Section: Tuesday **Date: November 14, 2016**

An Examination of Mass and Length on a Bungee System

ABSTRACT: This week, we aimed to quantify the differences in the expected versus the actual measured function for kinetic and potential energy. Due to Newton's second law, we know that the energy in this system is conserved- meaning that the sum of the Kinetic and Potential energy is equal at any given time. This system, however, may have extraneous factors affecting its' function such as the cross breeze in the lab, the drag of the mass, or simply human error. By examining the different functions the make-up total energy (kinetic and potential) we were able to design an experiment to make an alternate function for energy that applies to our model.

INTRODUCTION*:* This lab is the second part in a three-part laboratory assignment that aims to determine working variables for a bungee system. In part one, we investigated the differences in the spring constant k. This lab, we aimed to find not only k when dropped but also the spring constant.

Total mechanical energy is conserved and measure by two variables, the kinetic energy and potential energy of a system. The potential energy is measured as a function of mass, gravity, and the height at which the mass is being dropped and kinetic energy is measured by the change in location multiplied by the spring constant k squared. By adjusting different variables, we were able to determine these constants helping us better understand our spring constant for when we drop a raw egg off of a bungee in December.

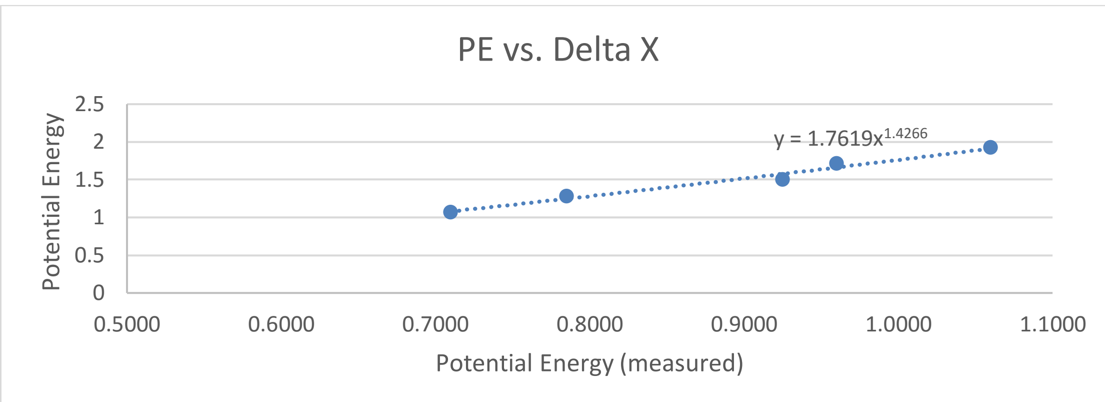
METHODS: We first consolidated our variables so we were able to focus on just a single one. Because energy is conserved in this system, we knew that potential energy and kinetic energy were equal to one another. We next measured the equilibrium, distance traveled from equilibrium, and the length of the bungee and found a function for it. Next, we kept the length constant and altered the mass.

Using a thin bungee cord, a set of masses, and a slow motion camera, we were able to test the extent to which the masses acted on their fall with the slow motion camera. Masses were dropped from the top of the hanger where the bottom part of the mass was equal to the 0 mark on our measuring tape. We took a slow motion video of the egg dropping to review where it's maximum displacement was. From that, we could find "delta x" or the change in distance from the original distance.

RESULTS:

length	k	mass* gravity*height	delta x (theoretical)	Measured	Delta x Measured	Delta X^2
0.545	3.039	1.06929	0.4813	1.225	0.6800	0.4624
0.545	3.039	1.06929	0.4813	1.225	0.6800	0.4624
0.545	3.039	1.06929	0.4813	1.195	0.6500	0.4225
0.545	3.039	1.06929	0.4813	1.211	0.6660	0.4436
0.78	2.137	1.06929	0.6844	1.648	0.8680	0.7534
0.78	2.137	1.06929	0.6844	1.695	0.9150	0.8372
0.78	2.137	1.06929	0.6844	1.714	0.9340	0.8724
0.635	2.615	1.06929	0.5592	1.398	0.7630	0.5822
0.635	2.615	1.06929	0.5592	1.45	0.8150	0.6642
0.635	2.615	1.06929	0.5592	1.43	0.7950	0.6320
0.435	3.791	1.06929	0.3857	1.38	0.9450	0.8930
0.435	3.791	1.06929	0.3857	1.36	0.9250	0.8556
0.435	3.791	1.06929	0.3857	1.37	0.9350	0.8742

mass	length	k	mass* gravity*height	delta x (theoretical)	Measured	Delta x Measured	Delta X^2
0.06	0.56	2.959	1.283148	0.5415	1.345	0.7850	0.6162
0.07	0.56	2.959	1.497006	0.5848	1.485	0.9250	0.8556
0.08	0.56	2.959	1.710864	0.6252	1.52	0.9600	0.9216
0.09	0.56	2.959	1.924722	0.6632	1.62	1.0600	1.1236
0.05	0.56	2.959	1.06929	0.4943	1.27	0.7100	0.5041



We first calculated our assumed potential energy values then plotted them against our obtained values from the experiment of the change in length.

While we originally thought that measuring the differences in length would give us the best idea for what we should expect to see when we drop the egg from the middle of the science center atrium in December. We were able to find the function y= 1.7619x^1.4266, an alternative exponential function for kinetic energy of a syte.

DISCUSSION:

Since the energy of the system is equal at all times, we manipulated with our functions for potential energy and kinetic energy by isolating variables. We knew that $mgh=k(x_f-x_i)^2$ so by plotting the differences in the change of height compared to the change in bungee length caused by the changing mass, we are better able to predict how a weighted system will work at different heights, masses, and k-values.

Our calculated $y= 1.7619x^{1.4266}$ for our function was proven by using the equation $mgy=.837L^{-.982}(x_f-x_i)^2$. By combining these equations, we were able to determine .595 as the constant K with our final value of $mgy=.595k(x_f-x_i)^{1.4266}$. This change in exponents helps account for any extraneous factors that may be going on.

By calculating the difference in our calculated versus our obtained values, we will be able to account for differences in our expected versus our obtained value to help us figure out what to do when it comes time for the real thing.

Since we were taking slow motion videos of the masses falling, there is a degree of uncertainty there. Furthermore, there could have been slight differences in how the masses were dropped (if they were accidentally pushed, or from different spots relative to one another.

CONCLUSION: While it took us a little bit to get there, we were able to determine the best way to find an applicable function for our fast-approaching egg drop laboratory assignment. We were able to compare different masses on a bungee system and account for extraneous factors outside of the typical kinetic energy function. This is to be expected in any physics assignment and is good practice for the future.

On my honor, I have neither given nor received any unacknowledged aid on this assignment.

Pledged: