

Rational

I took out an experiment where I had to measure the length of two springs that were attached to a piece of string. The springs were measured after I had added a 50g weight to the string. Each time I would add a weight, I would measure each spring to see how much further the springs stretch when a 50g weight is added to them. This entire experiment was to find out forces in equilibrium. This was done by investigating how the angle between the two springs varies as the mass that the string is supporting is increased. The purpose of this experiment was to find out how the angle of the string changed as more weight was added along with measuring the different lengths of the spring as more mass was added.

Apparatus set up

The apparatus was a meter ruler clamped onto a stand. One spring was attached to one end of the ruler at 20cm, the other was placed at 80cm. This made sure that the gap between the two springs was accurate and that they wouldn't move during the investigation. The way I measured the length of the spring was by using a 30cm ruler. I decided to start the measurement at the point where the spring starts to twirl as that is the first part of the spring that can vary and be changed by the weight. The ending point of the measurement was the other end of the spring where the springs twirl ends, as like the start of the measurement, it is the last part of the spring to vary or change its length. To make sure this was a fair test, the springs were identical, I used a device to make sure the ruler was flat and not slanting towards a certain spring which would have made the test unfair.

Method

The method I used during this investigation started out by making sure the two springs were in place at the correct placing, 20cm and 80cm. I then checked that the ruler wasn't offset at all and was perfectly flat so there wasn't an advantage to one of the springs. If the ruler was slightly off-centre then it could have had an effect on the length of the springs. If the ruler was leaning slightly to the right by a reasonable angle, the left spring would have been a greater length than the right spring and wouldn't have been a fair test. I then check I have the right amount of mass I need (600g) and then I start the experiment by measuring each spring and the angle of the string with no mass on it at all. After I get these results, I then proceed to add the first additional mass to the apparatus, that being an extra 50g piece of mass. I hang the mass as close the centre of the string as I can and then take the accurate measurements of the angle the string makes when the mass is stable and still. When taking the measurements, I make sure to not touch or move the apparatus when measuring as it could change the angle or length of the springs. I repeated this for every bit of mass I added to the overall mass which is 600g. this meant that there was 12 bits of mass to add and 12 measurements recorded. This was because the more measurement I do, the more accurate the result will be. If I only did two readings, then the result and outcome of this experiment wouldn't be as valid as they would be if I would have done 12 readings. After I completed the readings and got all the measurements and angles correct, i then started all over again to get a second reading for each mass, following the exact same steps as I did for the first reading. Starting with no mass on the string and increasing it by 50g for every reading until

the total mass reaches 600g with 12 different readings on both of the two tests I ran. Every reading was done and recorded onto a piece of paper with relevant columns and rows that show what weight equalled what length of springs and what the angle of the string was.

Results

I have put the results of the two readings in the following table that I created on excel:

	reading 1			Reading 2		
Mass	L1	L2		L1	L2	
g	mm		(°)	mm		(°)
0	27	23	180	28	22	180
50	42	38	126	40	35	123
100	60	44	116	58	45	112
150	75	60	111	74	60	108
200	86	69	105	89	70	102
250	102	81	102	104	85	100
300	115	95	97	115	95	96
350	125	111	90	129	110	91
400	140	118	86	140	120	88
450	155	127	85	151	130	85
500	176	136	84	165	145	88
550	180	150	80	175	160	80
600	189	160	80	185	170	80

I have then also made a table that shows the mean of the length of the spring at a certain weight and the angle of the string:

Mean	
Spring	Angle
mm	(°)
25	180
38.75	124.5
51.75	114
67.25	109.5
78.5	103.5
93	101
105	96.5
118.75	90.5
129.5	87
140.75	85
155.5	86
166.25	80
176	80

Uncertainties

percentage uncertainty		
weight	Spring length	String angle
0	4	0.555556
2	2.580645	0.803213
1	1.932367	0.877193
0.666667	1.486989	0.913242
0.5	1.273885	0.966184
0.4	1.075269	0.990099
0.333333	0.952381	1.036269
0.285714	0.842105	1.104972
0.25	0.772201	1.149425
0.222222	0.71048	1.176471
0.2	0.643087	1.162791
0.181818	0.601504	1.25
0.166667	0.568182	1.25

There are a few uncertainties with these results in the table. One of the main uncertainties that on both readings, spring 1 has a much longer length than spring two in all of the readings that I took, in test one and then also in test two.

