Work-Kinetic Energy Lab

Purpose: To investigate the work-kinetic energy relationship in a system and determine how the change in mechanical energy relates to the work done by friction.

Set-up:
You will need the Pasco track and the friction cart with the Teflon surface. Make sure the track and the Teflon cart are free of dust and dirt that may influence the amount of friction between the friction cart and the track. Use a level to ensure your track is level both end-to-end and side-to-side. Attach Airlinks to the force sensor and the motion sensor and get them recognized by Capstone. Use the graph functions and to create *Force vs Time* and *Velocity vs time* graphs with a common time axis. Set the sampling rate to 100 hz.

Activity 1: Determine the Coefficient of Kinetic Friction
Attach the motion sensor to one end of the track and connect the force sensor to the friction cart as shown in Figure 1.

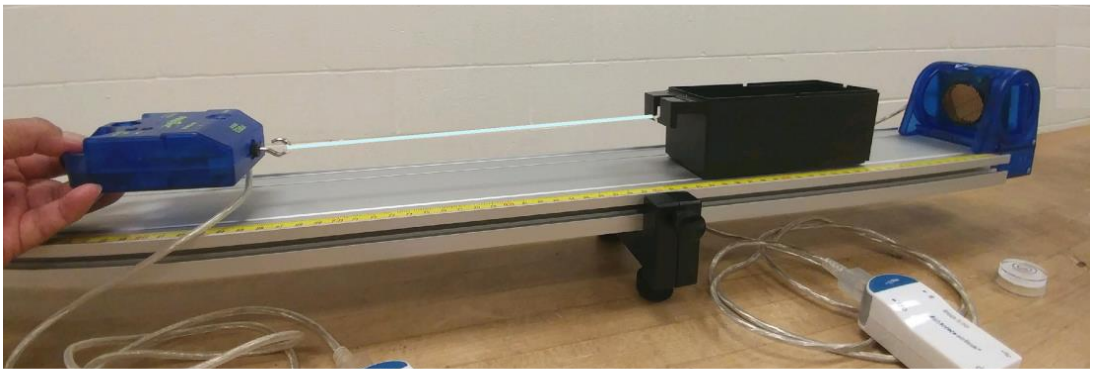

Fig. 1 - Set Up to Determine the Friction Coefficient

First, determine coefficient of kinetic friction μ_k for the Teflon block and track surface combination. You have determined μ_k for this block in a previous lab, but for a different surface combination. Think back and remember how you did that. Use a large amount of mass (~1250) in the friction block so that your force data is easy to interpret and you can calculate μ_k after just one trial.

Activity 2: Determine the Work Done by Friction.
After determining μ_k you will then investigate how the change in the kinetic energy of the system relates to the work done by friction. Set up the motion sensor, friction cart and the pulley as shown in Figure 2a. The hanging weight is a 200g mass. Be sure that the string is level and is not obstructed by or rubbing against any part of the endstop.

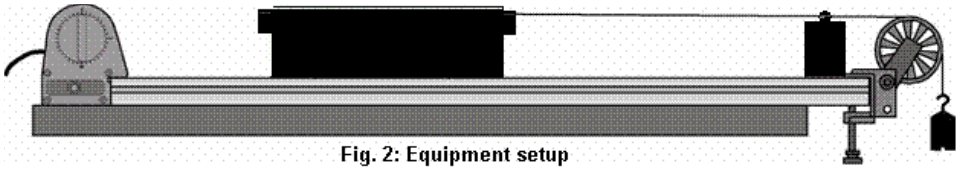

Fig. 2: Equipment setup

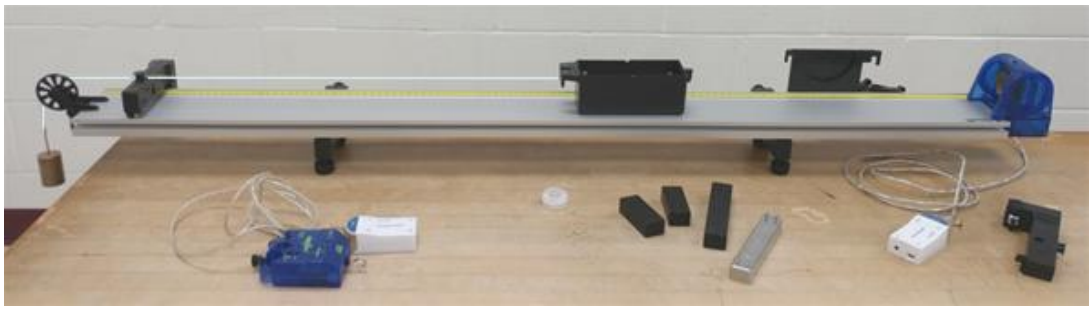

Fig. 2a - Set Up for Determining Work Done by Friction

You will obtain a *Velocity vs Time graph* as the hanging weight pulls and accelerates the friction cart containing some masses down the track in a smooth manner. Work on your technique to get a smooth and clean run. You may need to do some trials to find the most consistent part of your track. Also, be sure that the block moves in a straight line down the middle of the track.

You need to conduct **three trials**, with the friction cart containing masses of 0.25 kg, 0.5 kg, and 0.75 kg.

Using the results obtained in your three trials, determine the work done by friction on the moving block using **(method A) the work-kinetic energy theorem,** and the work done by friction using **(method B) the definition of work and your value of μ_k.**

Record and tabulate the values that you need to complete the required calculations in a clearly labeled, easy to read data table (group your data by trial number!).
Keep in mind the parts of the system that are "working" to increase the kinetic energy and the parts of the system that are "working" to decrease the kinetic energy, and the moving parts of the system that make up the kinetic energy.

Discussion/Questions:

1. Describe how you determined μ_k. Show your numerical calculation for μ_k.
2. Describe qualitatively how you used the resulting *Velocity vs Time* graph to determine the work done by friction on the moving block using the work-kinetic energy theorem (method A). (It is not enough to simply write a formula and say, "It is clear that I would plug-in the appropriate variables."). Choose one of your trials (indicate which one you used), show your actual calculation for the work done by friction using method A.
3. Describe qualitatively how you used the resulting *Velocity vs Time* graph and the definition of work (method B) to determine the work done by friction. (It is not enough to simply write a formula and say, "It is clear that I would plug-in the appropriate variables."). Using the same trial used in Question 2 above, show your actual calculation for the work done by friction using method B.
4. How should the values for the work done by friction obtained via the two methods relate to each other? Determine the ratio of the work done using method A to the work done using method B for each of your trials. Report these ratios and describe what they mean.

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