SAN DIEGO MESA COLLEGE
PHYSICS 125 LAB REPORT

TITLE: Conservation of Energy

Name__________________________
Date __________**Time**____________
Partners ________________________
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Objective: To study the conservation of mechanical energy for motion under gravity

Theory: The conservation of mechanical energy **E** for the motion of an object under gravity is expressed by the mathematical relationship

$E_o = E_f$, where E = K + PE

$$\Delta K + \Delta PE = 0 \qquad or\ \Delta K = -\Delta PE$$

where $K = \frac{1}{2}Mv^2$ *and* $PE = Mgh$

You will study energy conservation in two cases.

In the first case, an object is moving on a frictionless inclined plane. Conservation of mechanical energy holds because the normal force does no work. If the object is released from rest at a high elevation on the incline plane, and attains velocity v at a low elevation, we have

$\Delta K = \frac{1}{2}Mv^2 \qquad \Delta PE = Mg\Delta h$ where Δh is the change in elevation.

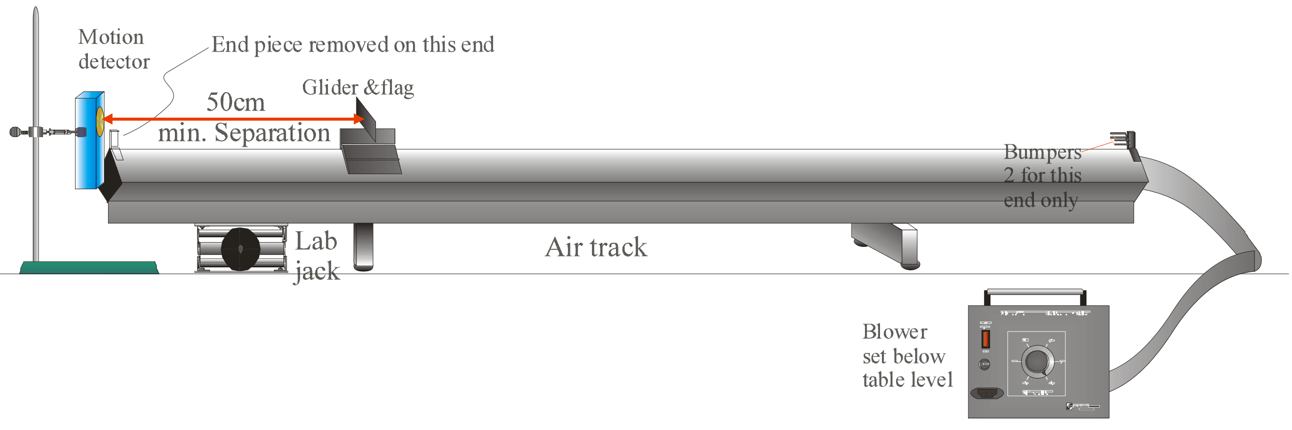
In the second case, the object is on a frictionless horizontal surface and tied to a hanging mass m by a string passing over a pulley. When released from rest, and after the hanging mass has fallen through a distance h, both masses are traveling with speed v. We have

$$\Delta K = \frac{1}{2}(M + m)v^2 \qquad \Delta PE = mg\Delta h$$

Equipment:
- Air Track with blower and hose
- Glider with flag
- Bumpers (2 each at low end of track)
- Lab jack
- Meter stick and ruler
- Hooked mass set
- Tube clamp
- Ring stand with 60 cm rod
- Motion detector
- Student computer work station
- Pulley

Rev. by Crivello 10-20-09

Setup:



Procedure:

Part I

1. Set up the air track, blower, lab jack, glider-flag assembly and bumper guard as shown. Set the lab jack at its lowest position (unextended) to yield a gentle incline plane.

