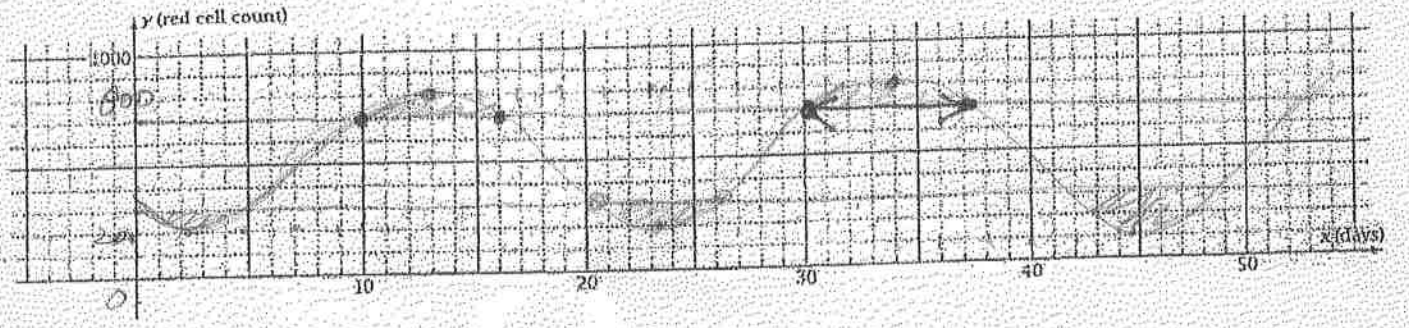
IB Pre HL Sinusoidal Modeling (Day 2): Chemotherapy Name: Key

Work with your group members and when you finished, let Ms. Shim check the answers by raising your hands. Ms. Shim will choose one of the papers randomly to check. Make sure all of your group members understand the process, Ms. Shim might quiz one of you.

Ima Patient has cancer. She must have a chemotherapy treatment once every three weeks. One side effect is that her red blood cell count goes down and then comes back up between treatments. On January 13 (day 13 of the year), she gets a treatment. At that time, her red blood cell count is at a height of 800. Halfway between treatments, the count drops to a low of 200. Assume that the red blood cell count varies sinusoidally with the day of the year, x.

Period: 3 weeks = 21 days

1. Draw the graph of the sinusoid on the given axes. Show enough cycles to fill the graph paper.



2. Write a particular equation for the(circular) sinusoid. It is recommended that you use the cosine function. Show your work such as period and etc.

C: Red cell counts. t: days

Amplitude: $\frac{800-200}{2} = 300$

Axis: $\frac{800+200}{2} = 500$

period: 21 days

Horizontal Shift: 13

$\Rightarrow C(t) = 500 + 300\cos\left[\frac{2\pi}{21}(t-13)\right]$

3. Enter your equation in your grapher. Plot the graph using the window shown. Explain the graph verified that your equation is correct.

window: $0 \le t \le 55$ days

$0 \le C \le 1000$ Red cells

4. Ima feels "good" if the red blood cell count is 700 or more, "bad" if the count is 300 or less, and "so-so" if the count is between 300 and 700. How will she be feeling on her birthday, March 19? Explain how you arrived at your answer.

March 19 $\Rightarrow$ Jan 31 + Feb 28 + Mar 19 $\Rightarrow t = 79$ days

$C(79) = 500 + 300\cos\left[\frac{2\pi}{21}(79-13)\right] \approx 748$ cells.

5. Show on your graph (above) the interval of dates between which Ima will feel "good" as she comes back from the low point after the January 13 treatment. State the values of x for the interval of feeling "good".

$C \ge 700$

$700 = 500 + 300\cos\left[\frac{2\pi}{21}(t-13)\right]$

$-500 = 300\cos\left(\frac{2\pi}{21}(t-13)\right)$

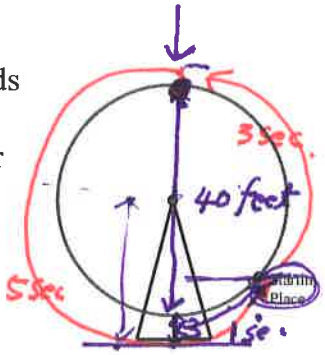
$\left[\cos^{-1}\left(\frac{200}{300}\right)\right]\cdot\frac{21}{2\pi} + 13 = t$

$\pm .84$

$\Rightarrow t = \begin{pmatrix} 10.2 \\ 15.8 \end{pmatrix} \Rightarrow [31.2, 36.8]$

Ferris Wheel:

As you ride a Ferris Wheel, your distance from the ground varies sinusoidally with time. When the last seat is filled, your seat is at the position shown. Let t be the number of seconds since the wheel started. You find it takes you 3 seconds to reach the top, which is 43 feet above ground, and that the Wheel makes one full revolution every 8 seconds. If the diameter of the wheel is 40 feet:



a. Find an equation that will determine your height, $h(t)$, above the ground at any time t.

period: 8 sec. → $h(t) = A\cos(B(t-h)) + k$

B: $\frac{2\pi}{8} = \frac{\pi}{4}$.

A: $\frac{43-3}{2} = 20$

k: $\frac{43+3}{2} = 23$

$h = ?$

$h(t) = 20\cos\left(\frac{\pi}{4}(t-3)\right) + 23$

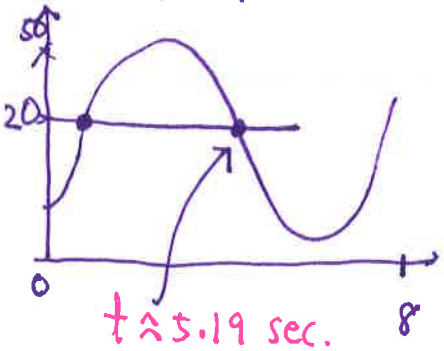
b. How high above the ground are you after 9 seconds?

$h(t) = 20\cos\left[\frac{\pi}{4}(9-3)\right] + 23$.

$h(t) = 23$ feet.

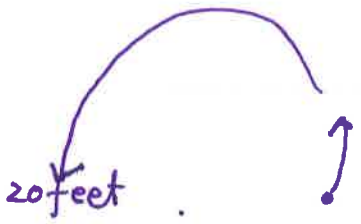
c. How long does it take for your to be 20 ft above the ground for the second time?

I. Use G. Calculator



$t \approx 5.19$ sec.

(Intersection)



II. Algebraically.

$20 = 20\cos\left[\left(\frac{\pi}{4}\right)(t-3)\right] + 23.$

-23

$\frac{-3}{20} = \frac{20}{20}\cos\left[\frac{\pi}{4}(t-3)\right]$

$-\frac{3}{20} = \cos\left[\frac{\pi}{4}(t-3)\right]$

$\frac{\pi}{4}(t-3) = \cos^{-1}\left(\frac{-3}{20}\right) = 1.7213 \Rightarrow t = (1.7213)\left(\frac{4}{\pi}\right) + 3 \approx 5.19$