1 Jupiter's Moons

In the following experiments, you will investigate the motion of Jupiter's moons and ultimately analyze the motion of Jupiter's moons in order to determine Jupiter's mass. For all answers, you should *explain your reasoning.*

1.1 Periodic Motion

1. Write an everyday definition of the word *periodic*.

2. Look at the simulation of a wheel at <http://linus.highpoint.edu/~atitus/physlets/physlet.php?filename=kin_circ-motion.html> . A point on the rim of the wheel is shown as a red dot. Is the motion of the red dot periodic?

3. What is the period of its motion?

4. Another example of periodic motion is an object that's attached to a spring and oscillates. Look at the example at <http://linus.highpoint.edu/~atitus/physlets/physlet.php?filename=kin_sho.html> .

   Click the `Start Animation` link to load the animation. If you click-and-hold with your left mouse button anywhere on the animation window, you'll notice a set of numbers. This set of numbers is the (x,y) location of your mouse click on the window.

   By clicking on the animation window, find the origin of the coordinate system.

5. Now, click the `Play` button. You'll notice that the object oscillates back and forth. On the graph, the x-position of the object after each successive 0.05 second time interval is graphed. On the vertical axis of the graph is the x-position of the object. On the horizontal axis is the clock reading (time).

6. What is the period of the object's motion? Measure it once using the animation window and measure it once using the graph window. Note that you can click in the graph window to measure (x,t) coordinates on the graph.

7. Let's change the period of the object's motion and see how it looks different. In the box, above the animation, change the period to 0.5 seconds and view the motion. After the graph is fully drawn, right-click on the graph. A screen capture of the graph will be created and will be displayed in a

separate window. Organize your desktop so that the browser window is on the left and the graph window is on the right. You want the browser window to be as large as possible, yet you should be able to view both windows

8. Change the period to 1 second, view the motion, and right-click the graph in order to capture a picture of the graph. Move this graph window to the side so that you can see the browser window and two graph windows.

9. Now, change the period to 2 seconds, view the motion, and right-click on the graph. Display all three graph window with one on top of the other. Based on what you observe, how does changing the period affect what you see on the graph?

10. Now change the amplitude of the object's motion. Note that the value is originally set at 0.1 meters. Change this to 0.05 meters, click `reset` , and view the motion. Change this to 0.12, reset, and view the motion. Right-click on the graph for all three cases and view all three graphs. How does changing the amplitude affect what you see on the graph?

11. What do you think *amplitude* means? Describe how it can be measured using the animation window and how it can be measured using the graph.

12. Reset the amplitude to 0.1 meters and the period to 1 second. `Step` the animation forward until the object is at or near the origin. What is the clock reading?

13. What do you suppose that *time at x=0* means?

14. Change the value of the *time at x=0* to 0. Reset and run the animation. Also, change it to 0.75 seconds, reset, and run the animation. How does changing the time at x=0 affect what you see on the graph? (Again, right-click the graph for each case. This will make comparisons much easier.)

15. Now, focus on the graph. Describe what the graph looks like at 0.75 s?

16. Change the value of the *time at x=0* to 0.5 seconds. Reset and run the animation and focus on the graph at t=0.5 s. Describe what the graph looks like at 0.5 s.

17. What is the amplitude, period, and time at x=0 for the graph shown below?

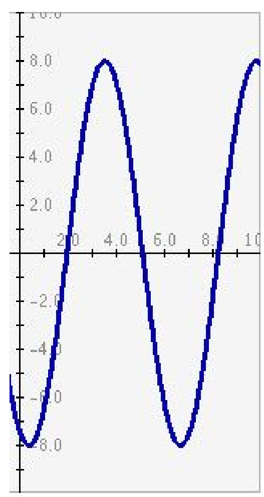

Figure 1:

Please ask your teacher to initial here before continuing.

1.2 Circular Motion

1. If you graph the x-position of an object on the rim of a wheel that rotates with a constant period, it is periodic, just like the position of the object attached to a spring. Check out the simulation shown at <`http://linus.highpoint.edu/~atitus/physlets/physlet.php?filename=kin_circle-sho.html`> .

2. What property of the circle does the amplitude of the x-position vs. time graph for the object moving in circular motion correspond to?

3. Whenever we look at the moons of Jupiter, we are seeing them from a side view. It's like looking at a point on the rim of a wheel that is on its side. To visualize this, go to <`http://linus.highpoint.edu/~atitus/courses/ast121/vpython/index.php`> , right-click on the file `jupiter-moon.py` and save it to the desktop of your computer. Double click the file to run it.

4. You are looking at a top view. To rotate the view, click-drag with your right mouse button and rotate the scene until you are looking from a side view. You can zoom out or in by holding both mouse buttons down and dragging the mouse.

5. What view do we see from Earth when looking at Jupiter through a telescope, a top view or a side view?

Please ask your teacher to initial here before continuing.

6. Now, proceed to the Jupiter's Moons CLEA simulation. In this simulation, you will observe the four Galilean moons, record their positions, determine their periods and radii of their orbits.