Name ____ Date __________ Period ________

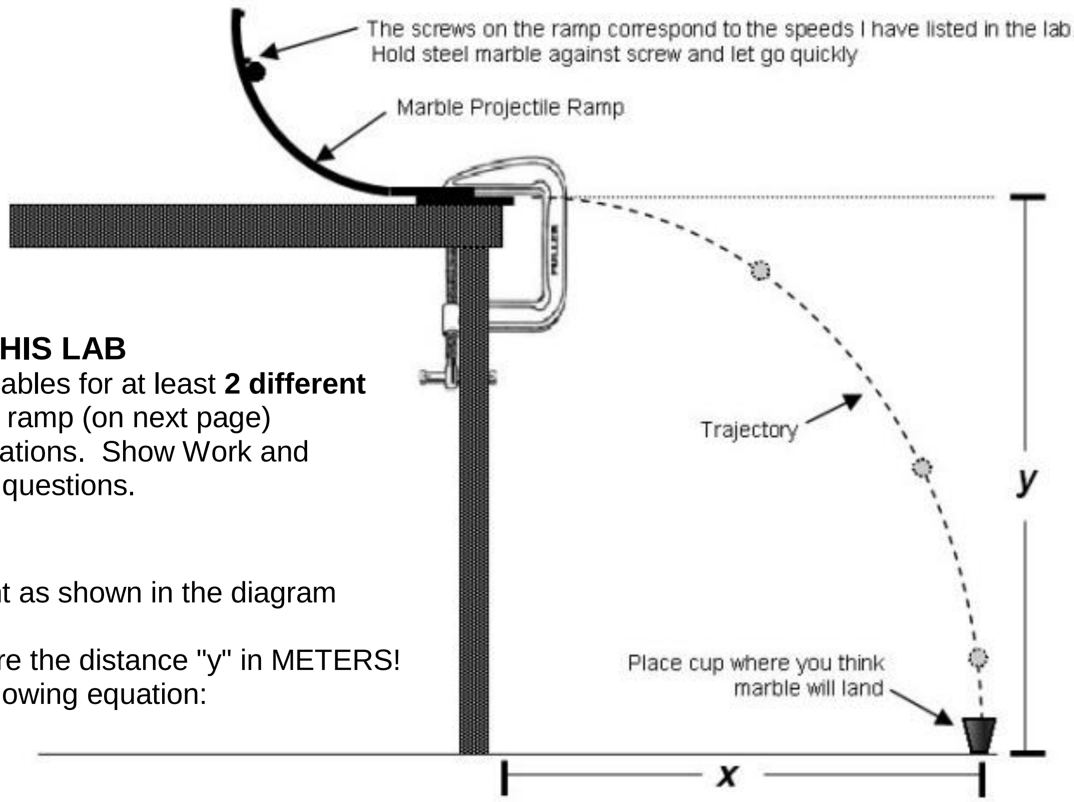
Lab: Hit the Cup

CONCEPTUAL PHYSICS: UNIT 2

Purpose: To correctly predict where a ball will hit a cup on the floor using mathematics and physics

Materials:

- Cup
- Steel Marble
- Ramp, Ruler
- Calculator
- Clamp



WHAT IS DUE FOR THIS LAB

1. Complete Data Tables for at least **2 different heights** from the ramp (on next page)
2. Drawings, Calculations. Show Work and answers to the 5 questions.

Procedure:

1. Set up the experiment as shown in the diagram on the board.
2. Use a ruler to measure the distance "y" in METERS!
3. Solve for "t" in the following equation:

$$y = \frac{1}{2}gt^2$$

⇨ y = the height of the end of the ramp to the ground in meters. (in a previous experiment, we referred to this variable as "d" for distance).

⇨ g = the gravitational constant of the earth which is **always** 9.81 m/s^2 at sea level.

⇨ t = the time the ball will remain in the air (in seconds).

4. Now you know how long the ball will remain in the air. If you know this, <u>and</u> you know the instantaneous horizontal velocity it is traveling at when it leaves the ramp, you can tell how far it will go - isn't that right? Let's say I travel at a velocity of 1 m/s and I travel for 5 seconds, how far would I go? (5 meters, right?)

5. Use the following equation to solve for "x" - this is the horizontal distance the ball will travel.

$$x = v_i t$$

⇨ x = horizontal distance traveled by the ball (in METERS)

⇨ v_i = the instantaneous velocity of the ball when it leaves the ramp (look at procedure #3)

⇨ t = the time the ball will be in the air (look at procedure #5)

- ***v_i* velocities** for the following heights on your ramp

a.	1.32 m/s	**a.**	***x* =** ____________________
b.	1.16 m/s	**b.**	***x* =** ____________________
c.	1.02 m/s	**c.**	***x* =** ____________________
d.	0.843 m/s	**d.**	***x* =** ____________________

6. Put all of your initial data into Data Table #1. Now try it! Put the cup "***x***" meters away from the table (line it up with the ramp) and roll the ball bearing down the ramp. Does it hit the cup?

7. Now try it at with the ball at a different starting height on the ramp. Put your new data into Data Table #2. The screws on the ramp correspond to the letters and speeds I have listed above.

Data: *Round all answers to the nearest 100th (eg. 2.34,* ***NOT*** *2.3)*

Data Table #1: Initial setup

v_i = __________________***m/sec***

y = __________________***m*** (this is the height of the end of the ramp above the ground)

t = ___________________***sec*** (this is the amount of time the ball will be in the air)

x = __________________ ***m*** (this is the horizontal distance the ball will travel)

Data Table #2: Different starting height

v_i = __________________***m/sec***

y = __________________***m*** (this is the height of the end of the ramp above the ground)

t = ___________________***sec*** (this is the amount of time the ball will be in the air)

x = __________________ ***m*** (this is the horizontal distance the ball will travel)

Questions:

1. Were you able to hit the cup? If not, what kind of adjustments did you need to make to your predicted distance – and why do you think you had to make those adjustments? Try putting a piece of clay on the ground where you think the ball will hit (instead of the cup). Does this work better than putting the cup in that same spot? Why?

2. What happened when you used the exact same set up but at a higher level above the floor? What did you predict would happen to the distance traveled? What actually happened? Were you able to get the cup in the right spot?

3. Assume you have a building height equal to the last two digits of your student ID#. A ball is now rolled off the building with a $\mathbf{v_i}$ equal to the last two digits of your ID#. (**EX. If your ID # is 2345, then use 45 for both values!)** How far away from the building does it land? SHOW YOUR WORK!

Remember: $y = \frac{1}{2}gt^2$ **and** $x = v_i t$

4. Finish this sentence: "As the height from which the ball is released increases, the distance it can travel, horizontally, _______________________" (increases dramatically or increases slightly).

5. Try this one. It uses the same two formulas but in different orders: A smoke jumper helping to fight fires in the far reaches of the wilderness. She is currently traveling at ***500 m/s*** in her plane above Yosemite National Park . While spotting the last unburned patch of forest she is faced with a dilemma. She needs to land on that spot so that she may attack the fire from the ground, but she has no parachute. Luckily, she jumps out anyway when she is ***4000 meters*** away from the patch and she somehow lands safely. How high above the ground was she when she jumped? <u>(HINT: Draw the problem out and see what you know and what you can solve for)</u>