PHYS 11A Lab - General Physics: Mechanics

Name: _____ Team:_____

Names: Santiago Bermudez, Jean Paul La, Celina Ries **Team: 09**

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Lab #7 – Work-Energy Principle

Date: 10/30/20

Objective Statement: Describe the purpose of the lab in a few sentences, and state any hypothesis formed ahead of doing the experiment.

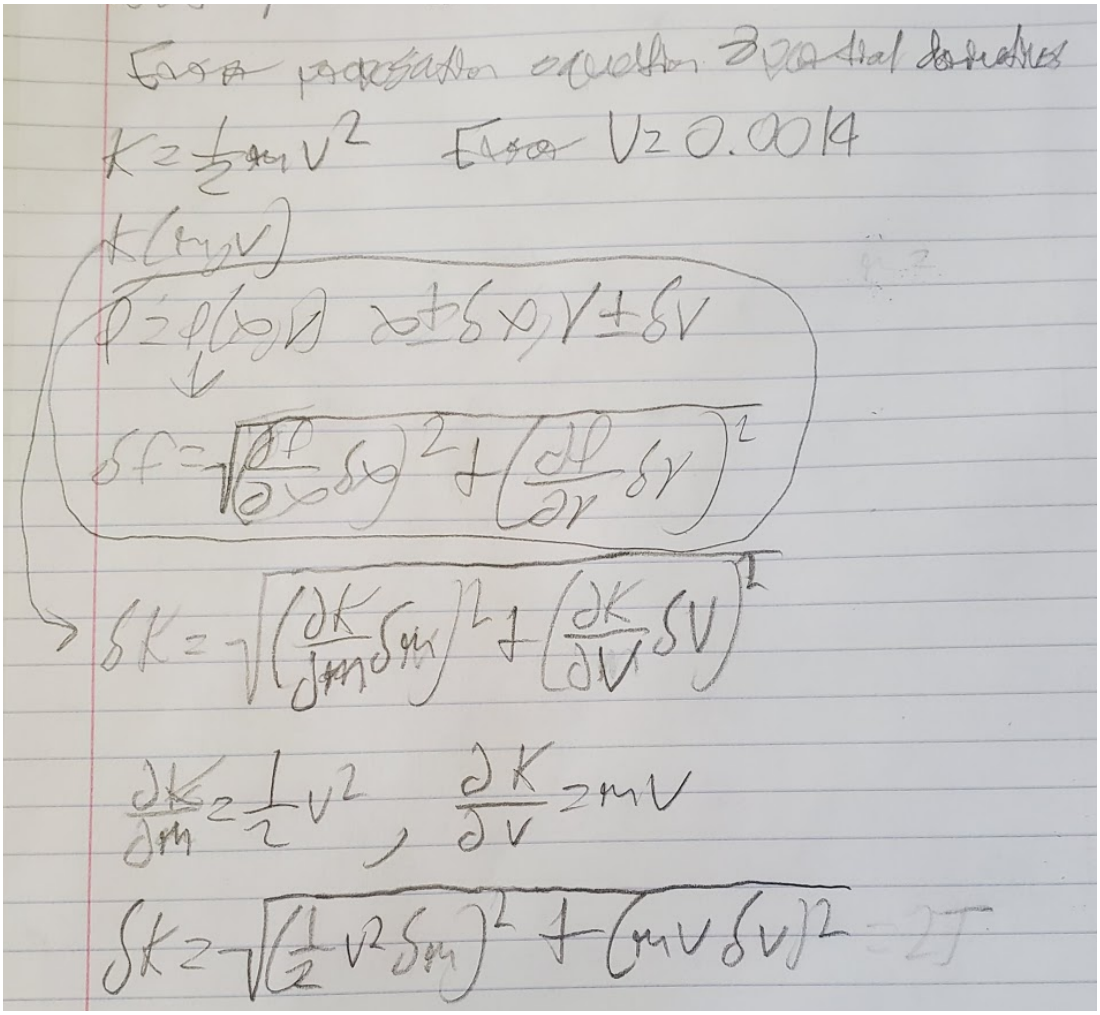
The purpose of the lab is to use the work-energy principle and to take what was done in the experiment as well as any data that we have received from the experiment and translate it into the force and position that we will be measuring. According to the work-energy principle, we have that the change in kinetic energy is equal to the work done by the net force acting on an object. As such, we hypothesize that our data for work will show a positive correlation with our data for kinetic energy.

