Physics: Lab E1 – Simple Harmonic Motion of a Pendulum

Introduction

One of the most ancient uses of astronomy was the keeping of time and the calendar. However, the measure of the passage of time based on the Sun is not precise enough for small intervals and inconvenient indoors (or at night)! One of the earliest clocks was probably the water clock (time interval equal to the time between successive drips) used in China about 5000 BC. The first precise mechanical device for measuring time was the pendulum clock, which dates back to about 1500 AD. This clock, and also the more modern quartz crystal and atomic clocks, depend on regular oscillations to "count" the passage of time intervals.

(For your information, the SI measurement system defines the *second* as the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom.)

For any regular oscillation, the period is defined as the time required for one complete cycle or oscillation. In case of a pendulum, this means the time required for one complete swing-from the starting position to the furthest away point and then back to the starting position.

- What are some of the variables that could possibly affect the period of a pendulum?

Problem
What effect does the length of a pendulum have on the period of the swing?

Prediction
Write a prediction based on a logical guess to answer this question.

Experimental Design
Five different values of the manipulated variable are chosen to cover as large a range as possible. For each value of the variable, the time for 10 periods is measured. This is repeated several times until a reliable average can be found. The maximum release angle of the pendulum is restricted to 20^{o}.

Materials
Prepare a list of all equipment required.

Procedure
Write a step-by-step list of instructions to be followed.

Evidence
Prepare labeled tables to record all data collected.

Analysis
1. Calculate the best average period for each length
2. Plot a graph (manipulated on the horizontal axis). Draw a smooth, best-fit curve.
3. Does the shape of your graph agree with the equation provided on p. 379.
4. Answer the question stated in the problem by writing a sentence to describe the relationship between period and length.
5. Find the predicted (or theoretical) value of the period of the pendulum for each length used. (Again see p. 379 in your text.)

Evaluation
Complete parts 1 and 2 of the evaluation outline (Appendix B). It will be necessary to calculate the accepted value of the period for your pendulum.