

4.2 Modeling Sinusoidal Functions

Essential
Question:

How do I write the equation of a real-world situation using sine or cosine?

$$y = C + A\sin B(x-D)$$

OR $y = C + A\cos B(x-D)$

A: Amplitude

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

C: Vertical Shift

D: Phase Shift

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The Ferris Wheel Problem

You are standing in line to ride the Texas Star Ferris wheel at the State Fair of Texas. As you are waiting, you notice that while riding the Texas Star a person's distance from the ground varies sinusoidally with time. You read in your "Official Guide to the State Fair of Texas" that the Texas Star has a diameter of 212 feet, and you notice that it takes 82 seconds for the Ferris wheel to make one revolution. As you approach the loading dock, you estimate that passengers load the cars 8 feet from the ground. It is finally your time to load the Ferris wheel, but once you are on they continue to load several other cars. When the Texas Star is fully loaded and begins to continuously turn, you start your stopwatch. It takes you 50 seconds to reach the top.

1. How high is the top of the Texas Star?

$$212 + 8 = 220 \text{ ft}$$

2. What time will your stopwatch read when you get back down to the bottom?

$$50 + 41 = 91 \text{ sec}$$

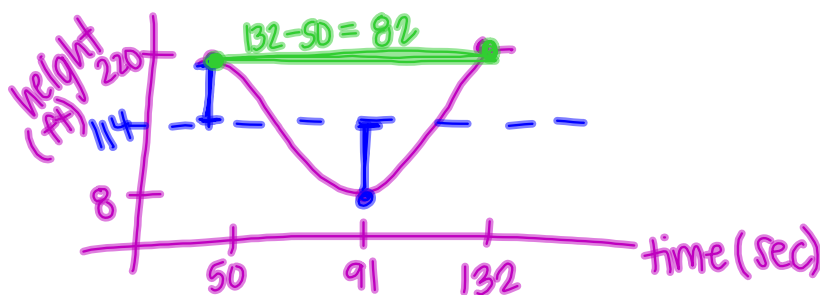
$$82 \text{ sec} \rightarrow 1 \text{ rev}$$

$$41 \text{ sec} \rightarrow \frac{1}{2} \text{ rev}$$

3. How much elapsed time will it take to reach the top of Texas Star for the second time?

$$91 + 41 = 132 \text{ sec}$$

4. Draw a sinusoidal graph of this situation. Label all critical points.



5. Write an equation of this sinusoid.

$$C = \frac{220 + 8}{2} = 114$$

$$A: 220 - 114 = 106$$

$$y = C + A \cos B(x - D)$$

$$B: \frac{2\pi}{\text{per}} = \frac{2\pi}{82} = \frac{\pi}{41}$$

$$D: \cos 50 \text{ or } 132$$

$$-\cos 91$$

$$y = 114 + 106 \cos \frac{\pi}{41}(x - 50)$$

6. Predict your height above the ground when:

a. $t = 15$ seconds $y = 114 + 106 \cos \frac{\pi}{41}(15 - 50) = 19.006 \text{ ft}$

b. $t = 75$ seconds $y = 78.170 \text{ ft}$

c. $t = 5$ minutes $y = 215.06 \text{ ft}$

7. How high were you when you started your stopwatch? Were you moving up or down when you started timing?

$$x = 0$$

$$y = 114$$

$$32.222 \text{ ft}$$

going down

8. What is the value of the second time you are 100 feet off the ground?

$$y = 100$$

$$72.229 \text{ sec}$$

9. What is the value of the fifth time you are 175 feet off the ground?

$$y = 175$$

$$201.502 \text{ sec}$$