Watch the Work-Kinetic Energy Theorem Video and complete the data analysis in your excel spreadsheet.

Give an estimate of δx, with explanation.

Our estimate of δx would be 0.0001. Looking at our data, we noticed that the position at the beginning has a fluctuation between 0.5832 and 0.5834. If we subtracted those values and divided by two, this gives us an uncertainty based on the accuracy of our measuring device and data. The whole point was not to omit anything or claim to have a certain level of accuracy that wouldn't make sense.

Derive the error propagation equation for δK (the kinetic energy).



Does *K* match *W* within the experimental uncertainty? If not, what could account for the discrepancy?

Our data for kinetic energy does not seem to match work within the experimental uncertainty we have. One possible explanation for this discrepancy would be instrument drift (systematic). It is possible that the readings have drifted significantly over time, skewing our results. Another explanation could be physical variations (random). Our data only comes from one trial. Perhaps if we performed the experiment multiple times, we may discover certain variations in the experiment that would otherwise go unnoticed.

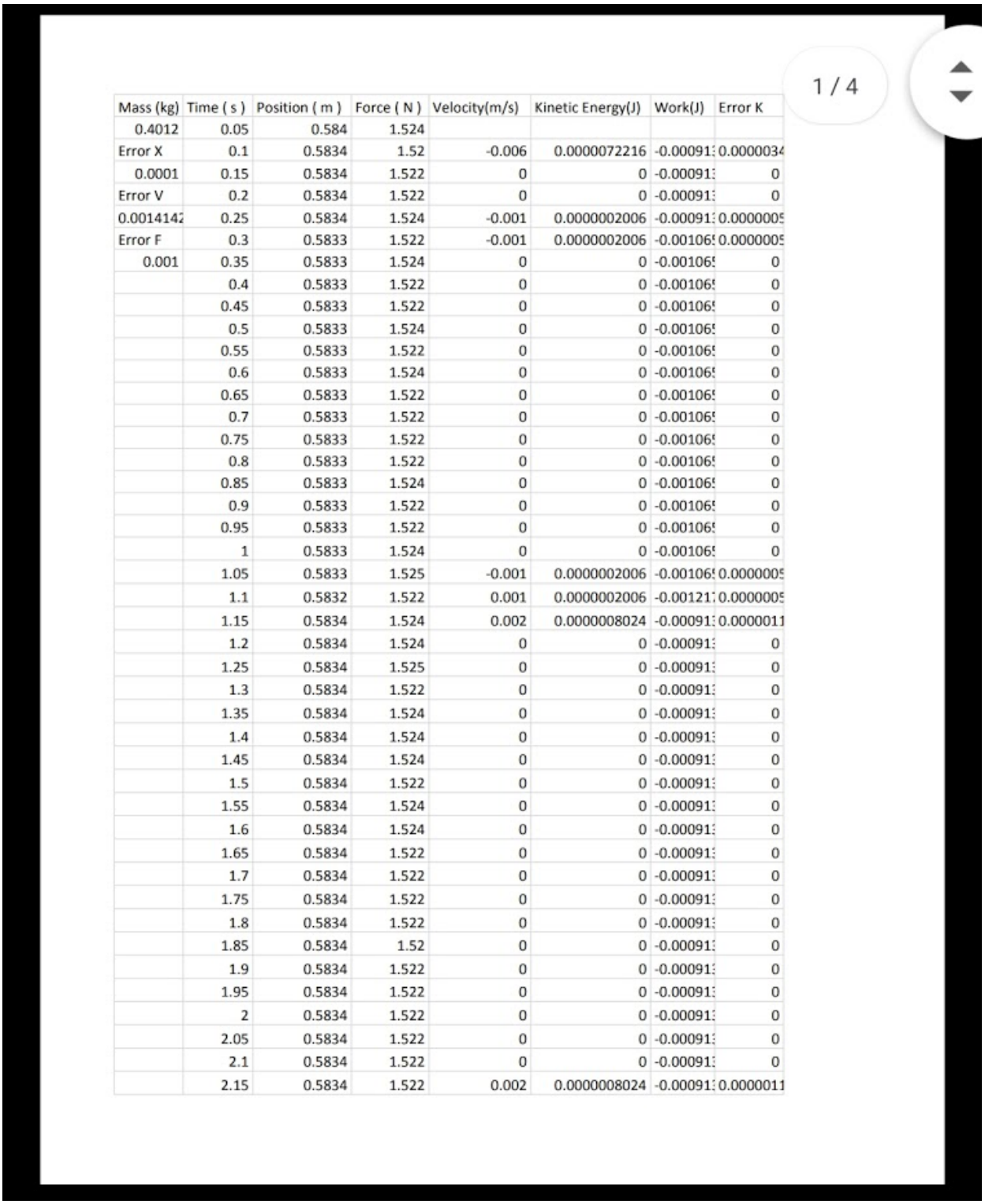
Give an estimate of *δF*, with explanation.