Another uncertainty is the in readings of 500g. In the first test the length of spring 1 is much greater than the length of the exact same spring in the second test. The spring had the exact same load on it, however it was stretched an extra 11mm. the same can be said with the second spring. In the first test the second spring was a lot shorter than it was in the second test. Nothing about the apparatus has changed for it to make this adjustment and therefore this measurement is an uncertainty in the test

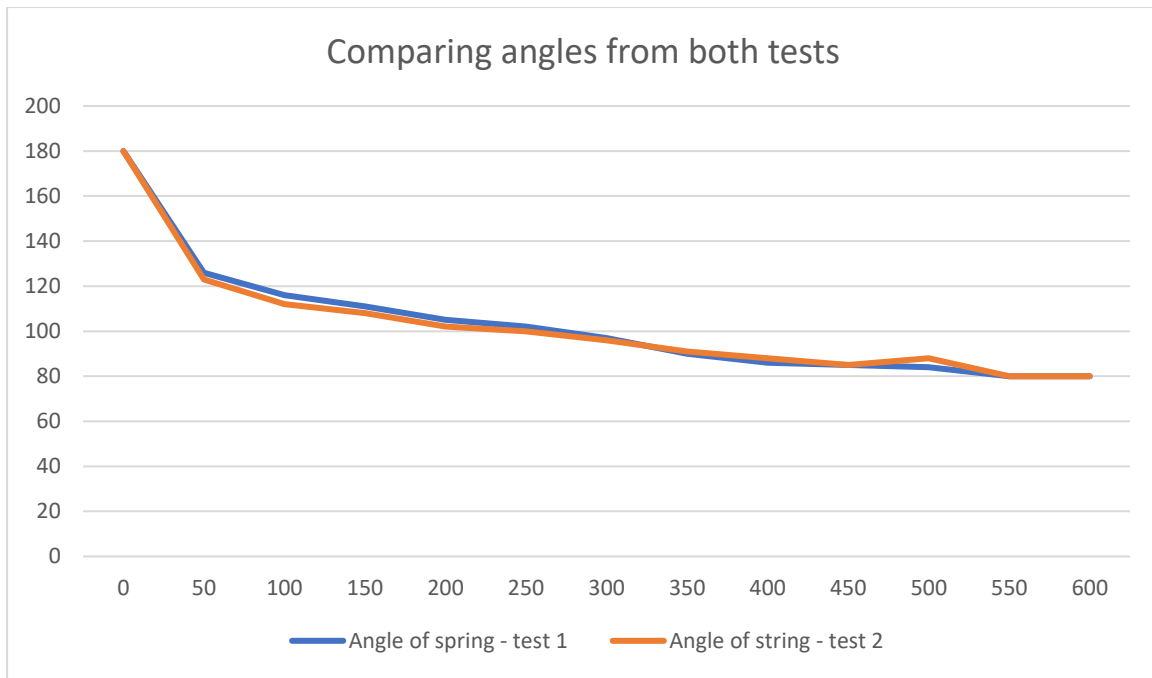
Graphs



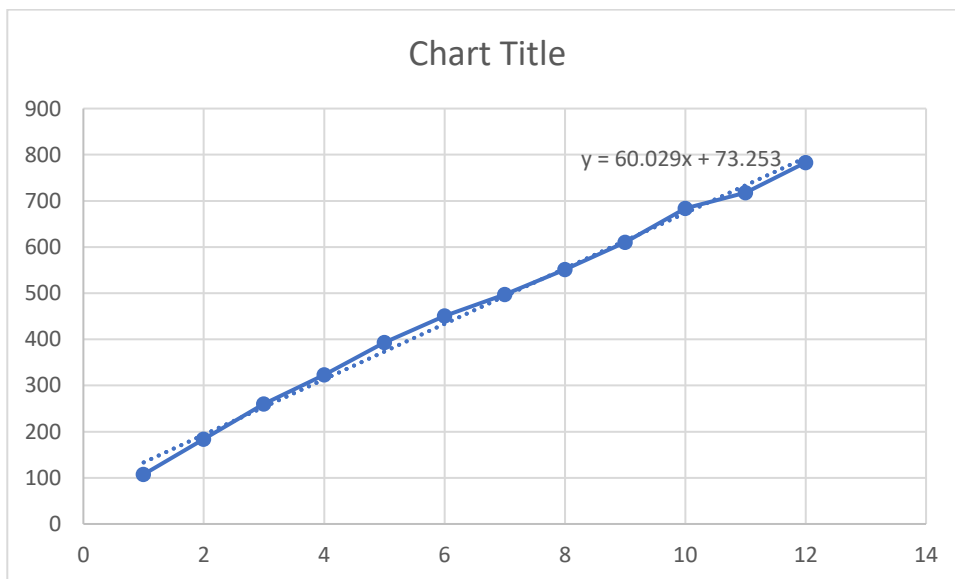
This is a graph of the first reading and a comparison of the two springs in that first reading. There are definitely some uncertainties here as the two lines separate greatly as more mass is applied.



