Conservation of Energy (Using Photogates)

Objective: The student will be able to verify the laws of conservation of energy.

Apparatus: Meter stick, glider, air track, computer interface, motion sensor

Background Information:

Energy is conserved from one form to another. In this lab we will calculate the potential energy a glider has on an air track. We will then determine the velocity that cart should have after its elevation has changed. Using a motion sensor we will verify the velocity we calculated is the velocity the object has after changing the specific vertical difference.

Procedure:

1. **Read the entire** procedure before starting.
2. **Do Not Turn on Air Track** until Your Instructor Informs you to do so.
3. Place the air track on an incline.
4. Open up Data Studios
5. Make sure the correct interface is chosen and select the motion sensor.
6. Change the sample rate to 100 Hz.
7. In Data Studio create a displacement time graph
8. Turn on the motion sensor and verify that the motion sensor can sense the glider along a majority of the length of the air track by moving the glider along the track with your hand while observing the graph to make sure that it is picking up the correct displacement of the cart.
9. Turn of motion sensor and clear data.
10. Now pick a point on the track about 1.2 m away from the motion and record this position according to the ruler on the track in the data table below under max horizontal displacement.
11. Measure the vertical displacement from the desk to the bottom of the track at the position located in #9. Record this value in Max vertical displacement.
12. Now pick a point on the track about 0.2 m away from the motion and record this position according to the ruler on the track in the data table below under min horizontal displacement.
13. Measure the vertical displacement from the desk to the bottom of the track at the position located in #11. Record this value in Min vertical displacement.
14. Calculate the change in vertical displacement and record it in Δ Vertical Displacement.
15. Calculate the displacement of the cart from the motion sensor at the Min. Horizontal Displacement by placing the cart at this position take the displacement data from the left side of data studios and dragging it to the digit display and then clicking start in data studios. Record this value in Calculated Min Horizontal Displacement.
16. Stop Data Collection
17. Calculate the velocity the cart should be going after changing the vertical displacement calculated in #12 using the Law of the Conservation of Energy. $E_{ki} + E_{pgi} = E_{kf} + E_{pgf.}$ Show your work in the section called conservation of energy. Place your answer on the line called calculated velocity.
18. Clear Data Studios data
19. Remove glider from track.
20. Get permission from your instructor to turn on Air Source.
21. Turn on Air Source.
22. Place and hold the glider at the Max Horizontal Displacement
23. Click start in Data Studios.
24. Wait 2 seconds
25. Release the cart and try to catch it at the bottom of the track without interfering with the motion sensor.
26. Click stop in Data Studios.
27. In the graph window, select the portion of the graph where the cart is moving.
28. Scale to Fit
29. Use the Smart Tool to find the point that has the position closes to the Calculated to Min Horizontal Displacement found in #15.
30. Select the data point found in #29 and the point to the left and to the right of that point
31. Click Fit and choose linear fit.
32. The slope of the line should the average velocity of the cart about the Calculated Minimum Position according to the fact that the slope of a displacement time graph is velocity.
33. Record the slope in #32 in the data table after Experimental Value.
34. Calculate the Percent Error

35. As a class report the data calculated on the board to compare the conservation of energy at various angles and vertical displacements.

Name:_____ Date:_____

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Data:

Max Horizontal Displacement: _____m

Min Horizontal Displacement: _____m

Calculated Min Horizontal Displacement: _____m

Max Vertical Displacement: _____m

Min Vertical Displacement: _____m

Δ Vertical Displacement: _____m

Conservation of Energy:

Calculated Velocity: _____m/s

Experimental Velocity: _____m/s

Percent Difference: _____%