COLLISION and IMPULSE

(L-12b)

Does *conservation of momentum* really hold? This lab will give you the opportunity to find out.

PROCEDURE--DATA

Part A: (a three-mass, one-dimensional collision)

a.) The system used in this lab shown on the next page. Refer to the sketch often when reading this procedure.

In this section, a special motion detector called a V-SCOPE will be positioned 30 to 40 centimeters from the end of an air-track upon which rests three gliders. Each glider will have an ultrasonic transponder attached to it (for identification, the transponders are color-coded red, yellow, and blue). During operation, the V-SCOPE will receive the signal from each transponder, feeding that information into the computer. The computer will then produce a *Position versus Time* graph for all three gliders.

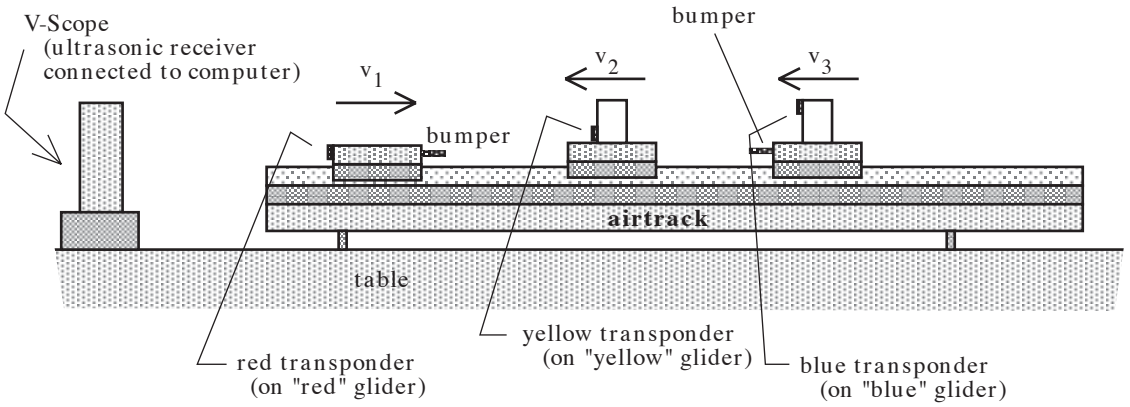
b.) In the old days, we used to actually do this experiment complete with the production of a three-glider *velocity versus time* graph in real time. Unfortunately, the system we used is, today, over fifteen years old (the computer used was an old Mac II) and each transponder's battery is dead as the proverbial door-nail. I attempted to buy new transponders, but the V-Scope device was made by an Israeli company that has long since gone out of business.

In short, we no longer have the device in working order. Fortunately for you, we DO have a representation of the data you would have accumulated if, indeed, the little devil had been working. I will also set up the air track device for your perusal.

Soooo, look at the sketch of the device on the next page, look at the graph, then look at the questions you will be asked to answer using that data.

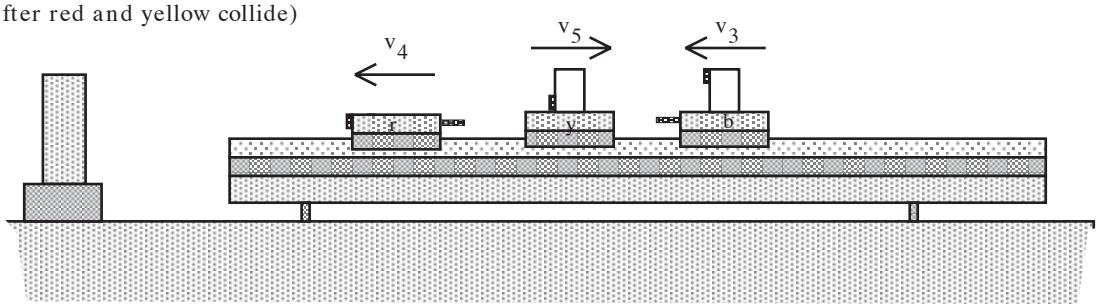
IMPORTANT NOTE: If you do play with gliders on the air track, NEVER move a glider over the track when the *air source* is OFF. Doing so may scar the aluminum.

