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**Pendula and Periods**

AP Physics C: Mechanics

**Objective:** I can describe the relationship between displacement and time for a simple pendulum by identifying the period of simple harmonic motion from a graph and comparing it to measured values.

**Pre-lab Questions**

1. What is the period of a simple pendulum provided to you?

   2pi sqrt(l/g)

2. What has to be true about the amplitude of the pendulum's motion for the above formula to hold?
   small angle approximation

**Materials**

- Pendulum (string, mass attached)
- Stopwatch
- Meter stick

**Procedure**

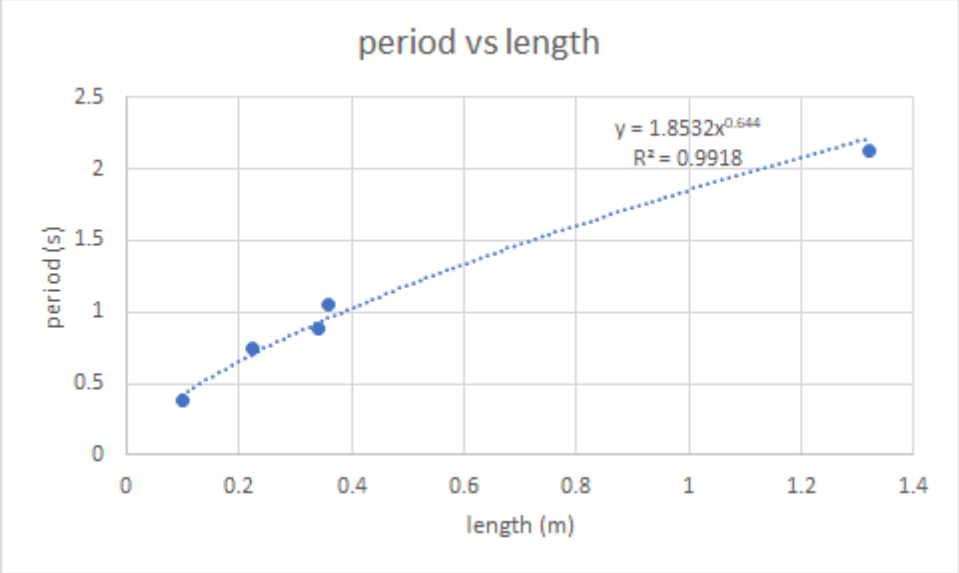
1. Swing the pendulum with a small angle, releasing it from rest at some low height.
2. Time the pendulum's period of oscillation using a stopwatch.
3. Repeat Steps 1-2 after changing the pendulum's length by wrapping/unwrapping the string more.

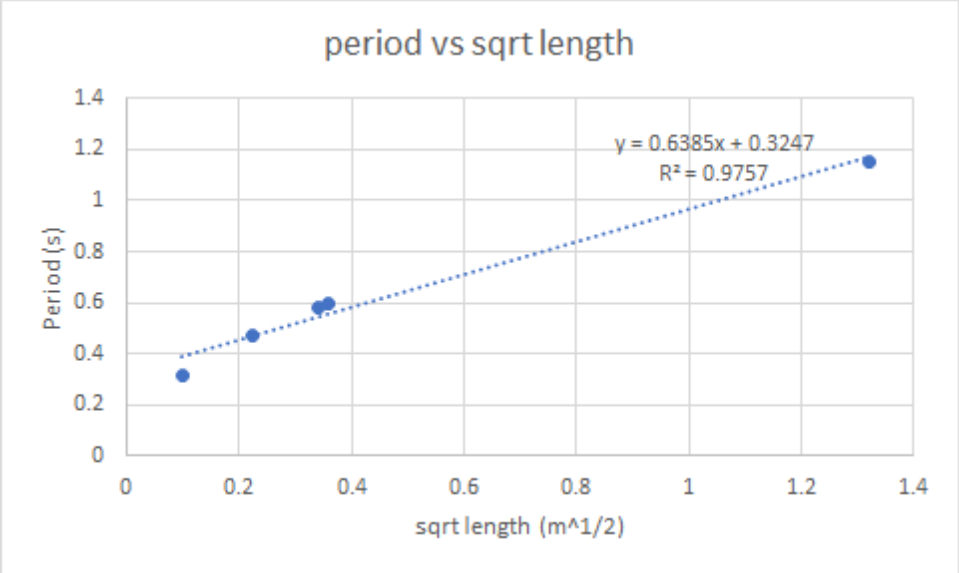
**Data**

| **Length (m)** | **Period Timed (s)** | **Percent difference (%)** | **Theoretical period (s)** |
|---|---|---|---|
| | | | |

| | | | |
|---|---|---|---|
| 0.36 | 1.05 | 12.80908843 | 1.204253954 |
| 0.225 | 0.75 | 21.22232234 | 0.952046344 |
| 0.098 | 0.39 | 37.92957219 | 0.628318531 |
| 0.34 | 0.89 | 23.95271432 | 1.170324479 |
| 1.32 | 2.12 | 8.064749275 | 2.30597076 |

**Results and Discussion**




Using your data above, graph the length of the pendulum on the x-axis and the period timed on the y-axis. Create a linearized graph if need be. Discuss whether changing the mass might affect the period of oscillations and why this may/may not be the case, physically. In addition, summarize the relationship between period and length, and discuss sources of error.

In this lab, the length of a pendulum was changed, and the value that varied with this was the period of the pendulum. Kept constant were values of mass and angle.

The graph of the length of the pendulum is square root proportional to the period. So, to linearize the graph, the length of the pendulum is square rooted while the period stays the same. In our graph, the power of the x value, the length, is 0.6 (close to 0.5), which agrees with the theoretical equation for period relation with length. Our linearized graph has an R^2 value of 0.97, so it is relatively accurate data.

Chaning the mass should not affect the period of oscillation. Because objects of the same mass experience the same acceleration due to gravity, the acceleration while on the pendulum should be the same, meaning a same period.

Sources of error include using an angle too large. The period that we calculated for only works when using smaller angles because it relies on the small angle approximation. Thus, using too large of an angle will skew the results. This could be avoided by using only smaller, tiny angles. Another potential source of error comes from human inaccuracy of measuring time, since the periods were very short, especially with short string lengths. Further, this could be reduced by using many trials and averaging results to reduce the noise caused by errors.