Hayne Ainslie, James, Andrew Wednesday Cumming Section 11-12-17
Bungee 2

This week we continued experimenting with our bungee cord. We continued to explore the idea of Hooke's law in relation to k. This time, however, we did a dynamic experiment where we dropped different masses with varying lengths of bungee cords. To find k, we used the law of conservation of energy. We set the initial potential energy equal to the $\frac{1}{2}kx^2$, where the height was the total distance the mass dropped, and x was the displacement of the cord. For our experiment, we used two different lengths of un-stretched bungee cord and dropped five mases for each length. Using video analysis, we were able to determine the maximum stretch which gave us both the height and displacement. Based on the equation $mgh= \frac{1}{2}kx^2$ we were able to determine the k value for each drop. To do this we graphed the data. Since the k value would change with mass we made mass the dependent variable on the x-axis and the k values for each mass the y values. Thus, the slope of the line for each of our bungee lengths represents the value of k for that length. We found two k values for the two lengths, y=453.17x + 91.516 (where x is the mass and y are the k value) the uncertainty for the slope and intercept respectively are .2 and .04. For our second length, the k value was y=456.45x + 110.3 with uncertainty in slope and intercept being .13 and .01. This equation will allow us to determine the k value for any mass with these two lengths. Then once we have the k value we will be able to determine how far the bungee will stretch using conservation of energy. The biggest source of error would have been due to how accurately we could measure. Measuring the un-stretch length of the cord was particularly challenging. Also during video analysis, it would not always be clear on exactly where the mass reached its final point. To mitigate this, next time we could use a highspeed camera that would allow for more accurate frames. With our data, we can now find out how much static string we will need to add to our cord to get as close to the floor as possible.

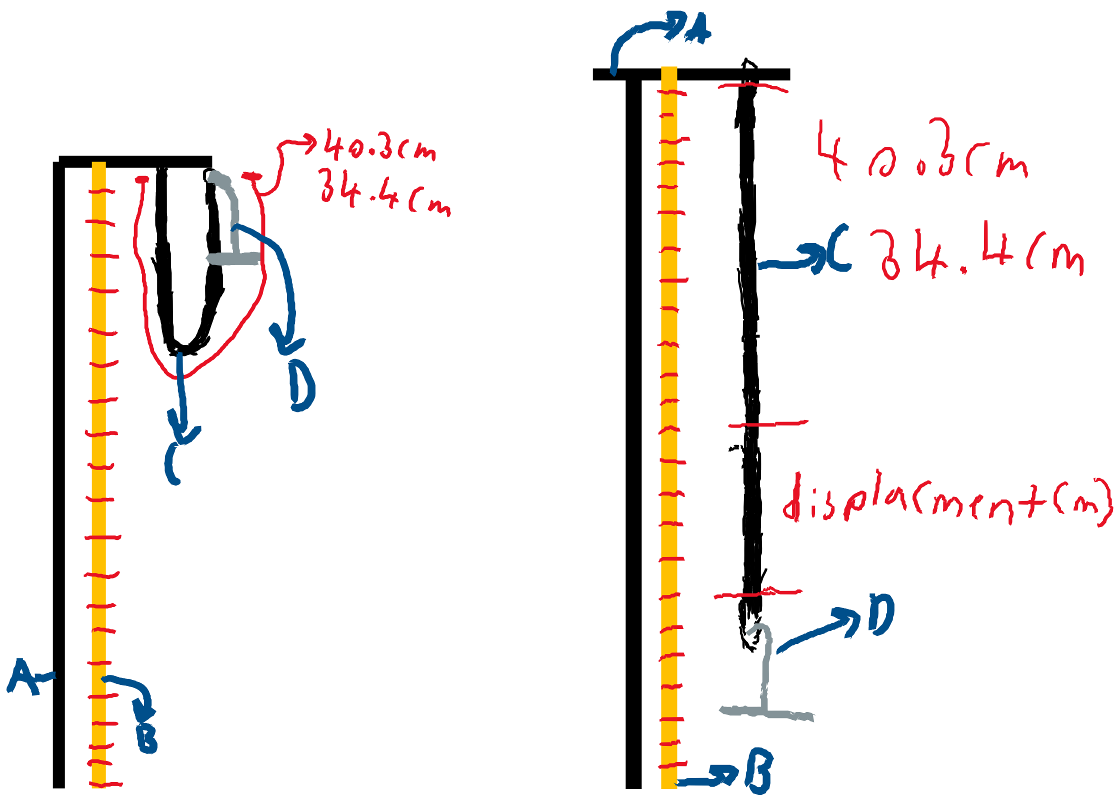

Diagram 1: Diagram 1: (A) represents the apparatus used to hang the measuring tape (B). Also, the un-stretched cord is (C) with the mass hanging from the cord at the top of the apparatus d. we used the same 5 masses for both cords.

