3.2 Modeling Sinusoids (The Ferris Wheel Problem)

Happy Birthday, Mollie!!

Warm-Up Tuesday

$\cos\left(-\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$ $\qquad \tan(\pi) = 0$

About Me

1. What's the best way to spend Halloween?
2. Candy corn - good or gross?

~~Questions, Comments, Concerns?~~

3.1 Evaluation of Sinusoidal Functions **Name:**_____

For each of the following functions use your graphing calculator to:

a.) Find $f(x)$ for the given value of x

b.) Find the first three positive values of x for the given value of $f(x)$

Round to three decimal places.

1. $f(x)=2+5\cos\frac{\pi}{10}(x-3)$

a.) Find $f(8.3)$

b.) $f(x)=5$

2. $y=4+3\sin\frac{\pi}{6}(x-2)$

a.) Find $f(12.7)$

b.) $f(x)=6$

3. $y=-2+4\sin\frac{\pi}{2}(x-0.3)$

a.) Find $f(2.8)$

b.) $f(x)=0$

4. $y=-1+3\cos\frac{\pi}{3}(x+5.2)$

a.) Find $f(5)$

b.) $f(x)=1$

5. $y=3+5\sin\frac{\pi}{9}(x-11)$

a.) Find $f(7)$

b.) $f(x)=2$

6. $y=1+6\cos\frac{\pi}{13}(x-20)$

a.) Find $f(4.3)$

b.) $f(x)=-4.5$

7. $y=5+4\sin\frac{\pi}{12}(x+10)$

a.) Find $f(1)$

b.) $f(x)=2.5$

8. $y=1+3\cos\frac{\pi}{8}(x+7)$

a.) Find $f(13)$

b.) $f(x)=-1$

3.2 Modeling Sinusoids (The Ferris Wheel Problem)

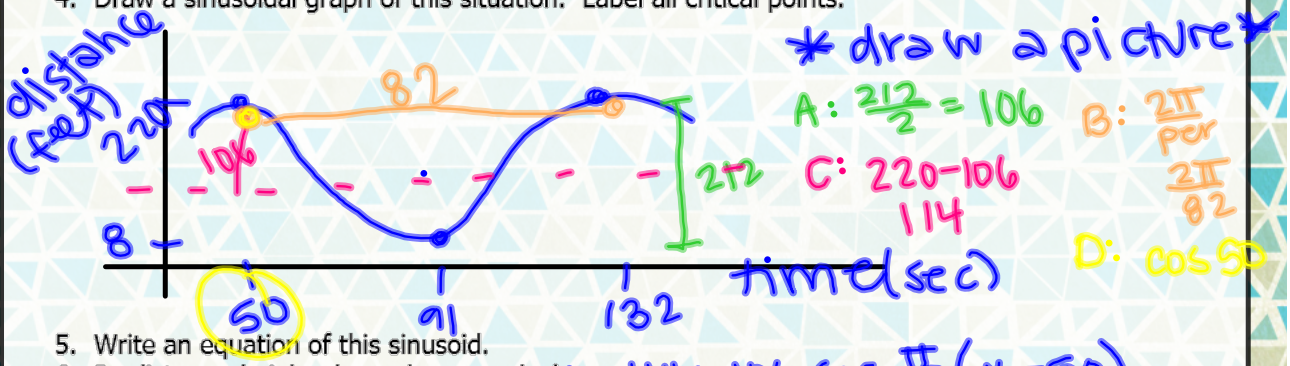
EQ: How do I write the equation of a real-world situation using sine or cosine?

Student Notes: 3.2 – Sinusoidal Functions as Mathematical Models (1)

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 ft
2. What time will your stopwatch read when you get back down to the bottom? 50 + 41 = 91 sec
3. How much elapsed time will it take to reach the top of Texas Star for the second time? 50 + 82 = 132 sec
4. Draw a sinusoidal graph of this situation. Label all critical points.



* draw a picture *

A: $\frac{212}{2} = 106$ B: $\frac{2\pi}{\text{per}}$ $\frac{2\pi}{82}$

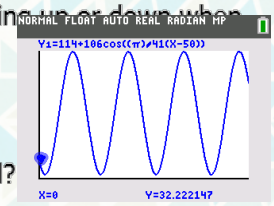
C: 220 − 106 = 114 D: cos

5. Write an equation of this sinusoid. $y = 114 + 106\cos\frac{\pi}{41}(x - 50)$
6. Predict your height above the ground when:
   a. $t = 15$ seconds
   b. $t = 75$ seconds 19.006 ft
   c. $t = 5$ *minutes* 78.170 ft

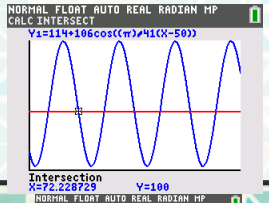
x-values — TRACE — x-value

5 · 60 = 300 → 216.060 ft

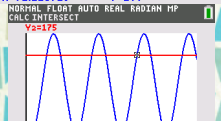
7. How high were you when you started your stopwatch? Were you moving up or down when you started timing?



8. What is the value of t the second time you are 100 feet off the ground? looking for Y; X = 0; 32.222 ft; down



9. What is the value of t the fifth time you are 175 feet off the ground? Y2 = 100; 72.229 sec



Y2 = 175; 201.502 sec

Exit Ticket on Classroom

3.2 – Sinusoidal Functions as Mathematical Models (1) Name:_____

1. Huckleberry Finn sat on the deck of a river steamboat. As the paddlewheel turned, a point on the paddle blade moved in such a way that its distance, d from the water's surface was a sinusoidal function of time. When his stopwatch read 6 seconds, the point was at its highest 15 feet above the water's surface. The wheel's diameter was 18 feet (part of the wheel is always underwater), and it completed a revolution every 14 seconds.
   a.) Sketch a graph of this sinusoid.

   b.) Write an equation for this sinusoid.

   c.) What was the height of the point when Huck started his stopwatch?

   d.) How far above the surface was the point when Huck's stopwatch read 20 seconds?

   e.) What is the first positive value of time at which the point was at the water's surface? At that time, was it going into or coming out of the water?

   f.) When was the point 10 feet above the surface for the third time?

2. Researches find a creature from an alien planet and discover that its body temperature varies sinusoidally with time. 35 minutes after they start timing, it reaches a high of 120°F. 20 minutes after that it reaches its next low, 104°F.
   a.) Sketch a graph of this sinusoid.

   b.) Write an equation expressing the alien's temperature in terms of minutes since the researchers starting timing.

   c.) What was its temperature when they started timing?

   d.) Find the first three times after they starting timing at which its temperature was 114°F.

3. The original Ferris wheel, built by George Ferris for the 1893 World's Fair, was much larger and slower than its modern counterparts. It had a diameter of 250 feet and contained 36 cars, each of which held 40 people. It made one revolution every 10 minutes and reached a maximum height of 264 feet. Grover Cleveland was given a private ride. He got on and the wheel starting slowly turning.
   a.) Sketch a graph of this sinusoid.

   b.) Write an equation expressing Grover's height above the ground in terms of time (in minutes) since the Ferris wheel started turning.

   c.) How high was Grover after 16 minutes?

   d.) When was he 200 feet above the ground for the 4^{th} time?