Physics Period B8 Date 11/28/19 Name Alex Yang

Unit 6 | Simple Harmonic Motion | Pendulum Simulation

$$f = \frac{1}{T}$$

Background: The time a pendulum takes to swing back and forth (*one cycle*) is referred to as one ***period***. The period of a pendulum is measured in seconds and is given by the formula shown to the right. The inverse of period is ***frequency***, the number of complete cycles each second. The ***equilibrium*** *position* is the point below the pivot, at a neutral position. The ***amplitude*** of the pendulum's swing is the displacement from the equilibrium. The top of each swing is referred to as ***maximum displacement*** or ***maximum amplitude***.

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Procedure: Run simulation https://phet.colorado.edu/sims/pendulum-lab/pendulum-lab_en.html

For all answers, ***type your responses in a color other than black!***

*Note: For the analysis below leave the friction slider at "none"

1. Using a 1.00 kg pendulum, adjust the length of the pendulum ***only*** and determine the period. Complete the table below:

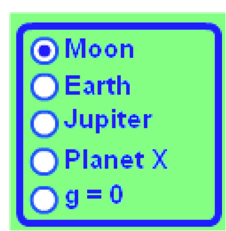
Mass (kg)	Length (m)	Period (s)	Amplitude (deg)	gravity
1.00 kg	0.50	1.4243	15	Earth
1.00 kg	1.00	2.0145	15	Earth
1.00 kg	1.50	2.4673	15	Earth
1.00 kg	2.00	2.8490	15	Earth

2. Repeat the investigation but adjust the mass of the pendulum ***only***, leaving all other variables constant.

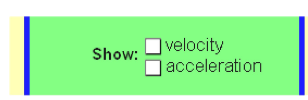
Mass (kg)	Length (m)	Period (s)	Amplitude (deg)	gravity
0.5	1.50	2.4673	15	Earth
1.0	1.50	2.4673	15	Earth
1.5	1.50	2.4673	15	Earth
2.0	1.50	2.4673	15	Earth

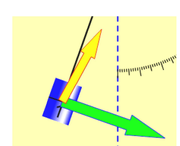
3. Repeat the experiment, but adjust the gravity (location) ***only*** leaving all other variables constant.

Mass (kg)	Length (m)	Period (s)	Amplitude (deg)	gravity
1.0	1.50	5.9803	15	*Moon*
1.0	1.50	2.4673	15	*Earth*
1.0	1.50	1.5183	15	*Jupiter*
1.0	1.50	2.0507	15	*Planet X*



__Velocity and Acceleration Vectors__





4. Turn on the velocity and acceleration vectors.

5. Observe the magnitudes and directions of the vectors as the pendulum moves.

6. The green vector represents Velocity and the yellow vector Acceleration .

Lab Questions and Calculations

1. What force causes the pendulum to speed up on the way down and slow down on the way up? Gravity

2. As pendulum length increases, the period of harmonic motion *increases / decreases / remains the same*.

3. As pendulum mass increases, the period of harmonic motion *increases / decreases / remains the same for theta<15deg*.

4. As gravity on the pendulum increases, the period of harmonic motion *increases / decreases / remains the same*.

5. A pendulum is at maximum velocity *at the equilibrium position / at maximum amplitude*.

Hint: Click on *Show Energy*

6. A pendulum is at minimum velocity *at the equilibrium position / at maximum amplitude*.

7. A pendulum is at maximum acceleration *at the equilibrium position / at maximum amplitude*.

8. A pendulum is at minimum acceleration *at the equilibrium position / at maximum amplitude*.

9. A pendulum has maximum PE (potential energy) *at the equilibrium position / at maximum amplitude*.

10. A pendulum has minimum KE (kinetic energy) *at the equilibrium position / at maximum amplitude*.

11. Create a method for calculating gravity based upon your observations in this lab. Use that method to calculate gravity for:

    a) the moon: L=1.50m, T=5.9803s

    g=1.656m/s^2

    b) Jupiter: L=1.50m, T=1.5183s

    g=25.688m/s^2

    c) Planet X: L=1.50m, T=2.0507s
    g=14.081m/s^2

Explain your method.

Set the pendulum length to 1.50m long and set the amplitude to 15deg. Record the period using the built-in photogate timer. Use the equation $T = 2\pi\sqrt{\frac{L}{g}}$ to solve for g, yielding $g = L(\frac{2\pi}{T})^2$.