Simple Harmonic Oscillator

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June 18, 2006

Evaluation

Hooke's Law states that the force applied on a spring and the resulting displacement are directly proportional. Using this principle, we were able to estimate the spring constant for our given spring. The spring constant was the slope of the Force vs. Displacement graph.

It can be shown from $\omega = \sqrt{\frac{k}{m}}$ and $\omega = \frac{2\pi}{T}$ that $T = 2\pi\sqrt{\frac{m}{k}}$. Using this formula, we were able to calculate the theoretical period of our simple harmonic oscillator.

From the above formula, it can be seen that the mass of the oscillating object does have an effect on the period of oscillation. The greater the mass, the greater the period of oscillation will be, and the slower the cart's oscillation. The mass is proportional to the square of the period. Therefore, if the mass was to be doubled, the period will be scaled by a factor of $\sqrt{2}$. This was indeed true, as when we doubled the mass, the scale factor for the period was nearly $\sqrt{2}$ ($\frac{12.23}{8.74} \approx 1.40$). Similarly, if the mass is halved (and the spring constant is kept the same), the period will be scaled *down* by a factor of $\sqrt{2}$.

Also, the initial displacement from equilibrium (amplitude of oscillation) has no effect whatsoever on the period. No matter how much the cart is displaced from its equilibrium position, the period remains the same. We tested this, and we got exactly the same period for any amplitude of oscillation chosen. In other words, a change in the amplitude of oscillation does not affect the period of oscillation. This can be further supported by the fact that the variable A does not occur in our equation for period of oscillation.

Despite all this, the percent discrepancy between the measured and the theoretical values was a bit large. The primary reasons for this are friction and air resistance. This had a big effect on our oscillation period. In addition, it was assumed that the springs themselves were massless, while in reality, they weren't. This could have also contributed to the large discrepancy. Also, we didn't have a good number of readings from which an average could be taken.
