

Intermediate Physics Lab 4: A Higher-Order Mathematical Description of the Simple Pendulum, Comparing Data and Modeling

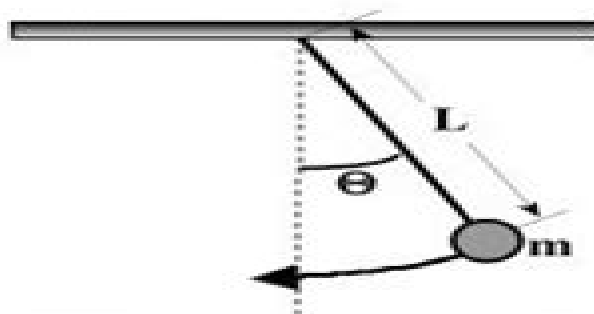
"Why," said the Dodo, "the best way to explain it is to do it." Lewis Carroll in Alice in Wonderland.

Imagination is more important than knowledge. Albert Einstein

Its hard to imagine what knowledge would be like without some imagination. Physics Lab Instructor

Introduction

In examining the behavior of a simple pendulum (below) in a previous (possibly 290) lab, we made the simplifying assumption that, for small initial launch angles, the $\sin\theta$ can be approximated by θ itself.



This gave us a rather simple expression for the period of a simple pendulum, T , that depended on the physical parameters L (length of pendulum), and g (acceleration at the Earth's surface owing to gravity) but not m (the mass of the pendulum bob). The simple expression is arrived at by considering the "return torque" ($\tau = L \cdot mg \sin\theta$), on the oscillator and the inertia which causes it to overshoot equilibrium, in this case the moment of inertia $I = mL^2$. The simple expression is the equation of motion for the pendulum:

$$\ddot{\theta} + \frac{g}{L} \sin\theta = 0 \Rightarrow \ddot{\theta} + \frac{g}{L} \theta = 0 \quad (1)$$

This simple expression can be solved for the period of the pendulum in the usual way, by assuming that t is some periodic function in time such as $A\sin(\omega t + \phi)$, taking it's second derivative, substituting, and solving for ω . This equation constitutes a simple *model* for the pendulum motion, given ω , ϕ and A , we state the mass's position at a time t .

Some assumptions are built into our simple model for the period of a simple pendulum as we have conceived it. An explicit assumption is that the initial (or *launch*) angle of the pendulum, sometimes called its initial displacement, is small. Less than 20° to be more precise. There is

Lab Report Investigating A Simple Pendulum

D Keegan



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