Name: _____ **Partner(s):** _____

Lab 2: To Catch A Ball

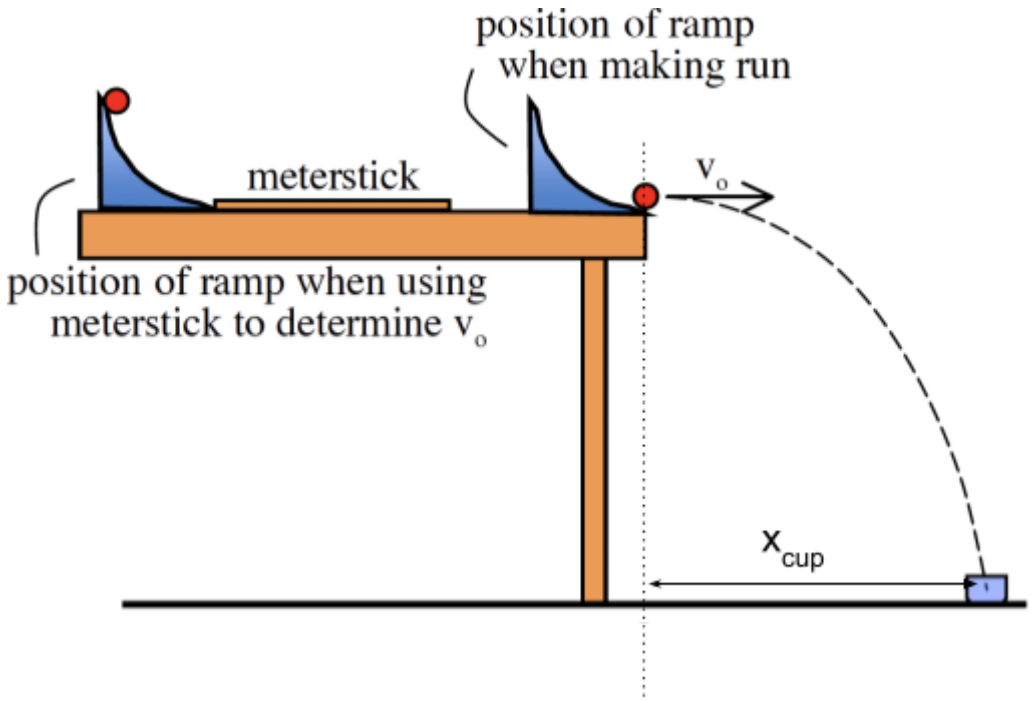
Introduction: Two-dimensional motion is just two, independent, one-dimensional motion problems happening at the same time. In most cases, *time* links the two independent motions. This lab will allow you to examine the idea of two-dimensional motion.

This lab is a "run and shoot" lab, which means you do a little prep before class, have class to finalize your calculations/predictions, and then get one shot to try it out. There is no formal write-up; you will turn in this sheet with your work and results at the end of class. To that end, **all instructions in red must be completed before coming to class.**

Objective: To catch in a cup a ball that has rolled with a known velocity off a table.

Materials: 1 small ramp
2 meter sticks to make a track for your ball (and for measurements)
1 metal ball
Timer on phone

Procedure: The general set up is shown below. You will have a ramp down which your ball will roll. Assuming the ball is always released from the same point on the ramp, its velocity at the bottom of the ramp (and, hence, the velocity as it leaves the table) will always be the same.



1. A rough sketch of the set-up is shown in the graphic on the previous page. **On the right side of the sketch (where the ramp is at the edge of the table), DRAW IN your axes and label all the parameters you will need to solve for or measure in order to determine where the cup must be put if the ball is to land in it.** I've put v_o and x_{cup} in for you.

2. Assuming the ball is always released from the same point and no energy is lost while it rolls on the table, we need to determine how fast the ball is moving as it proceeds across the table and then off its edge.

   Note: while determining the speed of the ball, the ball MUST NOT leave the table! Place a book or backpack to prevent the ball from rolling off the table. The ball is only permitted to leave the table during final testing with the instructor observing.

   a) Consider the left side of the sketch on the previous page, where the ramp is on the table, not at the edge. **Sketch that part of the set-up again here (just the table part), and briefly describe HOW you will determine the ball's rolling speed at the bottom of the ramp.**

   b) In class, take the data you need to determine the ball's rolling speed. Make a table of your data here:

   c) Starting with the kinematic equation used, calculate the rolling speed of the ball and clearly box your result.

2. To predict where the ball will hit the ground, which in turn will tell you where to place the cup, you will need to write one equation associated with the x-motion and one equation associated with the y-motion. With *time* being common to both equations and the final horizontal position x_{cup} being the only other unknown, you should be able to solve the equations simultaneously for x_{cup}. With that in mind:

a) **In algebraic form, write out the x-motion equation you believe you will need for this problem.** Remember, you are trying to determine x_{cup} and it's probable that *time* will be one of the parameters. Don't put numbers in, and eliminate any unneeded variables.

b) **In algebraic form, write out the y-motion equation you will need for this problem**. (Again, *time* is probably involved, and don't put any numbers in yet). Eliminate unneeded variables.

c) **Use parts a and b together to derive an algebraic expression for x_{cup}. This will be in terms of things like h, g, and v_x from the previous part, and should <u>not</u> include time.**

d) During class, take whatever data you need to use the algebraic expression you derived in part c. Don't do the calculation here, just present the DATA you need in a neat, orderly table.

e) Now for the calculation: rewrite the expression you got in (c), then use your data from (d) and any other measurements to calculate x_{cup}.

f) MOMENT OF TRUTH: Call me over to witness your ONE run. If the ball makes it into the cup, put a happy face below! If it doesn't make it into the cup, briefly explain why you think that was -- what specifically caused the error?

Write-up information:

This lab will be turned in at the end of class, and does not require a formal write-up on the green paper -- you'll just turn this sheet in! This type of "run and shoot" lab is worth 20 points (typical for this type of lab in this class). The grading for write-ups can be found in the lab guidelines on MyPoly (same as always).