Lab 02 – Hooke's Law & Simple Harmonic Motion

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1 Results

We designed two different experiments to measure the k value a given spring. Both experiments made use of the

$$F_s = -k \cdot x \tag{1}$$

where F_s is the spring force acting on an object, k is the spring constant, and x is the displacement from the equilibrium point of the spring. In our first experiment, we used five different masses and statically analyzed the system to find a k value of $9.49 \pm 0.1 \left[\frac{N}{m}\right]$. (see Figure 1) In our second experiment, we dynamically analyzed the system while it was is simple harmonic motion (SHM). We found the $k = 9.3 \pm 0.1 \left[\frac{N}{m}\right]$. (see Figure 2)

While each of the measurements were equally uncertain, we decided that the measurement using both of the Lab Quest sensors was more precise, and had less variability than Experiment 1 did. We also decided the system in Experiment 2 was able to stay more stable and constant, while everything done in Experiment had some variability from things shaking due to the movement of the lab group.

To decrease the uncertainty, we decided that it would be helpful to fine tune the experiment to decrease error in the measurement devices, like how the sonic motion sensor works great at a certain range, and to find a mass that is large enough that side to side movements are mostly canceled out. I think if we also attempted to find a way to make more precise and replicable the way that we started the spring oscillation, then it would lead to less uncertainty.

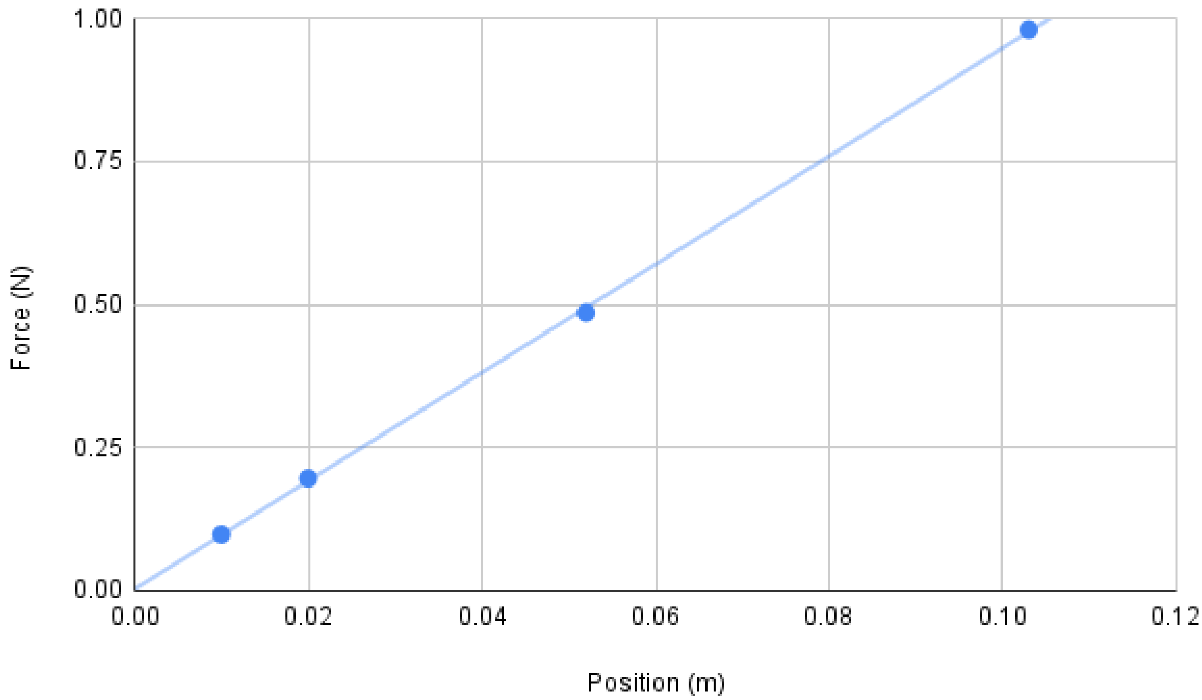

Figure 1: The relationship between the force (F) of a mass on a spring and the position (x) of that mass. On this graph there are 4 masses used and the data records its displacement from the equilibrium of each masses using a ruler. The line of best fit is graphed as well and is represented by the equation $F = 9.48x \pm 0.05$ N/m. The slope of the line of best fit represents the force constant of the spring.

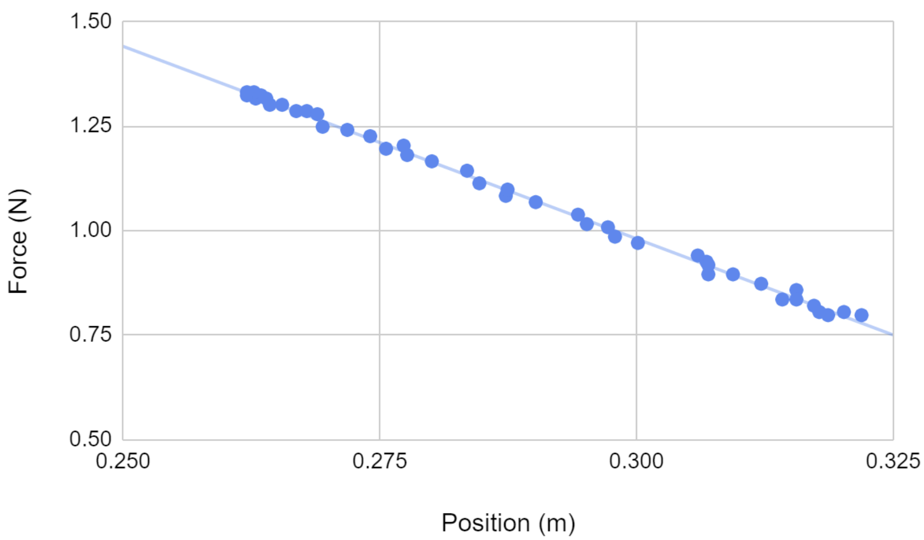

Figure 2: The relationship between the force (F) of a mass on a spring and the position (x) of that mass while it was suspended from a spring and oscillating vertically. The mass used weighed 110 grams and the data was collected over 1.68 seconds. The line of best fit is graphed as well and is represented by the equation $F = -9.3x \pm 0.1$ N/m. The slope of the line of best fit represents the force constant of the spring.