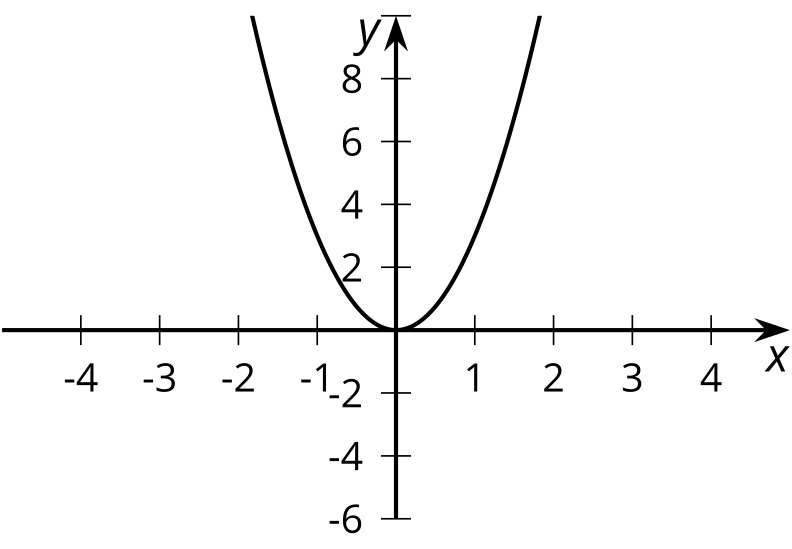
## Lesson 13: Amplitude and Midline

* Let's transform the graphs of trigonometric functions

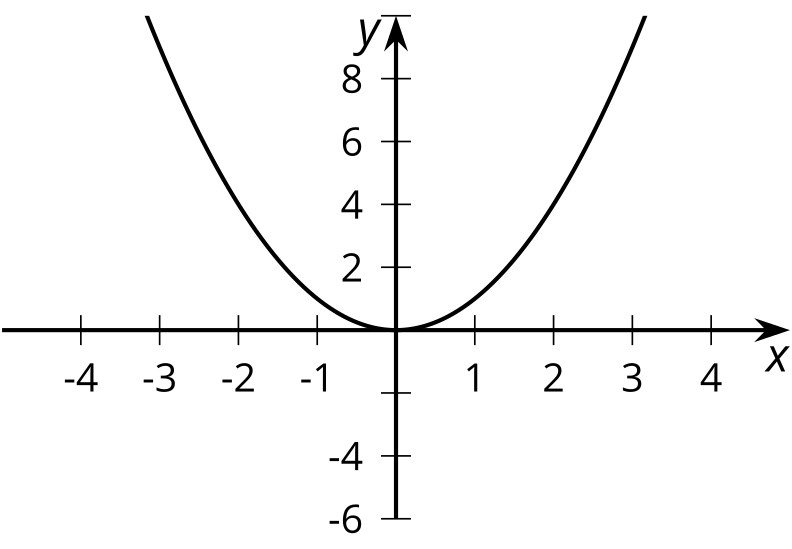
### 13.1: Comparing Parabolas

Match each equation to its graph.

