

Work-Energy Theorem

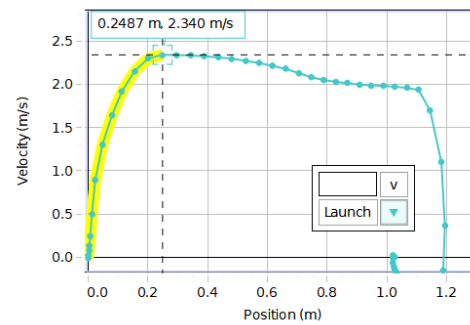
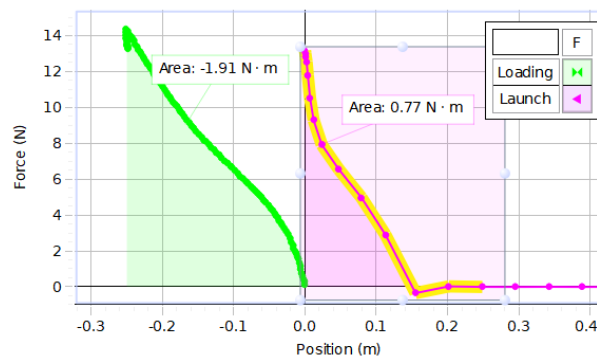


1. Take your Smart Cart out of the box.
2. Turn it on and open your choice of software: SPARKvue or Capstone.
3. Wirelessly connect to the Smart Cart.
4. Change the sample rate of the Smart Cart Position and Force sensors to 40 Hz.
5. Make a graph of Force vs. Position and another graph of Velocity vs. Time.
6. Install the hook on the Smart Cart's force sensor. Without anything touching the force sensor, zero the force sensor in the software.
7. Put a rubber band on the force sensor hook. Start recording and while one person holds the rubber band in place, the other person slowly pulls the cart back, stretching the rubber band. Then hold the cart in place with the rubber band stretched and stop recording. Do not let go of the cart or rubber band.
8. Start recording again. Let go of the cart and move the hand holding the rubber band out of the way. Let the cart go up to its maximum speed and then stop recording.

Analysis

1. Determine the work done in stretching the rubber band by finding the area under the Force vs. Position curve.
2. Determine the work done as the stretched rubber band pulls the cart by finding the area under the Force vs. Position curve.
3. On the Velocity vs. Time graph, determine the maximum velocity. Calculate the kinetic energy of the cart and compare to the work done to accelerate the cart.
4. Why isn't the work done to stretch the rubber band equal to the work done to accelerate the cart?

Sample Data



The work done loading the rubber band is -1.91 Nm. The work done unloading (when the cart is launched) the rubber band is 0.77 Nm. The resulting kinetic energy of the cart is

$KE = \frac{1}{2} mv^2 = \frac{1}{2} (0.252 \text{ kg})(2.34 \text{ m/s})^2 = 0.69 \text{ J}$. This is 10% less than the energy available in the stretched rubber band.

The energy stored in the rubber band is less than the work done to stretch the rubber band. Some of that energy goes into heating the rubber band and making the rubber band move.