Sample calculations for lab 07

Here, I want you to study how the results that give the period are obtained.

A mass m is attached to the end of a string of length L forming a simple pendulum. Initially the mass is at an angle θ_0.

Period of the simple pendulum

The torque on the pendulum is initially given by (assuming the end of the string to be the pivot point:

I: Torque about the axis: $\vec{\Gamma}=\vec{R}\,x\,\vec{R}\Rightarrow|(\vec{\gamma})|=-|\vec{R}||\vec{F}|\sin(\theta)$

II: small angle approximation:if θ is small, then $\sin(\theta)\approx\theta$

III: response of system to the torque: it produces a time rate of change in angular momentum or: $\Gamma=I\alpha$ where I is the moment of inertia. The moment of inertia about the pivot is $I=mL^2$.

From this find α in terms of the torque. $mL^2\alpha=-Lmg\sin(\theta)\Rightarrow\alpha\approx\frac{-g}{L}\theta$

IV: Equation of motion: Write the resulting equation in "standard form" as $\alpha+\frac{g}{L}\theta=0$.

Recall that the general solution to this type of equation is: $\theta=\theta_0\cos(\omega t);\omega=\sqrt{\frac{g}{L}}$ when the pendulum is at an amplitude.

V: From ω, find the period, T, of the simple pendulum when L=1 m.

T=____________________

Period of the Spring mass system

A mass m is connected to a spring of spring constant k. The system is held horizontal in the Earth's gravitational field.

I: the spring exerts a force on the mass given by: $F=-kx$ (ignoring the - sign here).

II: the mass responds to this force by Newton's laws: $F=ma$

III: Equate these to obtain the equation of motion in standard form:

$$ma=kx\Rightarrow a+\frac{k}{m}x=0$$

IV: Recognize the solution to this is: $x=A\cos(\omega t);\omega=\sqrt{\frac{k}{m}}$ when the mass is initially at an amplitude.

V: From this find the period, T, of the spring mass system when k=1 N/m and m =.5 kg.

T=____________________