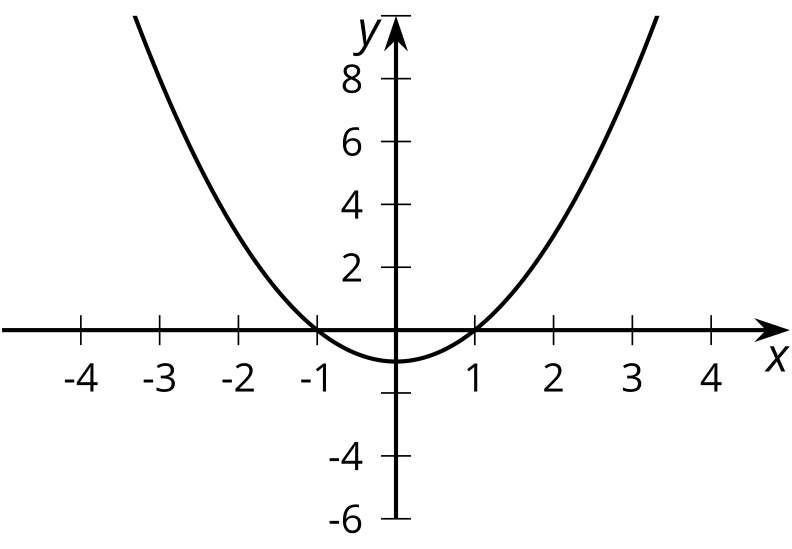
A



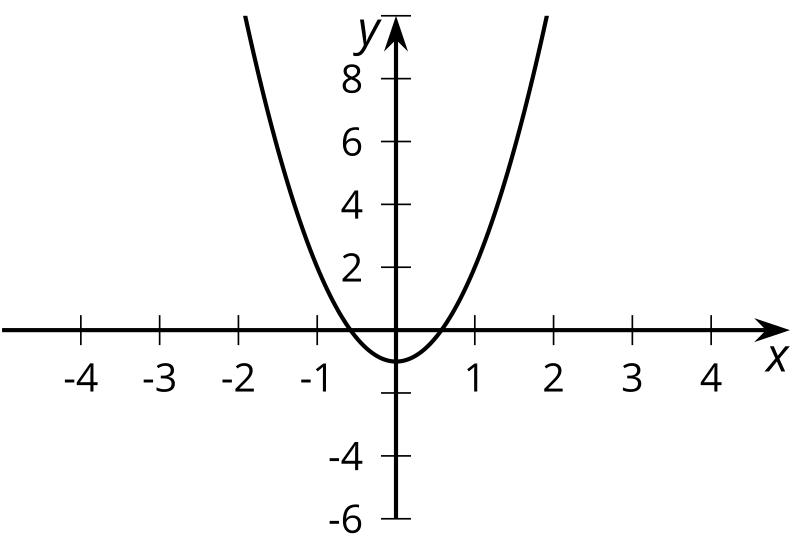
B



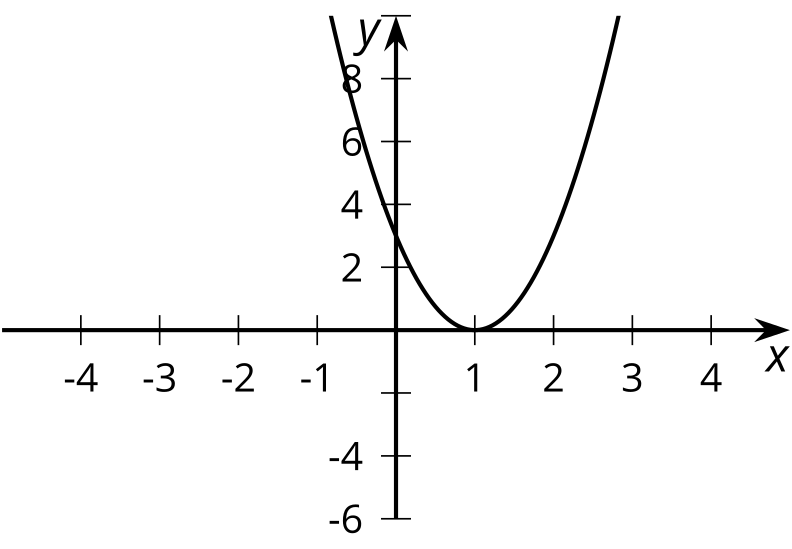
C



D

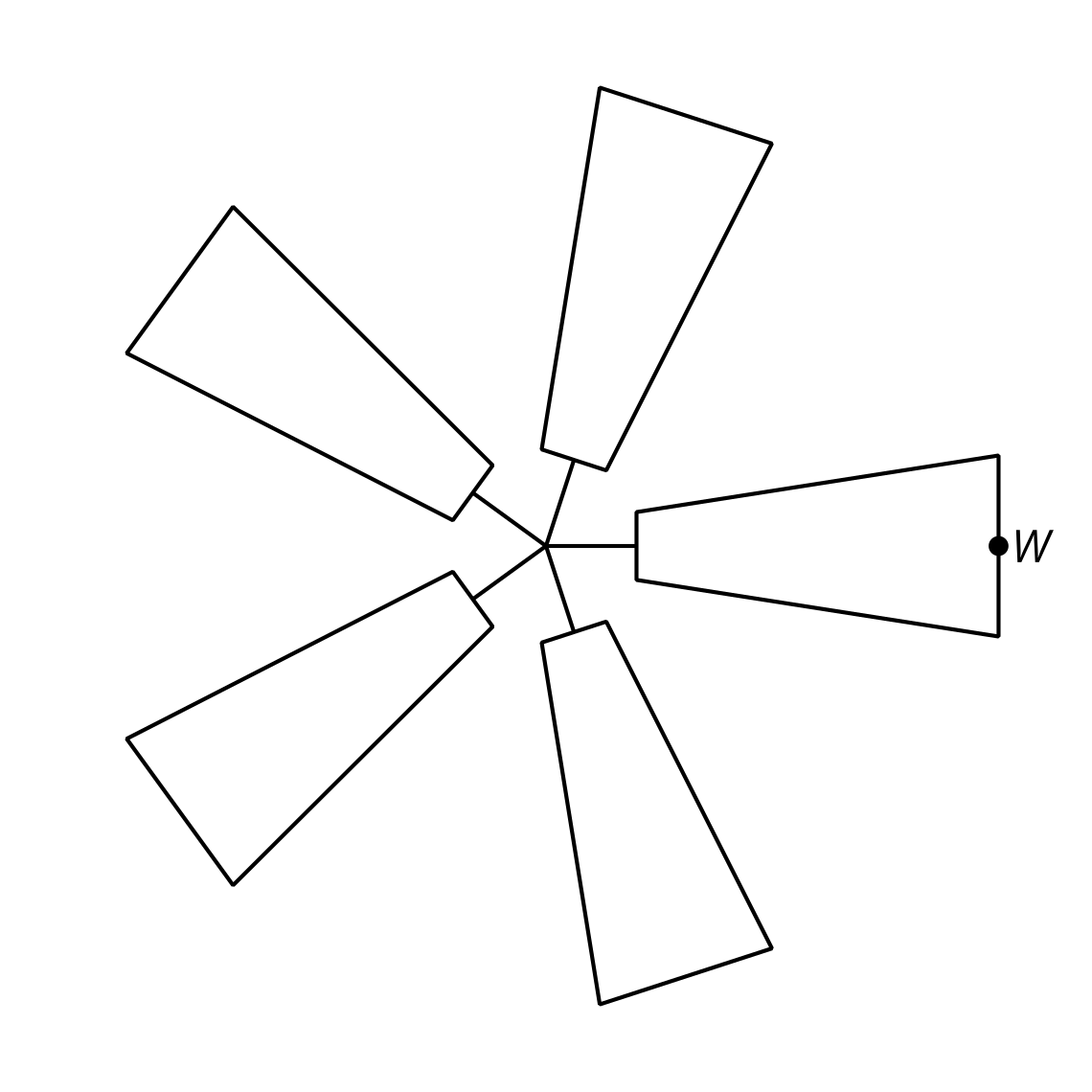


E



Be prepared to explain how you know which graph belongs with each equation.

### 13.2: Blowing in the Wind



Suppose a windmill has a radius of 1 meter and the center of the windmill is on a coordinate grid.

