Portfolio Answer Key: Periodic Functions

**Modeling Periodic Phenomena Portfolio**

**Student answers will vary as they each self-select numbers to complete the questions. (This answer key was created by selecting numbers proposed within Question 1.) Please remember to review documents prior to using with students.**

Directions: Use this worksheet to record your answers to the questions or problems for the Modeling Periodic Phenomena Portfolio. When you are finished, save this worksheet with your answers and submit it for a portfolio grade.

Where indicated, draw figures on a blank sheet of paper or on a sheet of graph paper. Be sure to label each sheet so that your teacher knows which answer goes with which question. You can scan these figures and submit them as individual documents with your portfolio worksheet, or you can take pictures of them and insert the pictures on the portfolio worksheet.

**Question 1**

Cheryl’s cousin is about to embark on a 50-mile bike ride. Cheryl draws a little heart on the front wheel of her cousin’s bike for good luck.



When Cheryl’s cousin starts riding, the heart goes up before coming back down and hitting the pavement. The diameter of the wheel is [choose a number between 20-27.5] inches. Cheryl’s cousin rides at a steady pace and the wheel makes a frequency of [choose a number between 60-80] revolutions per minute. Find the equation that models the height of the heart in inches as a function of time (x) in minutes.

1. Make a list of the given information. Choose two numbers as indicated in the problem.
   1. Diameter of the wheel is 27.5 inches
   2. The wheel turns at a frequency of 60 revolutions per minute.
   3. Radius of the wheel is 13.75 (
   4. Time for one revolution is minute
   5. Vertical motion: the heart starts at the lowest point, rises to the highest point, then returns to the lowest point on each revolution.

(The answers provided in this key are based on the given information listed in a and b above.)

1. Make sense of the problem. On graph paper, sketch a graph that shows the height of the heart in inches over time in minutes after a few revolutions and then calculate the frequency. Do not worry about scaling the x-axis, refer back to the graph on page 3. Note that electronic graphing is not always necessary nor successful.
   1. Graphs will vary but should represent the following characteristics:
      1. follows a sinusoidal wave because it repeats periodically
      2. heart should oscillate between min height of 0 and max height of 27.5
      3. the period of the wave is the time for one revolution (T=1/60 minutes)
      4. sketch a sine wave starting at y=0, peaking at y=27.5
   2. Calculate B (angular frequency)

|  |  |
| --- | --- |
| Formula |  |
| Input problem information |  |
| Calculate |  |
| Answer |  |

1. Decide whether you will write an equation that involves sine or cosine. Explain your decision.

The pavement would be considered zero (0). A sine function typically starts at 0. Since the heart initially starts moving away from the pavement, it is better to use a sine function since the heart is initially closer to the pavement (0) and then moving away from the pavement.

1. Persevere in solving the problem. Use your sketch of the graph along with the given information to determine the values of *A, B, C*, and *D*. Explain how you determined each value.
   1. Calculate A (amplitude)

|  |  |
| --- | --- |
| Formula |  |
| Input problem information |  |
| Calculate |  |
| Answer |  |

* 1. Calculate B (angular frequency)

|  |  |
| --- | --- |
| Formula |  |
| Input problem information |  |
| Calculate |  |
| Answer |  |

* 1. Calculate C (phase shift)
     1. Since the sine wave starts at the lowest point (y=0), no phase shift is needed, C=0
  2. Calculate D (vertical shift)

|  |  |
| --- | --- |
| Formula |  |
| Input problem information |  |
| Calculate |  |
| Answer |  |

1. Write the equation that models the scenario using the values of *A, B, C and D.*
   1. The general form of the sine function is therefore the equation that models this scenario is

Question 2

1. Predict the height of the heart exactly 30 seconds into the ride. Use your equation from Question 1. Show your work.

Step 1: Write the equation and substitute x=.5 into the equation:

Step 2: simplify the equation:

Step 3: Continue to simplify:

The heart will be at about 13.75 inches at 30 seconds.

1. Predict the height of the heart exactly 5 minutes into the ride. Use your equation from Question 1. Show your work.

Step 1: Write the equation and substitute x=5 into the equation:

Step 2: simplify the equation

Step 3: Continue to simplify

The heart will be at about 13.75 inches at 5 minutes.

When you are ready to submit your portfolio, be sure to include all of these items:

* The completed Modeling Periodic Phenomena Portfolio worksheet
* A rough sketch of a graph that shows the height of the heard in inches over time in minutes.