Our estimate of *δx* would be 0.001. According to the data on our spreadsheet, we noticed that before the cart is released that the force fluctuates between 1.524 and 1.522. To calculate our uncertainty for force, we would subtract the minimum value (1.522) from the maximum value (1.524) and divide that by 2. During this period of time the cart has not moved and the value of F is relatively constant.

Does the rubber band appear to obey Hooke's Law? If so, what is the spring constant?

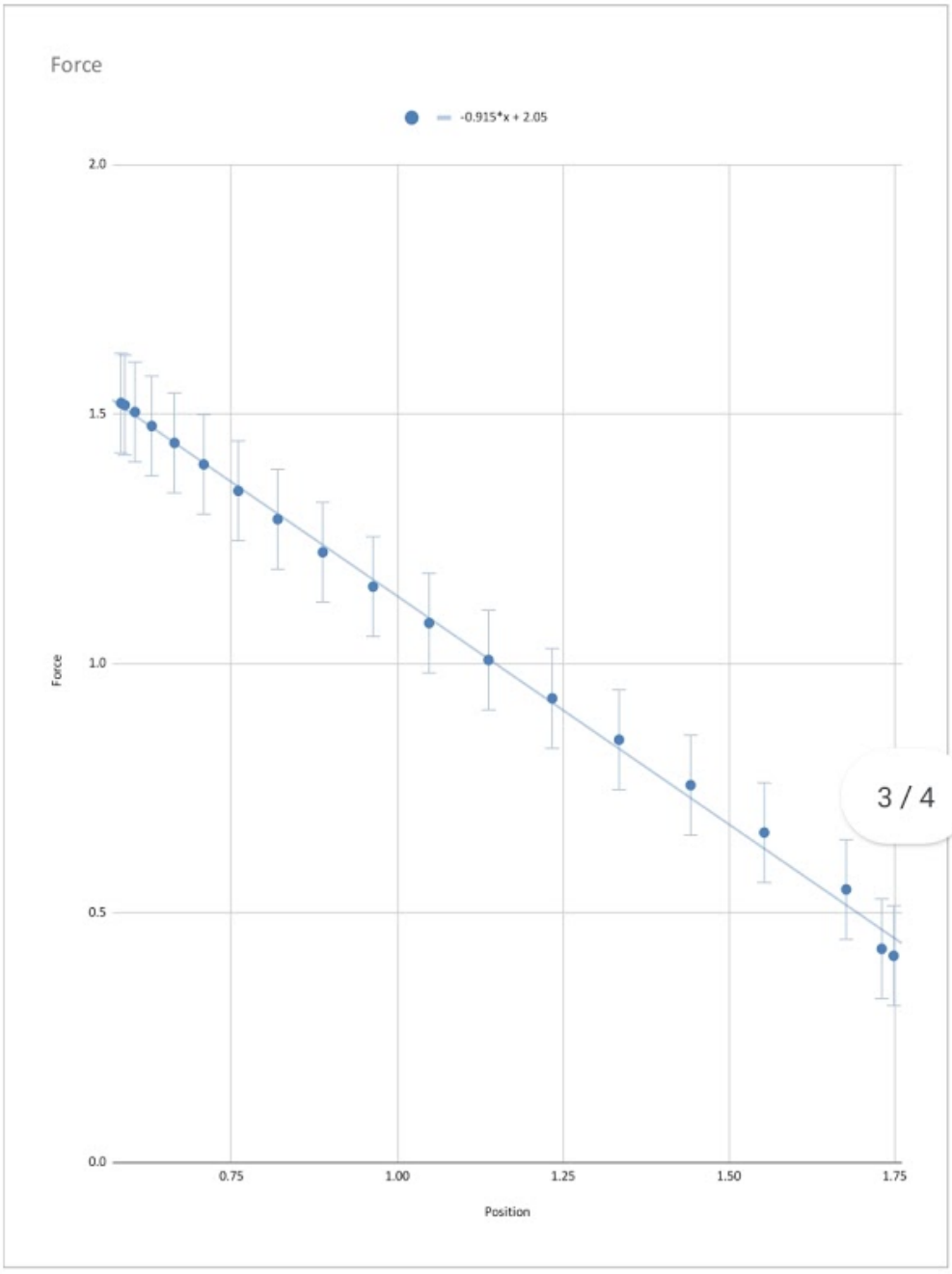
The rubber band does appear to obey Hooke's Law because the plot of force vs position appears to be linear. The spring constant can be calculated by taking Hooke's Law, F=kx, and solving for k. As a result, we calculated the spring constant to be y=-0.915x+2.050

