PHYS2502 Mathematical Physics Lab #3 6 Feb 2022

This lab assignment is at 8am, the morning after the date shown, although you should able to complete it easily before the end of the lab period. When you're done, upload your code to the github *repository, and a PDF of your output to the* canvas *page for the course.*

This lab involves numerical integration. You are encouraged to use whatever programming language or computing application that you are most familiar with.

The total mechanical energy of a simple pendulum of length ℓ and bob mass m is

$$E = \frac{1}{2}m\ell^2\dot{\theta}^2 + mg\ell(1-\cos\theta) = mg\ell(1-\cos\theta_0)$$

where $-\theta_0 \le \theta \le \theta_0$ is the angle through which the pendulum swings, and $\dot{\theta} \equiv d\theta/dt$. Find an integral for the period $T(\theta_0)$, divided by the "small angle" period that you learned in your first Physics course. This is most easily done by integrating dt from $\theta = 0$ to $\theta = \theta_0$ and then multiplying by four.

Carry out this integral numerically, for a set of angles θ_0, ranging from something small to something approaching π. Your scaled period should, of course, approach unity for small θ_0, and infinity as θ_0 approaches π.

If you do this lab in MATHEMATICA, then you'll want to use the function NIntegrate.

Make a table of your θ_0 values and the scaled period. Plot these values as the scaled period as a function of θ_0, and connect the points with straight line segments. Use enough values of θ_0 so that the plot looks like a smooth curve.