The Pendulum  
Tanner Gibson  
Rick Greenwood  
Breanna Bloemker  
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Objective:   
To investigate if weight influences the period of a pendulum by using different masses for bobs, adjusting the length of the string, and pulling the bob back to a certain distance.

Theory:   
A simple pendulum consists of a mass, called a bob, connected to the end of a suspended string. When the bob is pulled to one side of its position of rest then released, it begins to vibrate in a simple harmonic motion (SMH). In general, a vibration is any back and forth motion that repeats itself. SHM occurs when there is a restoring force that is equal to and opposite to a displacement. The restoring force, of course, comes from gravity acting on the bob.   
A complete vibration is called a cycle. A cycle is the movement from some point (say far left), to a maximum displacement in the other direction then back to the same point again. The period (T) is simply the time required to complete one cycle. The number of cycles per second is called the frequency (f). The length (L) of the pendulum is measured from the point of suspension to the center of gravity of the bob.

Procedure:   
First, we got our pendulum set up with the pivot on a stand 25cm above the table. Then, we attached our string 100cm from the pivot point to the center of the mass swinging. After that we pulled the mass back 10cm and we counted the oscillations for one minute and recorded our results for all 50g, 100g, and 200g masses.  
The second part we kept the 100cm length and we used a 200g mass but did two tests with the string at 10cm and 20cm and counted the oscillations for one minute and recorded our results in the table.  
The third part we had the 200g mass with both different amplitudes and length of the string and we counted the oscillations for one minute for each run and recorded our results in the table.  
The fourth and final part we used the 200g mass and a length of 50cm and did two runs with 10cm and 20cm pull backs and we used a stop watch for 25 oscillations and we recorded what we got in the table.

Date:   
Table 4.1 – Effect of Bob Mass on Period

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mass (g) | n₁ | n₂ | n₃ | n (avg) | T (exp) |
| 50 | 30 | 30 | 30 | 30 | .033 |
| 100 | 30 | 30 | 30 | 30 | .033 |
| 200 | 30 | 30 | 30 | 30 | .033 |

Table 4.2 – Effect of Amplitude on Period

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Amplitude(m) | n₁ | n₂ | n₃ | n (avg) | T (exp) |
| 0.10 | 30 | 30 | 30 | 30 | .033 |
| 0.20 | 29.5 | 30 | 29.5 | 29.67 | .034 |

Table 4.3 – Effect of Length on Period

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Length(m) | Amp(m) | n₁ | n₂ | n₃ | n (avg) | T (exp) | T (theo) | T (exp)² |
| 0.50 | 0.20 | 41 | 41 | 42 | 41.3 | 1.45 | 1.42 | 2.10 |
| 0.75 | 0.133 | 34.5 | 34.5 | 34.5 | 34.5 | 1.74 | 1.74 | 3.03 |
| 1.00 | 0.10 | 30 | 30 | 30 | 30 | 1.98 | 2.01 | 3.92 |

Table 4.4 – Time for 25 Oscillations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Amp (m) | T₂₅ | T₁₀₀ | T (avg) | g | Error (%) |
| 0.10 | 36.1 | 144.4 | 1.444 | 9.47 | 3.34 |
| 0.20 | 36.3 | 145.2 | 1.452 | 9.36 | 4.49 |

Formulas:  
T(exp) = (1/n(avg))  
T(theo) = 2π(L/g)¹ˈ²  
T(exp)²  
T₁₀₀ = (4 \* T₂₅)  
T(avg) = (T₁₀₀/100)  
g = 4π²(L/T²)  
Error % = (|accepted – measured|/accepted) \* 100

Results:   
1. The weight has no effect on the period of a pendulum.  
2. The amplitude has little to no effect on the period of a pendulum.  
3. The shorter the length of the string then the more oscillations per minute, which will affect the period of the pendulum.  
4. When you simplify the period equation you end up with T = 2π, and you notice that the period and frequency do not depend on the mass of the bob.  
5. Yes, the purpose of the lab was accomplished, because we proved that with the same length and angle of the string that the mass does not matter for the period or the frequency. We also found out that changing the length will affect the period and frequency of the bob.

Error Analysis:  
Some of the errors we found were; the pole vibrated too much causing the bob to be thrown off, the stick holding the weight on wasn’t straight and caused the bob to swing at an angle, and the string may have gotten stretched out after a while.

Conclusion:  
See Results Number 5

References:  
None we just used each other as a reference.