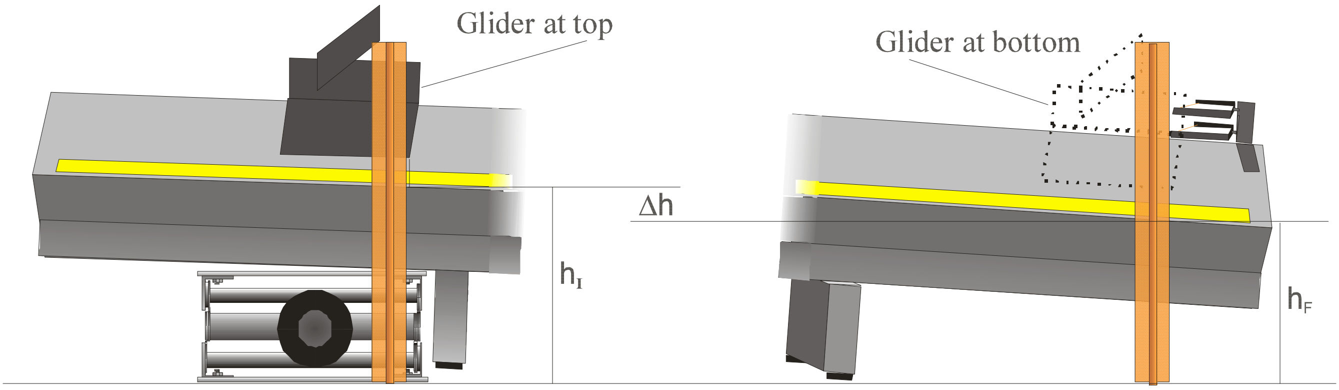
2. Set up the motion detector to record velocity-time graph, choosing appropriate experiment time and sampling rate

3. Measure and record the mass of the glider/flag assembly and call it M .

4. Place the glider on the upper end of the airtrack so that the flag is ***at least*** 50 cm from the face of the motion detector ***and*** the flag is parallel to the face of the motion detector.

5. You will see a scale on the edge of the airtrack. Set the leading edge of the glider on the track at a whole number on the scale and record it so that you can repeat the experiment.

6. Use the ruler to measure the height from the surface of the table to the edge of the track at the point of the leading edge of the glider (h_i). See diagram.



7. Place the glider at the low end of the track so that it just rests against the bumpers and measure the vertical distance from the table-top to the edge of the track at the leading edge of the glider (h_f). The change in height (Δh) is given by

$$\Delta h = h_f - h_i$$

8. Turn on the blower and adjust the setting so that the glider doesn't drag on the track. Do not set the blower too high or it may interfere with the motion detector.

9. Place the glider on the track at the initial height and start the motion detector. Wait two seconds, and then release the glider. Record the highest velocity (of the glider) in the data table.

10. Repeat the above three times at the same initial height and record your results. Obtain the average of the highest velocity in these runs. This is the value of v.

Part II

11. Remove the lab jack and level the air track. This can be done by seeing to it that the glider-flag assembly is more or less motionless on the air track.

12. Attach a pulley to the end of the air track away from the motion detector. Tie a string on the glider, pass it over the pulley, and make a hook on the other end of the string to hang a small mass from it. (suggested value 10-20g). The length of the string should be chosen to allow the small mass a long fall near the edge of the table to the floor, while making sure that the flag of the glider is more than 50cm from the motion detector.

13. Set the hanging mass at a high position and measure the distance between the bottom of the mass and the floor.

14. Release the mass and read the highest velocity recorded by the motion detector. Repeat the procedure three times to obtain the average velocity.

Data and Analysis: Draw and label a diagram.

Part I

Glider-flag assembly mass $M =$

$h_i =$ $h_f =$

$\Delta h =$

$$v = \frac{length\,of\;glider\;flag}{time} =$$

Calculate the following quantities:

$K_{initial}$: $PE_{initial}$ (with respect to the lab table):

K_{final} : PE_{final} (with respect to the lab table):

$\Delta K =$ $\Delta PE =$

Test for Energy Conservation:

$$\textbf{\%}\text{ error} = \frac{\Delta E}{E_{initial}} * 100\% = \frac{E_{final} - E_{initial}}{E_{initial}} * 100\% = \frac{\Delta K + \Delta PE}{\Delta PE} * 100\%$$

Part II   Draw and label a diagram.

Glider-flag assembly mass M =

Hanging mass m =

Initial Height of hanging mass from floor h =

$$v = \frac{length\, of\ glider\ flag}{time} =$$

Calculate the following quantities (Note: the Potential Energy of the glider does not change because it is moving horizontally.)

$K_{initial}$:

$PE_{initial}$ (with respect to the floor):

K_{final} :

PE_{final} (with respect to the floor):

$\Delta K =$

$\Delta PE =$

Test for Energy Conservation:

% error $= \dfrac{\Delta K + \Delta PE}{\Delta PE} * 100\%$

Conclusion and Summary of Results:

Write a brief conclusion, including a brief discussion of the physics involved in this experiment, including possible sources of error. State and summarize your numerical results and indicate whether these results give support or validate the purpose of the lab exercise.