

# HRHS Physics

## January 2019

### Ramp Lab

*During class – In groups of three (or two).*

*Date: Jan 21 & 22, 2019*

*Due: Jan 30, 2019*

- Set up the ramp at a fixed angle so that the paper is a several centimeters from the edge of the desk. The paper at the end of the ramp is to allow the marble to transition smoothly to rolling on the table. The marble should leave the table horizontally. Use the block of wood to raise the angle iron above the table to facilitate a smooth transition to rolling on the table. NOTE: Do not damage the equipment in any way.
- Take measurements to be able to calculate the ramp angle relative to the horizontal of the table.
- Measure the height of the table from the floor.
- Tape paper on the floor to be able to mark the point where the marble lands. You can use carbon paper to mark where the ball lands. NOTE: Do not abuse, scratch, damage the carbon paper. You will return the paper at the end of the lab.
- Place the marble at a given distance up the ramp and note how far the ball lands from the table. Repeat at least three times for each initial position on the ramp.
- You are to take measurements for four to seven starting positions on the ramp (three trials per starting position).

*Outside class – Report due Jan 30, 2019.*

You are to submit a report with the following sections.

- Introduction – Introduce the lab and the concepts used in analysis.
- Data – Present the data in a table including a **standard deviation** for the horizontal distance the ball traveled. Make a plot of the data of the distance traveled versus distance up the ramp.
- Calculation 1 – Use kinematics to calculate how fast the marble would be going at the bottom of the ramp in the absence of friction. Present the results of these calculations in a table. The acceleration in absence of friction would be  $g \sin\theta$ , where  $\theta$  is the angle between the ramp and the horizontal.
- Calculation 2 – Calculate the actual speed the marble had based on how far it traveled horizontally. Present the results of these calculations in a table.
- Discussion – Briefly describe what you have done. Compare the values of the velocities from calculation 1 and 2. Does the data and calculations indicate that the marble was tending towards or reached a terminal velocity on the ramp? Discuss any limits to the physics used to describe the motion of the marble in the lab. Are there ways to improve this lab for the future? Describe three sources of potential error.
- Appendix 1 – The raw data sheet where you recorded your measurements.
- Appendix 2 – Handwritten example of Calculation 1.
- Appendix 3 – Handwritten example of Calculation 2.