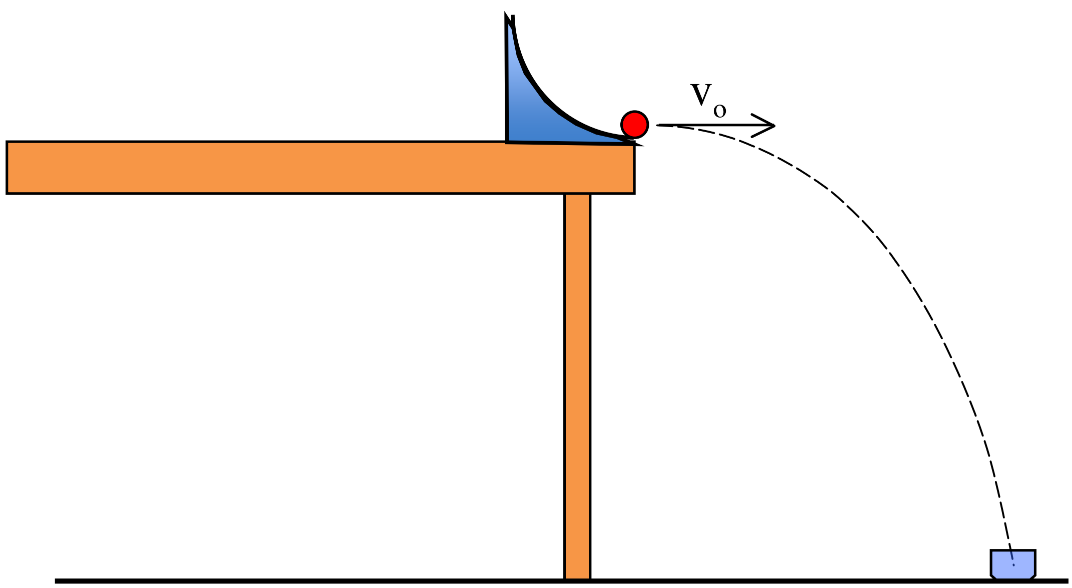
LAB: TO CATCH A BALL (L-99)

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. (Execute all instructions in **bold face** before coming to lab.)

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

Equipment:
1 small ramp
2 meter sticks to make a track for your ball (and for measurements)
1 wood board (to make a stopper for the ball so it can't roll off the table)
2 clamps to hold the ramp and the board
1 metal ball
1 string with a metal washer attached, to hang from the table's end

Procedure:
The set-up is simple. You will have a ramp down upon which your ball will roll. Assuming the ball is always released at the same point on the ramp, its velocity at the bottom of the ramp (and, hence, its velocity as it leaves the table assuming it doesn't lose any velocity while rolling over the table) will always be the same.



1.) **A rough sketch of the set-up is shown in the graphic above. On that sketch, DRAW IN all the parameters you will need to solve for or measure to determine where the cup must be put if the ball is to land in it (I've given you** x_{cup} **).**

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.

NOTE: *You only get one shot at rolling the ball off the table, and you can't take practice runs before doing the deed in my presence. This is not an engineering class, it's a physics class!*

a.) **Briefly describe how you will determine the ball's rolling speed.**

b.) Take the data you need to determine the ball's rolling speed. List that data on the left side of the line. On the right side, do the rolling-speed calculation boxing 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, just write out the equation.)

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

c.) Use *Parts a* and *b* to derive an algebraic expression for x_{cup}.

d.) During class, take whatever data you need to utilize the algebraic expression derived in *Part c*. Don't do the calculation in this part, just present the DATA you need in a neat, orderly fashion.

e.) Now for the calculation: Starting by rewriting the equation you derived in *Part c* (you don't have to re-derive it, just rewrite it), use the information gleaned from *Part d* and predict where your ball will hit the ground after rolling off the table (i.e., determine x_{cup}).

g.) MOMENT OF TRUTH: Call me over to witness your <u>ONE</u> run. If the ball makes it into the cup, say so below. If it doesn't make it into the cup, LIST THE CIRCLE NUMBER within which the ball hit.