

## Energy on an Incline Lab

### Teacher's Guide

**Topic:**

Work, Energy and Power

**The following information is provided to the student:**

### Energy on an Incline Lab

**Question:**

What is the total amount of mechanical energy for a cart moving along an incline plane at five different locations? How do the results compare to the expected results?

**Purpose:**

To determine the total amount of mechanical energy of a cart on an inclined plane at five different positions and to compare the results to the expected results.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion. The Data section should include the provided table. Work must be shown for the KE, PE and TME calculations. The energy bar charts should be completed. The Conclusion/Discussion should include a comparison of the total energy at the five positions and a generalization about the principle which the data support. An error analysis should be conducted in which the expectations are discussed; the degree to which the data align with the expectations should be described. Averaging and percent differences should be used.

**Materials Required:**

Cart; track; computer-interfaced motion detector; lab poles; clamps; meter stick; mass balance.

**Description of Procedure:**

A track is inclined by propping it up on one end using a lab pole and clamps. A motion detector is placed at the elevated end of the track. A cart is given a quick push from the bottom of the track, imparting to it an initial amount of kinetic energy. The cart travels up the track, slows down, turns around and accelerates back down the track. Students view the plot of the cart's position and velocity with respect to time on the computer. Five positions along the trajectory are chosen. The speed of the cart and the distance from the motion detector are read from the plots for these five positions. The cart is then placed along the track at the measured distance from the motion detector and a meter stick is used to measure the height above the table top for this position. Kinetic, potential, and total mechanical energy values are computed for the five positions along the track.

**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.

## The Laboratory

### Suggestions, Precautions, Notes:

1. Before running any trials, students should practice giving the cart a push so that it travels up the track to a peak position near the top of the track and just prior to colliding with the motion detector.
2. One student should be assigned the sole task of being the *body guard* of the motion detector. If trouble is foreseen, they should throw their body (or at least their hand) between the speeding cart and the motion detector. Likewise, the student who pushes the cart should be assigned the task of catching it at the bottom of the track before it crashes into the table or the floor.
3. Inform students to select five positions for analysis - one position should correspond to the highest point along the cart's path; two positions should correspond to when the cart is traveling upward and two positions should correspond to when the cart is traveling downwards.
4. Caution students to not select as one of their five positions a position which corresponds to the pushing phase.
5. If a greater challenge is desired, do not provide a lot of details about how the height is determined from the distance away from the motion detector.

### Auxiliary Materials:

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

#### Data:

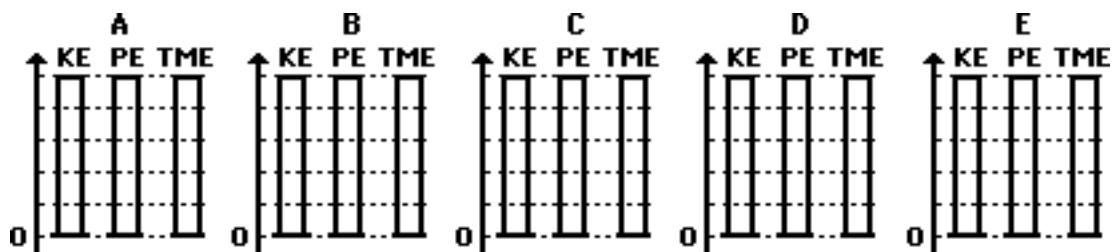
Mass of Cart = \_\_\_\_\_ kg

	Position (m)	Speed of Cart (m/s)	Height of Cart (m)
A			
B			
C			
D			
E			

	PE (J)**	KE (J)**	TME (J)
A			
B			
C			
D			
E			

\*\* Indicates **Please show your work in the cells of the table!!!**

## The Laboratory



### Scoring Rubric:

E7. Energy on an Incline Lab	Score
<ul style="list-style-type: none"><li data-bbox="305 617 1230 651">— Included, labeled and organized all parts of the lab report.</li><li data-bbox="305 651 1230 772">— The Data section includes the provided table. Work is clearly shown for the KE, PE and TME values. Data are reasonably accurate; all measurements were made after the initial <i>push</i>. Energy bar charts are correctly completed.</li><li data-bbox="305 772 1230 945">— Conclusion/Discussion describes the energy at the five positions. Discussed expectations regarding the energy values and discussed the degree to which expectations matched the results. Might have averaged all TME values and calculated percent differences. Discussion reveals understanding.</li></ul>	____/____

### Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

<http://www.physicsclassroom.com/Class/energy/u5l2bb.cfm>

<http://www.physicsclassroom.com/Class/energy/u5l2bc.cfm>

### Connections to Minds on Physics Internet Modules:

Sublevels 7 and 8 of the Work and Energy module are a suitable accompaniment to this lab:

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