In the second test there aren't as many uncertainties as the first reading as the lines are closer together, however it isn't completely fair and certain as there is still a reasonable gap between the two springs.

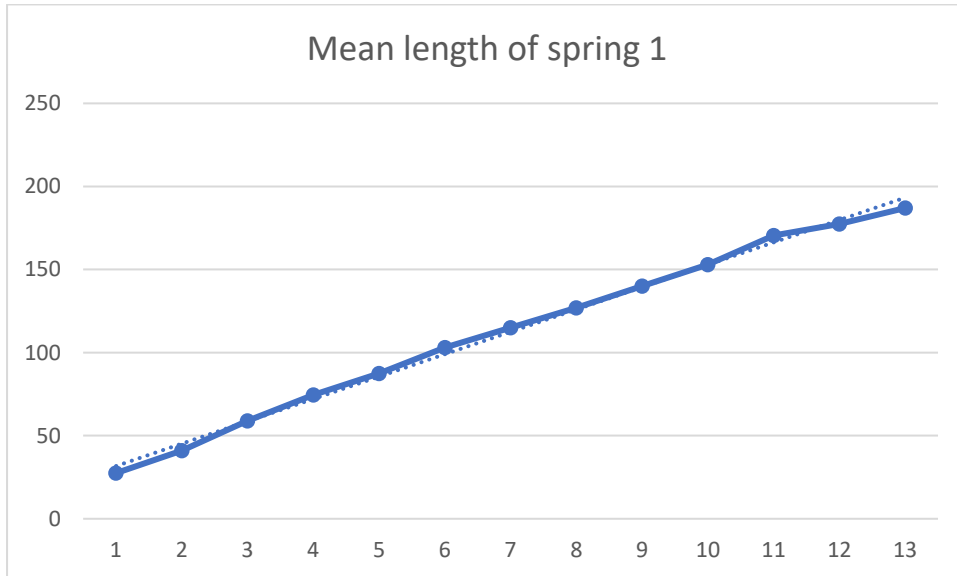


Here we have the comparison between the results of the angle of the strings in both tests. This graph shows that the results are fairly certain, however the 500g for test 2 indicates a misreading.

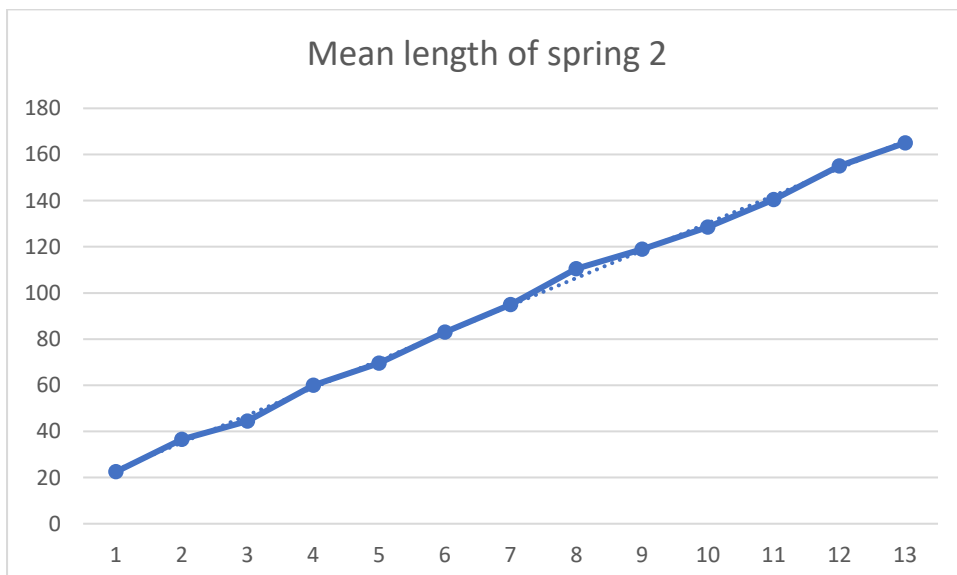


Conclusion

The results that I have calculated and found out show that the test was a very fair test and was reliable. The graphs show us that the tests were reliable by having the lines straight and close together whenever I compared to readings.



Here is a graph of the mean results of the length of spring 1. I created this to make sure that they were consistent with their measurements. If the line wasn't straight and had a bend in it then there would most likely be an error. This graph shows a straight-line implicating that there aren't any errors and that the test was reliable.



The same as the last graph, I have calculated the mean of the second spring readings, stuck them in a table and then drew a best line to make sure that the line wasn't too far off the best fit. The graph shows a relatively straight line so I believe the readings are accurate and reliable.

