Conservation of Mechanical Energy

Trevor Swan - tcs94

Department of Physics, Case Western Reserve University

Cleveland OH, 44106-7079

Abstract:

I have tested the conservation of mechanical energy using a cart and a mass block on a track pulled by a counterweight along with a spring in a similar manner. After releasing the cart at rest with a counterweight at the end of a string hanging off the table, I measured the distance and velocity of the cart as a function of time using *Logger Pro*. According to the conservation of mechanical energy, the total change in energy, $\frac{\Delta E}{\Delta y}$, should be 0. The data I have collected does not agree with this theory, yielding $\frac{\Delta E}{\Delta y} =- 87 \pm 3$ mJ. Likewise, I released a spring connected to a string holding a counterweight in a similar manner, this time with varying counterweight masses. I plotted the spring's displacement against the mass used using *Origin* and reported the appropriate spring constant. Using these data , I determined a value for ε, the total change in energy for the system. According to the conservation of mechanical energy, this value should be 0. My measured value does not agree, however, yielding $\varepsilon = 0.78 \pm 0.02$. Based on the aforementioned data, I could not conclude that mechanical energy is conserved in these systems, and that external forces played a significant role in my data collection.

Conclusion:

The expected value of the change in energy in the system was $\frac{\Delta E}{\Delta y} = 0$. The measured value of the change in energy in the system was $\frac{\Delta E}{\Delta y} = -87 \pm 3$ mJ. These two values do not agree. This is potentially the result of the track not being level with the table. Since the PASCO tracks in the lab have been being used for long periods of time, they are no longer flat and the warping results in inaccurate data. Newer tracks or more extensive leveling of the tracks could have reduced this systematic error. The expected value of the Spring's energy conservation was $\varepsilon = 0$, but the measured value of the spring's energy conservation was $\varepsilon = 0.78 \pm 0.02$. These values do not agree either. A possible cause of this may have been an old spring or a slow *Logger Pro* wheel. If the spring was not in pristine condition with unwavering endpoints, then the measured value may have been closer to 0. We observed slight stretches towards the end of the spring, which would introduce systematic error. The *Logger Pro* wheel at the end of the track, in combination with the possible error discussed in $\frac{\Delta E}{\Delta y}$, may also play a role in introducing variables that systematically corrupt our data. We **cannot** conclude that mechanical energy is conserved because $\frac{\Delta E}{\Delta y} \neq 0$ and $\varepsilon \neq 0$.

Acknowledgements:

I would like to thank Adi Mallik, Case Department of Physics, for helping me obtain the data used in this experiment as well as for helping with the generation of the figures.

References:

1. Driscoll, D., General Physics I: Mechanics Lab Manual, "Inclined Plane," CWRU Bookstore, 2014.

Trevor Swan   Conservation of Mechanical Energy