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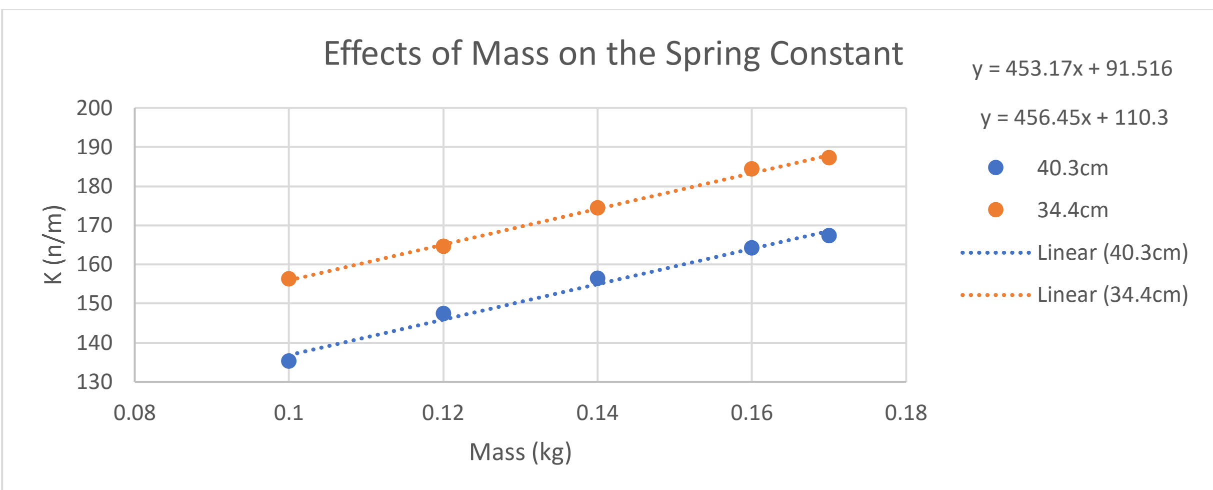
.344m	+/- .0001 (kg)	+/- .001(m)	+/- .001(m)	+/- .707 (j)	
mass g	mass (kg)	Height (m)	displacement (m)	Pei	k (n/m)
100	0.1	1.255	0.1255	1.2299	156.1753
120	0.12	1.43	0.143	1.68168	164.4755
140	0.14	1.574	0.1574	2.159528	174.3329
160	0.16	1.702	0.1702	2.668736	184.2538
170	0.17	1.78	0.178	2.96548	187.191

.403m	+/- .0001 (kg)	+/- .001(m)	+/- .001(m)	+/- .709 (j)	
mass g	mass (kg)	Height (m)	displacement (m)	Pei	k (n/m)
100	0.1	1.45	0.145	1.421	135.1724
120	0.12	1.596	0.1596	1.876896	147.3684
140	0.14	1.755	0.1755	2.40786	156.3533
160	0.16	1.911	0.1911	2.996448	164.1026
170	0.17	1.992	0.1992	3.318672	167.2691

Table 1: This is the data from our two un-stretched lengths which are recorded in the top right-hand corner, using video analysis we measured the height of the drop (also the height for PE) then we subtracted the initial length from the height to get displacement. The uncertainties of mass, height, and displacement come from the accuracy of the, measuring tools. While the percent error for PE came from standard deviation.



Graph 1: This is the graphed data from the tables above. The data points were linear and the equations for each slope are found above with the top equation pertaining to 40.3cm and the bottom one 34.4cm. The uncertainties of the slope were found using data regression analysis. 40.3cm slope and intercept have uncertainties of .2 and .04 with the 34.4cm have uncertainties of .13 and .01.

The experimental values of interest are the equations that allow us to determine the k value for any mass on a specific length cord. For the cord of length 40.3 the equation y = 453.17x + 91.516 with the uncertainty of the slope being +/-.2 and the intercept +/-.04 (k/n). For the cord with length 34.4cm the equation is y = 456.45x + 110.3, the uncertainty in the slope is +/-.13 and the intercept +/-.01 (k/n). the values found are acceptable within the range of uncertainty. To test this to make sure we could use the same length bungee cord and predict the distance of the fall. Then we would perform the test with the same masses used in the experiment and see if our prediction was correct. If it was then we would know that our results were acceptable.