Time Period of a Simple Pendulum

Link for online lab:

https://phet.colorado.edu/en/simulation/pendulum-lab

OBJECTIVES:

- Investigate the factors affecting time period of a simple pendulum.

- Determine gravitational field strength at a location by swinging a simple pendulum and performing curve fitting on linearized data.

PROCEDURE:

Click on the Intro window.

Click on Stopwatch. Make sure that speed is set to Normal (radio button) and Friction (slider) is set to None.

Throughout the experiment, do not increase the Amplitude beyond 30 degrees.

Choose Earth in Gravity window for Parts 1, 2 and 3.

Part 1 – Time Period vs. Mass – Length, Gravity & Amplitude constant

1. Choose constant values for length, gravity and amplitude. Choose mass of the pendulum to be 0.1 kg and measure time for 10 oscillations.

2. Keep length, gravity and amplitude same. Change mass to 0.4 kg and again measure time for 10 oscillations. Repeat this for a total of 6 readings.
   (Mass values in kg: 0.1, 0.4, 0.7, 1.0, 1.3, 1.5)

Part 2 – Time Period vs. Amplitude – Length, Gravity & Mass constant

3. Choose constant values for length, gravity and mass. Choose amplitude of the pendulum to be 5 degrees and measure time for 10 oscillations.

4. Keep length, gravity and mass same. Change amplitude to 10 degrees and again measure time for 10 oscillations. Repeat this for a total of 6 readings.
   (Amplitude values in degrees: 5, 10, 15, 20, 25, 30)

Part 3 – Time Period vs. Gravity – Amplitude, Length & Mass constant

5. Choose constant values for amplitude, length and mass. Choose Moon from the Gravity drop down menu and measure time for 10 oscillations.

6. Keep amplitude, length and mass same. Change gravity location to Earth and again measure time for 10 oscillations. Repeat this for a total of 3 readings.
   (Gravity locations: Moon g = 1.63 m/s^2, Earth g = 9.81 m/s^2, Jupiter g = 26.0 m/s^2)

Part 4 – Time Period vs. Length – Amplitude, Gravity & Mass constant

7. Choose constant values for amplitude, gravity and mass. Choose length of the pendulum to be 0.2 m and measure time for 10 oscillations.

8. Keep amplitude, gravity and mass same. Change length to 0.4 m and again measure time for 10 oscillations. Repeat this for a total of 6 readings.
   (Length values in m: 0.2, 0.4, 0.6, 0.8, 0.9, 1.0)

GRAPHS:

Plot the following graphs and paste here. All graphs must have a title and axes labeled with quantities plotted (& units).

a) From Part 1: Period vs. Mass (T vs. M)

b) From Part 2: Period vs. Amplitude (T vs. A)

c) From Part 3: Period vs. Gravity (T vs. g)

d) From Part 4: Period vs. Length (T vs. L)

e) From Part 4: Period^2 vs. Length (T^2 vs. L)

ANALYSIS:

Based on graphs, answer the following questions:

1. From Period vs. Mass graph, does the period appear to depend on mass?

2. From Period vs. Amplitude graph, does the period appear to depend on amplitude?

3. From Period vs. Gravity graph, does the period appear to depend on gravity? What is the relation between Period and Gravity (directly related or inversely related)?

4. From Period vs. Length graph, does the period appear to depend on length? What is the relation between Period and Length (directly related or inversely related)?

5. Explain how you can graphically determine g of Earth using Period^2 vs. Length graph? Obtain the value of g by doing a curve fitting and compare it with the known value of 9.81 m/s^2.

   (Hint: $T = 2\pi \sqrt{\frac{L}{g}}$)

6. Explain how you can graphically determine length of a pendulum using Period^2 vs. 1/ g graph?

DATA TABLE:

Part #	Run #	Length (m)	Mass (kg)	g (m/s^2)	Amplitude (degrees)	Time for 10 oscillations (s)	Time Period (s)
	1						
1	2						
	3						

	4						
	5						
	6						
2	1						
	2						
	3						
	4						
	5						
	6						
3	1						
	2						
	3						
4	1						
	2						
	3						
	4						
	5						
	6						
	7						