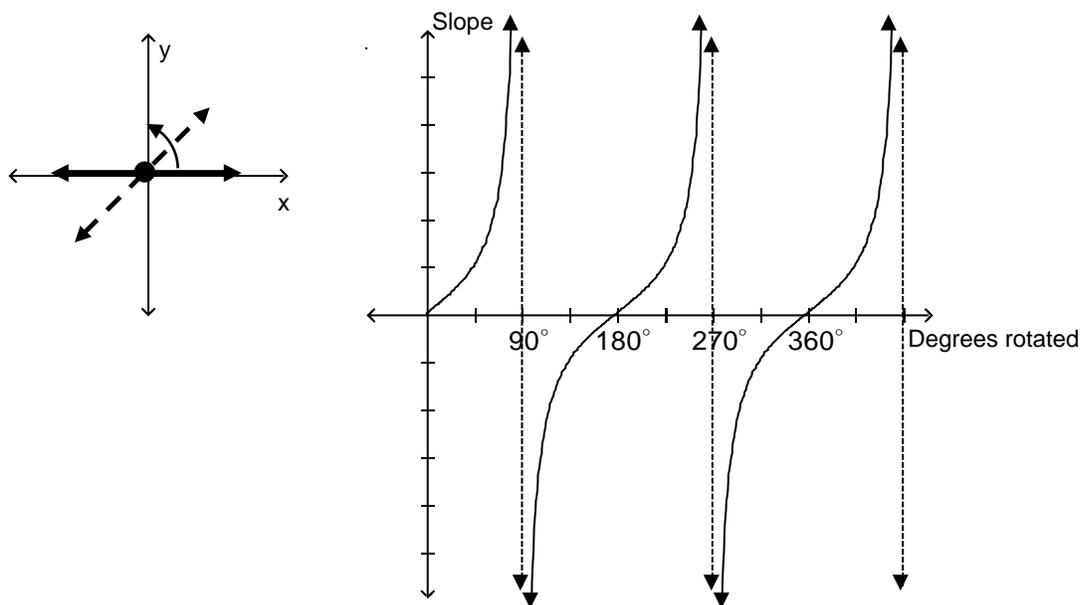
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Example 3: As you ride the Ferris wheel at the amusement park, your distance from the ground depends on how long you have been riding.



The Ferris wheel has a radius of 164 feet. If you make ten complete revolutions in one of the Ferris wheel's compartments, how far will you have traveled? Show how you get the answer.

Example 4: A line starts along the positive x-axis and rotates counterclockwise around and around the origin of a coordinate system. The slope of the line depends on the number of degrees through which the line has rotated.



Recall:

The slope of a line with the points  $(x_1, y_1)$  and  $(x_2, y_2)$  is defined to be  $m = \frac{y_2 - y_1}{x_2 - x_1}$ .

A horizontal line has a slope  $m = 0$ .

A vertical line has a slope that is undefined.