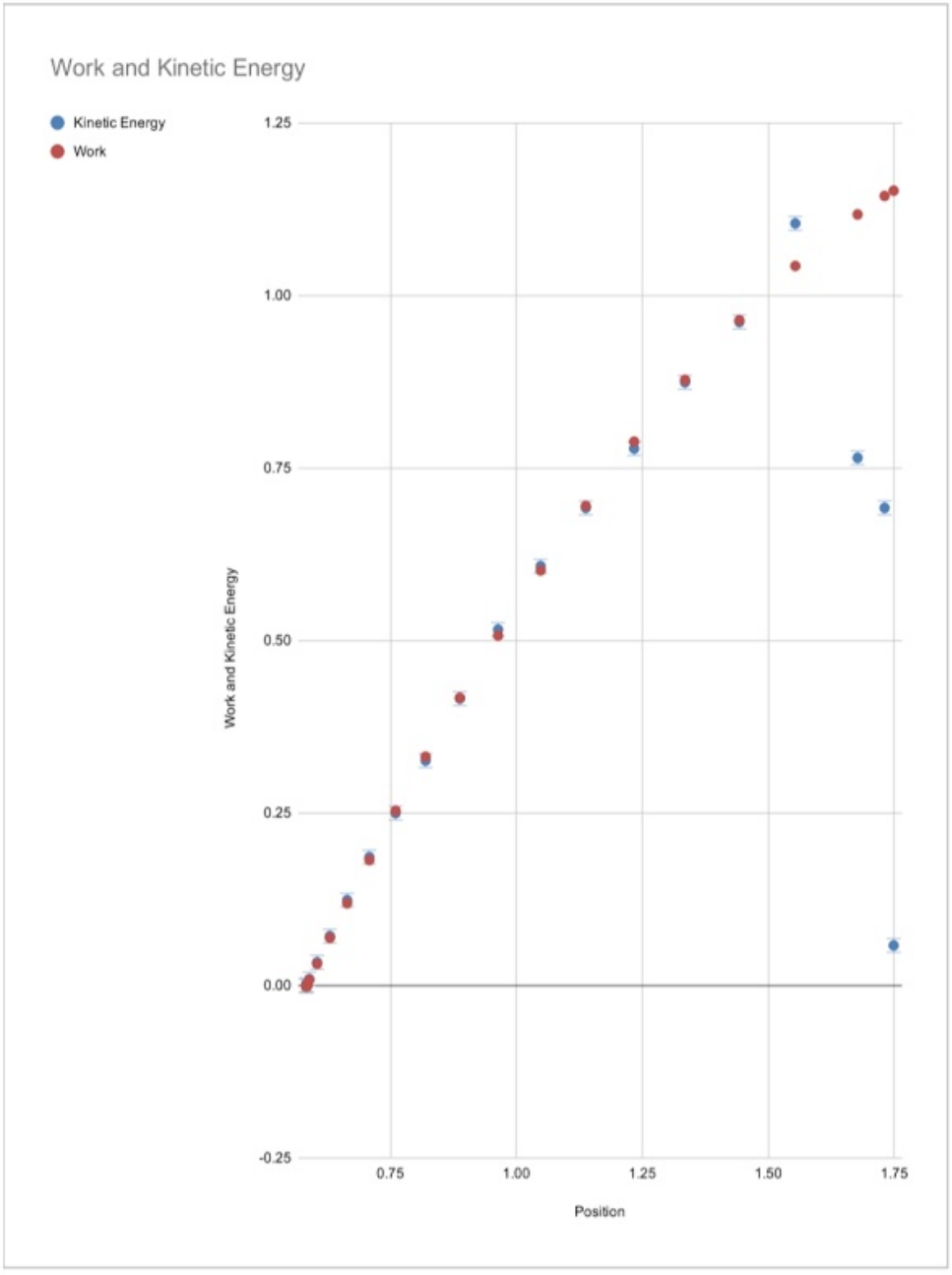
When done upload your spreadsheet, along with your worksheet, onto canvas.



