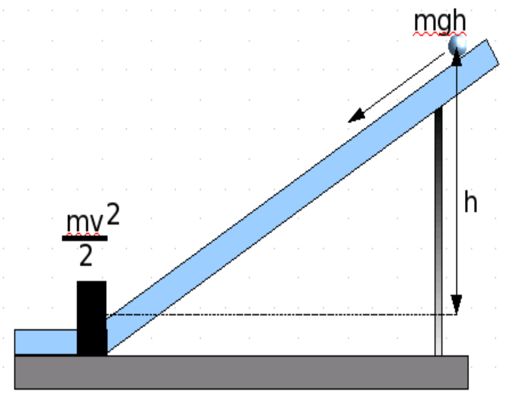
Conservation of Energy

Dr. Tim Niiler, WCU Department of Physics

Introduction

While energy can take many different forms, in a closed system it is neither created nor destroyed. This conversion of energy from one form to another is known as *conservation of energy*. In this lab, we will be studying how gravitational potential energy converts to kinetic energy.

To investigate this phenomena, we will be using an inclined ramp, a ball, and a photo gate. When the ball is at the top of the ramp, its gravitational potential energy is given by the quantity mgh, where m is the ball's mass, g is the acceleration of gravity, and h is the height of the ball above the base of the ramp (where we will measure its velocity). Under ideal conditions - where we have accounted for all possible sources or sinks of energy - the kinetic energy at the bottom of the ramp will be equal to the potential energy at the top of the ramp.



1) $PE_{top} = KE_{bot}$

or

2) $mgh = mv^2/2$

Ideally, then, the velocity (within experimental uncertainty) at the photo gate should be:

3) $v = \sqrt{2gh}$

if all the potential energy is converted to kinetic energy.

Procedure

Setup the apparatus as indicated in the diagram above. Connect the Pasco photo gate sensor as directed by your instructor. You will need to measure the diameter of the ball and ensure that the sensor is set up so that the ball breaks the beam of the sensor at its midpoint. Your ability to ensure that this happens will affect your uncertainty in velocity. Be certain to set up the photo gate at the base of the incline and not further out along the ramp. (Why?)

Part 1

Use the smooth metal ball for this portion. Measure the height from which you release the ball, and record the velocity with which the ball passes the photo gate. Repeat this ten times trying to be as consistent as possible of the release height. Using proper analysis technique, find the best representative height (and uncertainty) and the best representative velocity (and uncertainty) from these trials.

width of ball = ___________________

Trial	***h* (m)**	**v_{calc} (m/s)**	**v_{meas} (m/s)**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
	Average =		
	STDev =		

What type of average are you using? How are you determining the uncertainty in your average? Justify your method.

Part 2

Use a golf ball for this portion. You will need to re-measure the diameter and re-calibrate the photo gate to properly measure velocity. Now, starting from the same height as you used in the first part, release the ball and allow it to roll down passing the photo gate. Repeat ten times, again finding the best representative height and velocity from these trials.

width of ball = ___________________

Trial	***h* (m)**	**v_{calc} (m/s)**	**v_{meas} (m/s)**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
	Average =		
	STDev =		

Analysis

What sources of uncertainty were there in this experiment? How did they affect your results? Was all the gravitational potential energy converted to kinetic energy within your experimental uncertainty? Cite your evidence. (Hint: discuss how well the measured and calculated velocities match.) Does your data support conservation of energy in the context of the experiment?