Name: _____Period: ____

Pendulum Lab I: Swinging Sinusoid

Advanced Precalculus (Foerster 2nd ed.)
October 5, 2021
22 pts

Your goal for this project is to model the movement of a pendulum. You will take measurements of a real pendulum, then use your measurements to produce two models- one for the horizontal motion of the pendulum, and the other for the vertical motion.

Part 1: Imagining the Experiment

1. Describe some properties of a sinusoidal function that might contribute to its use as a good model for the motion of swinging pendulum- what properties of the motion can your model capture? (1 pt)

2. Describe some properties of a sinusoidal function that might make it difficult to use as a model for the pendulum's motion—Are there aspects of this real-world phenomenon your model will ignore? Will you make some assumptions? If so, what are they? (2 pts)

3. Explain how you will capture the horizontal and vertical dynamics of the pendulum needed for your model. (1 pt)

Part 2: Modeling the Horizontal Position of the Pendulum

You will create a formula for horizontal position, x, of your pendulum as a function of time, t.

4. Clearly define your variables including units and frames of reference. (1 pt)

5. Record measurements for the horizontal dynamics of the pendulum here. (1 pt)

6. Write a function to model the motion; use the form $x = C + A\cos B(t - D)$. Carefully *show and explain* how you arrive at each of the values for the parameters A, B, C and D. (2 pts)

7. Draw a graph of your model. Label important features of your model, and incorporate the measurements you took. Label axes with units and scale. (2 pts)

Part 3: Modeling the Vertical Position of the Pendulum

8. Clearly define your variables including units and frames of reference. (1 pt)

9. Record your measurements for the vertical position of the pendulum here. (1 pt)

10. Write a function to model the vertical motion; use $y = C + A\cos B(t - D)$. Carefully *show and explain* how you arrive at each of the values for the parameters A, B, C and D. (2 pts)

11. Draw a graph of the model. Label important features of your model, and incorporate the measurements you took. (2 pts)

Part 4: Reflection and Discussion

12. How are the periods of the horizontal and vertical models related? Explain this in the context of a real pendulum. (2 pts)

13. Look back at the aspects your models neglected and assumptions you made. It is possible to change the functions to incorporate some of these properties. For instance, what aspect of pendulum motion could $y = ab^t \cos B(t - D) + C$ incorporate into the model? Explain. (2 pts)

14. Would the angle you choose to start the pendulum swing impact your data? Experiment and explain. (1 pt)