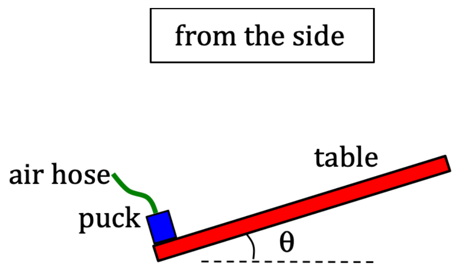
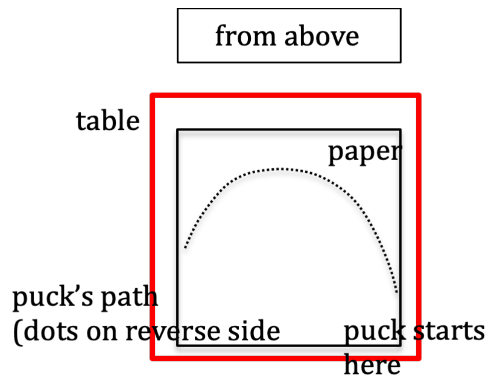
<u>Tilted Table Lab</u>

(two dimensional freefall)





a.) The device is a glass table upon which floats an air-levitated puck (i.e., air from a hose is forced down through a hole in the puck creating a cushion of air between it and the table). The table will be at a small angle (see sketch). Begin by using a protractor to measure the angle θ of the table (in fact, if you had done this with the data I took when I did this lab, you would have measured 9^o).

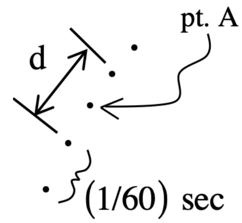
b.) Put a large piece of white butcher paper centered squarely on the table. Positioning the puck on the bottom right-hand corner and holding it low so it doesn't torque when pushed, push the puck upward as shown in the sketch. Practice this until you get the feel for the force required to execute this motion.

c.) The puck is attached to a spark timer that sparks every 1/60 of a second. The spark passes from the generator to the puck via a chain running through the air hose. When the spark jumps to the table, it leaves a mark on the paper. A foot pedal engages the spark timer (push on the pedal and you can hear the sparker clicking).

Once you can make the puck move appropriately, press the spark timer's foot pedal and make your run.

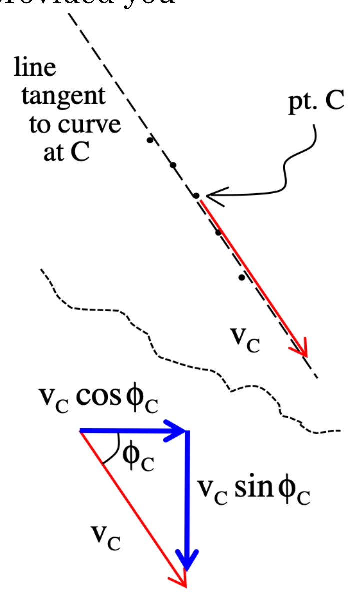
d.) Upon completion of the run, pick up the sheet and turn it over. You should be able to discern the puck's trajectory by the trail of tiny dots left on the paper (again, see the sketch). It is from these dots that you will take all your data.

e.) Now it's time to look at the data I have provided you. On that sheet, I have picked point A (the origin) and point associated with t=0. I have also identified point B at the top of the motion and point C somewhere on the downside. I have also provided you with a coordinate axis complete with numbered grid marks.



$$v_A = d/t = d/(2/60) = 30d$$

f.) At some point you are going to have to determine the magnitude of the puck's velocity at points A, B and C. To do that, note that the average velocity over a time interval equals the instantaneous velocity at the *halfway time point* of the interval. To do that average velocity calculation, I have provided you with the distances over a 2/60 second interval around points A, B and C. **(Note:** Dividing the distance traveled by (2)(1/60 second), or 1/30 second, is the same as multiplying that distance by 30).



g.) The velocity vector is always tangent to the path the body is following at a given point. I have used that information and a straight edge to present vectors A, B and C on your data sheet, along with the angles those vectors make with the x-axis. From that information, you can determine the velocity components for each.

CALCULATIONS

Part A: (two-dimensional free-fall)

1.) For the vectors A, B and C, show your calculations, then MAKE A TABLE to list the following information for each vector:

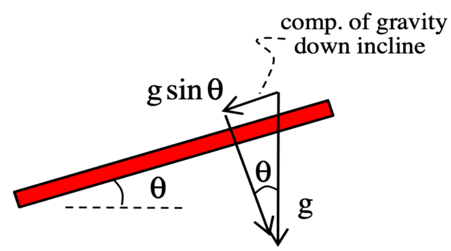
i.) The magnitude of the velocity vector (that's the $\frac{\Delta x}{\Delta t} = \frac{\Delta x}{\left(2/60\right)} = \frac{\Delta x}{\left(1/30\right)} = 30\Delta x$ procedure—call these v_A, v_B, etc.);

ii.) The x and y *components* of the velocity (this is done with trig functions—call these $v_{x,A}$, $v_{y,A}$, $v_{x,B}$, etc);

iii.) The elapsed time (count the 1/60 of a second intervals) between points A and B, and between B and C (call these Δt_{AB}, etc);

iv.) The x and y coordinate for each vector (call these x_A, y_A, x_B, etc.).

2.) The puck's *acceleration* while moving over the table was equal to $-g\sin\theta$ in the *y* direction, where *g* is the acceleration of freefall (980 cm/s^2) and θ was the angle of the table (again, this is 9° *if you are using my data*). Calculate the system's acceleration in the y-direction (we are assuming that its acceleration in the x direction is zero):



3.) Using your data and whichever kinematic equation you think is applicable (there is, in fact, one that will do it all for you), determine the *theoretically expected vertical displacement* Δy of the puck during its motion between points A and B.

4.) Off your graph, you determine the y-coordinate of the puck when at A and when at B. The difference between those two values gives you the *actual vertical displacement* Δy of the puck during its motion between points A and B. Do a % comparison between that value and the value you calculated in Part 3, then comment.

5.) You have values for the puck's *x-component* of velocity when the puck was at *Points A, B,* and *C*. In theory, those x-components of velocity shouldn't have changed throughout the motion.

a.) Explain briefly but completely why they should *not* have changed.

b.) You listed the *x velocity components* in Question 1. How do they compare? If there was *any* deviation, explain where it came from (and no, it probably wasn't all from *friction*).

NOTE: IF, WHEN YOU LOOK BACK OVER YOUR LAB, YOU DON'T SEE BLURBS, YOU WILL LOSE POINTS. AS AN INCENTIVE TO DO AS YOU'VE BEEN ASKED IN THIS REGARD, IF YOU GET ALL THE BLURBS DONE APPROPRIATELY, I WILL GIVE YOU AN EXTRA CREDIT POINT. DON'T LOSE BY MESSING THIS UP!!!!!!!