

Work-Kinetic Energy Lab

Teacher's Guide

Topic:

Work, Energy and Power

The following information is provided to the student:

Question:

What is the relationship between the work done upon a cart and the kinetic energy change of the cart as it is pulled along a level surface by a horizontal force?

Purpose:

To determine the mathematical relationship between or equation relating the work done upon a cart and the kinetic energy change of the cart as it is pulled along a level surface.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion of Results. The Data section should include the provided table of data. A sample calculation should be provided for each type of calculation; work should be clear and labeled. The Conclusion/Discussion should include a mathematical statement or equation which relates the work done upon the cart to the kinetic energy change of the cart. Evidence supporting the statement should be provided. An error analysis should be conducted.

Materials Required:

Cart; track; computer interfaced force probe and motion detector; mass balance; light thread; pulley; 100-g mass.

Description of Procedure:

A cart is equipped with a computer interfaced force probe and placed upon the track. A low-friction pulley is connected to one end of the track. A 100-gram mass is suspended from the end of a string. The string is stretched over the pulley and connected to the force probe on the cart. A motion detector is positioned behind the cart in order to detect the motion of the cart. The force probe and the motion detector are both zeroed. The cart is released and the string does work upon the cart to change its kinetic energy. The computer displays force as a function of time and position and velocity as a function of time. Several positions are selected; for each position, the displacement and velocity is determined. The mean force is determined using the statistical capabilities of the software. Work and kinetic energy values are calculated from the measurements and compared to one another.

Alternative Materials and Procedure:

Alternative materials and procedures are not recommended.

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

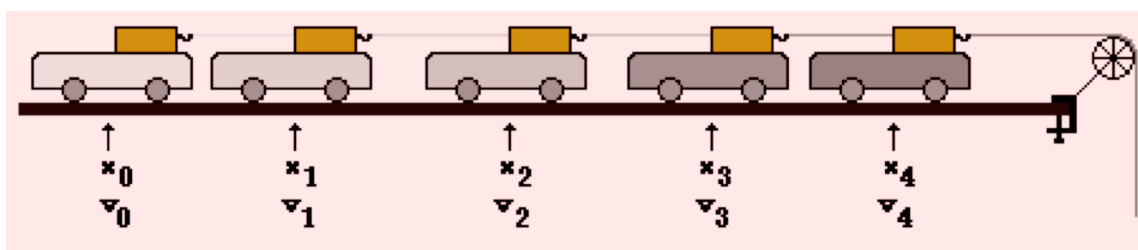
Suggestions, Precautions, Notes:

The Laboratory

1. The force probe will likely detect small fluctuations in force. The line on the force-time plot can be selected from the beginning of the cart's motion to the end of its motion; an average force value can usually be determined by clicking on an on-screen button.
2. To lengthen the lifetime of your equipment, one student in each lab group should be assigned the task of catching the cart before it collides with the pulley.

Auxiliary Materials:

The following page is provided to the student for completion and inclusion in the Data section of their lab notebook.



Data:

$m =$ _____ kg $F_{ave} =$ _____ N

| x (m) | v (m/s) | Work (J) | KE (J) | % Difference |
|-------|---------|----------|--------|--------------|
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Scoring Rubric:

| E6. Work-Kinetic Energy Lab | Score |
|---|---------|
| <ul style="list-style-type: none"> ___ Included, labeled and organized all parts of the lab report. ___ Data section includes the provided table. Data are reasonably accurate. Sample calculations are shown for calculated quantities; work is clear. ___ Conclusion/Discussion uses an equation or a mathematical statement which relates the work to the kinetic energy change. Evidence supporting the statement is provided and discussed. The validity of the results is evaluated via an error analysis. | ___/___ |

Connections to The Physics Classroom Tutorial:

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The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/energy/u5l2a.cfm>

<http://www.physicsclassroom.com/Class/energy/u5l2b.cfm>

Connections to Minds on Physics Internet Modules:

Sublevel 9 of the Work and Energy module is a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/mop/module.cfm>