Mass (kg)	Time (s)	Position (m)	Force (N)	Velocity(m/s)	Kinetic Energy(J)	Work(J)	Error K
0.4012	0.05	0.584	1.524				
Error X	0.1	0.5834	1.52	-0.006	0.0000072216	-0.00091	0.0000034
0.0001	0.15	0.5834	1.522	0	0	-0.00091	0
Error V	0.2	0.5834	1.522	0	0	-0.00091	0
0.0014142	0.25	0.5834	1.524	-0.001	0.0000002006	-0.00091	0.0000005
Error F	0.3	0.5833	1.522	-0.001	0.0000002006	-0.00106	0.0000005
0.001	0.35	0.5833	1.524	0	0	-0.00106	0
	0.4	0.5833	1.522	0	0	-0.00106	0
	0.45	0.5833	1.522	0	0	-0.00106	0
	0.5	0.5833	1.524	0	0	-0.00106	0
	0.55	0.5833	1.522	0	0	-0.00106	0
	0.6	0.5833	1.524	0	0	-0.00106	0
	0.65	0.5833	1.522	0	0	-0.00106	0
	0.7	0.5833	1.522	0	0	-0.00106	0
	0.75	0.5833	1.522	0	0	-0.00106	0
	0.8	0.5833	1.522	0	0	-0.00106	0
	0.85	0.5833	1.524	0	0	-0.00106	0
	0.9	0.5833	1.522	0	0	-0.00106	0
	0.95	0.5833	1.522	0	0	-0.00106	0
	1	0.5833	1.524	0	0	-0.00106	0
	1.05	0.5833	1.525	-0.001	0.0000002006	-0.00106	0.0000005
	1.1	0.5832	1.522	0.001	0.0000002006	-0.00121	0.0000005
	1.15	0.5834	1.524	0.002	0.0000008024	-0.00091	0.0000011
	1.2	0.5834	1.524	0	0	-0.00091	0
	1.25	0.5834	1.525	0	0	-0.00091	0
	1.3	0.5834	1.522	0	0	-0.00091	0
	1.35	0.5834	1.524	0	0	-0.00091	0
	1.4	0.5834	1.524	0	0	-0.00091	0
	1.45	0.5834	1.524	0	0	-0.00091	0
	1.5	0.5834	1.522	0	0	-0.00091	0
	1.55	0.5834	1.524	0	0	-0.00091	0
	1.6	0.5834	1.524	0	0	-0.00091	0
	1.65	0.5834	1.522	0	0	-0.00091	0
	1.7	0.5834	1.522	0	0	-0.00091	0
	1.75	0.5834	1.522	0	0	-0.00091	0
	1.8	0.5834	1.522	0	0	-0.00091	0
	1.85	0.5834	1.52	0	0	-0.00091	0
	1.9	0.5834	1.522	0	0	-0.00091	0
	1.95	0.5834	1.522	0	0	-0.00091	0
	2	0.5834	1.522	0	0	-0.00091	0
	2.05	0.5834	1.522	0	0	-0.00091	0
	2.1	0.5834	1.522	0	0	-0.00091	0
	2.15	0.5834	1.522	0.002	0.0000008024	-0.00091	0.0000011