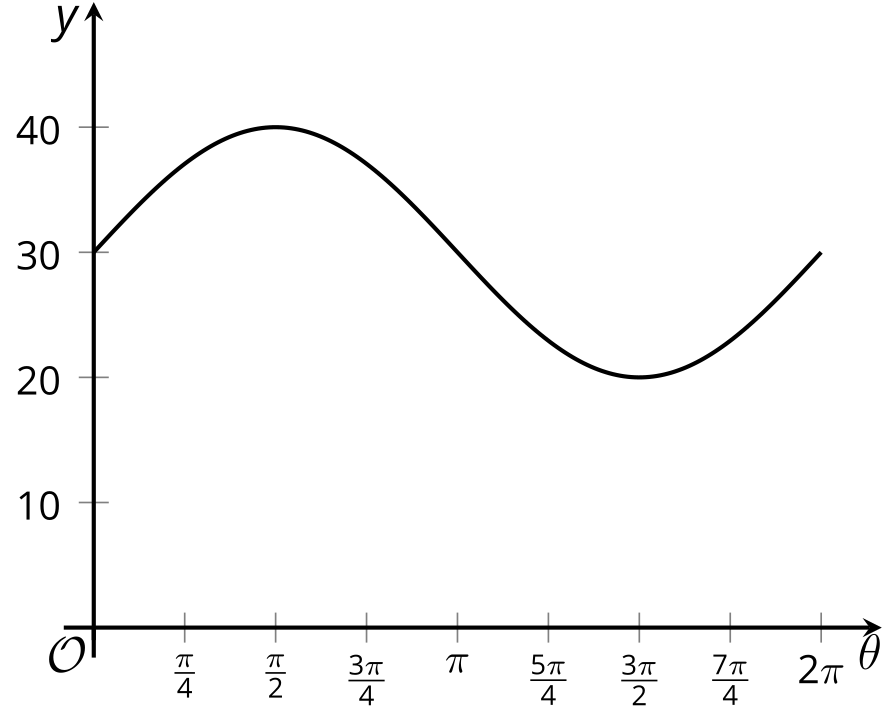
1. Write a function describing the relationship between the height of and the angle of rotation . Explain your reasoning.
2. Describe how your function and its graph would change if:
   1. the windmill blade has length 3 meters.
   2. The windmill blade has length 0.5 meter.
3. Test your predictions using graphing technology.

### 13.3: Up, Up, and Away

1. A windmill has radius 1 meter and its center is 8 meters off the ground. The point starts at the tip of a blade in the position farthest to the right and rotates counterclockwise. Write a function describing the relationship between the height of , in meters, and the angle of rotation.
2. Graph your function using technology. How does it compare to the graph where the center of windmill is at ?
3. What would the graph look like if the center of the windmill were 11 meters off the ground? Explain how you know.

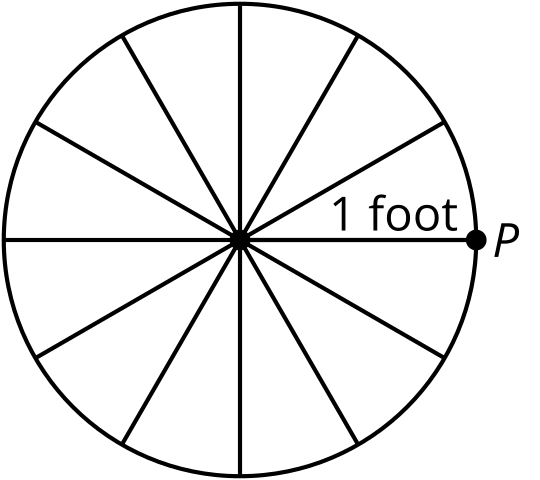
#### Are you ready for more?

Here is the graph of a different function describing the relationship between the height , in feet, of the tip of a blade and the angle of rotation made by the blade. Describe the windmill.