	2.2	0.5836	1.52	0.002	0.0000008024	-0.000605	0.0000011
	2.25	0.5836	1.522	0	0	-0.000605	0
	2.3	0.5836	1.522	0	0	-0.000605	0
	2.35	0.5836	1.524	0	0	-0.000605	0
	2.4	0.5836	1.522	0	0	-0.000605	0
	2.45	0.5836	1.522	0	0	-0.000605	0
	2.5	0.5836	1.524	0	0	-0.000605	0
	2.55	0.5836	1.522	0	0	-0.000605	0
	2.6	0.5836	1.524	0	0	-0.000605	0
	2.65	0.5836	1.522	0	0	-0.000605	0
	2.7	0.5836	1.524	0	0	-0.000605	0
	2.75	0.5836	1.524	0	0	-0.000605	0
	2.8	0.5836	1.522	0	0	-0.000605	0
	2.85	0.5836	1.522	0	0	-0.000605	0
	2.9	0.5836	1.522	0	0	-0.000605	0
	2.95	0.5836	1.524	-0.002	0.0000008024	-0.000605	0.0000011
	3	0.5834	1.522	-0.002	0.0000008024	-0.000913	0.0000011
	3.05	0.5834	1.52	0	0	-0.000913	0
	3.1	0.5834	1.522	0	0	-0.000913	0
	3.15	0.5834	1.522	0	0	-0.000913	0
	3.2	0.5834	1.522	0	0	-0.000913	0
	3.25	0.5834	1.522	0	0	-0.000913	0
	3.3	0.5834	1.518	0	0	-0.000913	0
	3.35	0.5834	1.522	0.057	0.0006517494	-0.000913	0.0000361
	3.4	0.5891	1.518	0.211	0.0089309126	0.007750	0.0002527
	3.45	0.6045	1.504	0.407	0.0332291894	0.031019	0.0008598
	3.5	0.6298	1.476	0.596	0.0712563296	0.068716	0.0018079
	3.55	0.6641	1.442	0.784	0.1232999936	0.118760	0.0031053
	3.6	0.7082	1.399	0.962	0.1856440664	0.181404	0.0046593
	3.65	0.7603	1.346	1.115	0.249390935	0.252911	0.0062482
	3.7	0.8197	1.289	1.274	0.3255890456	0.331171	0.0081475
	3.75	0.8877	1.223	1.439	0.4153866326	0.416579	0.0103857
	3.8	0.9636	1.154	1.603	0.5154635654	0.506786	0.0128801
	3.85	1.048	1.081	1.74	0.60733656	0.601103	0.0151701
	3.9	1.1376	1.007	1.857	0.6917588694	0.694645	0.0172744
	3.95	1.2337	0.93	1.969	0.7777183766	0.787718	0.0194169
	4	1.3345	0.847	2.087	0.8737271414	0.877279	0.0218100
	4.05	1.4424	0.756	2.189	0.9612192326	0.963761	0.0239907
	4.1	1.5534	0.661	2.346	1.10404543	1.042404	0.0275507
	4.15	1.677	0.547	1.952	0.7643469824	1.117059	0.0190836
	4.2	1.7486	0.414	0.536	0.0576315776	1.151463	0.0014683
	4.25	1.7306	0.428	1.857	0.6917588694	1.143885	0.0172744
	4.3	1.9343	0.432				


Force
-0.915*x + 2.05
2.0
1.5
1.0
0.5
0.0
Force
0.75
1.00
1.25
1.50
1.75
Position



Below is a link to our spreadsheets and graphs, just in case.
https://docs.google.com/spreadsheets/d/1bP-SHUHsYJH2uKjav6xkWIIzZmY_cIlQ13jiVXSmeIA/edit#gid=938851503

Conclusion: Summarize your findings (including relevant numbers, uncertainties, etc.), and compare them to your objective statement/hypothesis.

As far as things went, we did seem to find what looked like a positive correlation between our work and kinetic energy in the data graphs we have, but we also found that our kinetic energy did not match work within our experimental uncertainty. From our work and kinetic energy graph, if you were to zoom in closely, you may notice that there is more fluctuation in our data for the kinetic energy data points than is accounted for by the random error that was calculated from the uncertainty in velocity. What this implies is that there is some uncertainty that may not have been accounted for, which is related to the sensor itself. We can't monitor every particle in the universe to determine what is going on, but we can say that instrument drift may have played a significant factor.