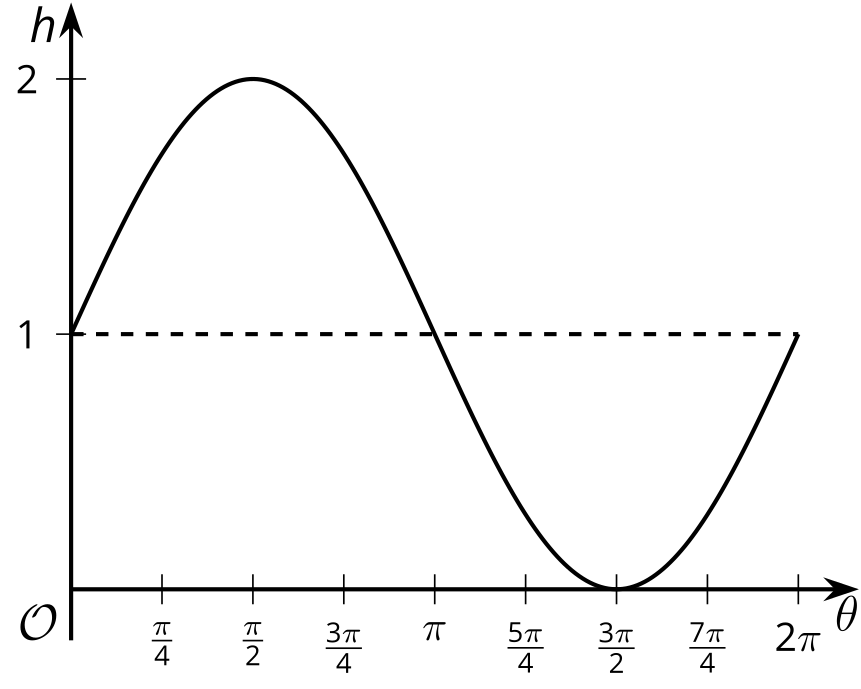


### Lesson 13 Summary

Suppose a bike wheel has radius 1 foot and we want to determine the height of a point on the wheel as it spins in a counterclockwise direction. The height in feet of the point can be modeled by the equation where is the angle of rotation of the wheel. As the wheel spins in a counterclockwise direction, the point first reaches a maximum height of 2 feet when it is at the top of the wheel, and then a minimum height of 0 feet when it is at the bottom.

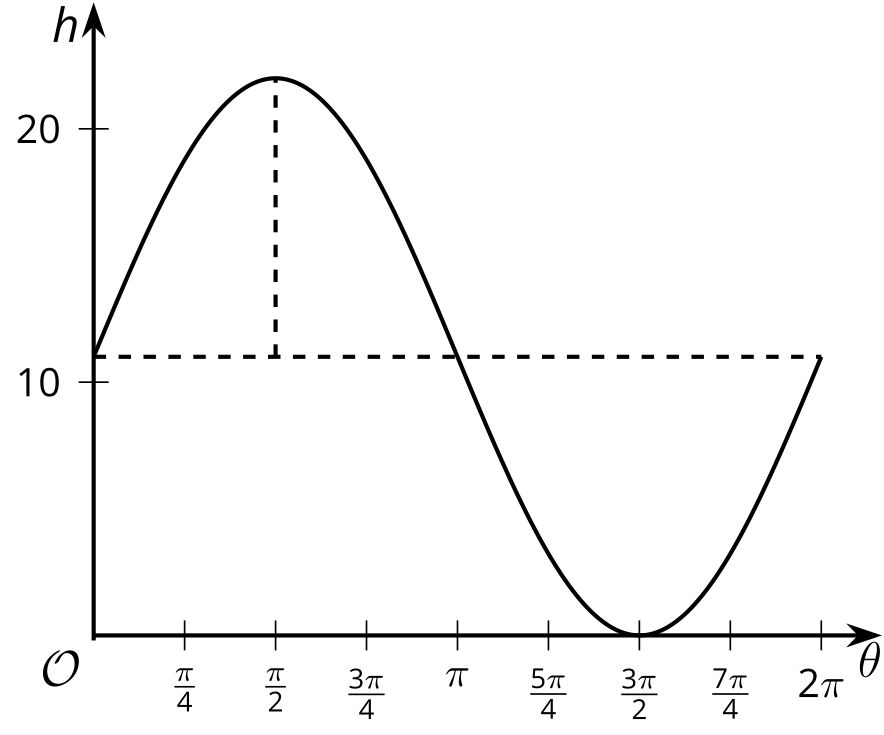


The graph of the height of looks just like the graph of the sine function but it has been raised by 1 unit:



The horizontal line , shown here as a dashed line, is called the **midline** of the graph.

What if the wheel had a radius of 11 inches instead? How would that affect the height , in inches, of point over time? This wheel can also be modeled by a sine function, , where is the angle of rotation of the wheel. The graph of this function has the same wavelike shape as the sine function but its midline is at and its **amplitude** is different:



The amplitude of the function is the length from the midline to the maximum value, shown here with a dashed line, or, since they are the same, the length from the minimum value to the midline. For the graph of , the midline value is 11 and the maximum is 22. This means the amplitude is 11 since .



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