INITIAL MOTION



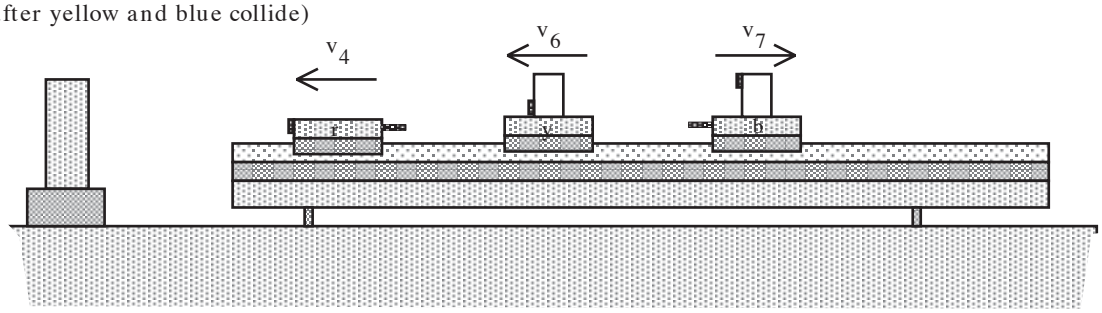
MID-MOTION

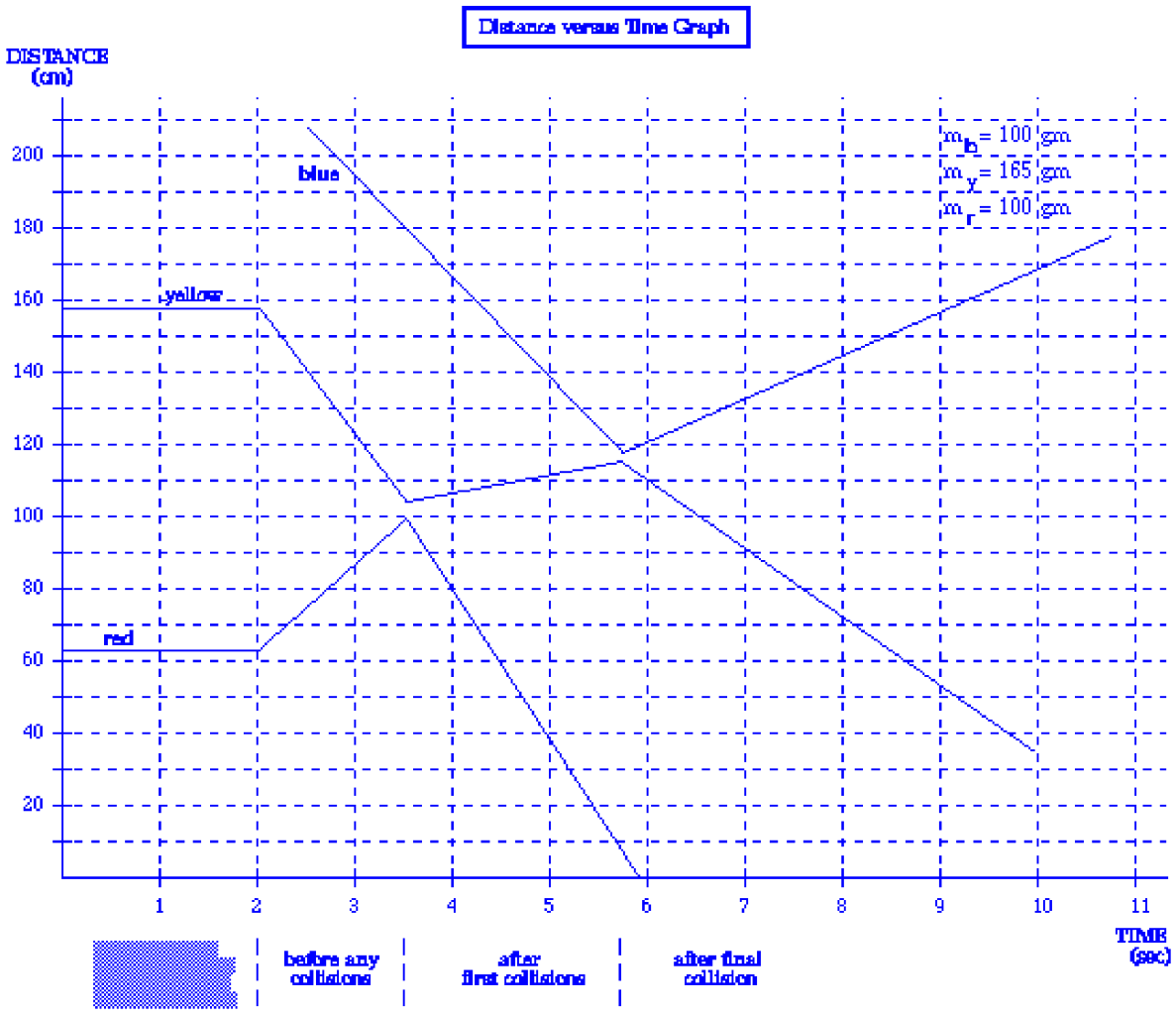
(after red and yellow collide)



FINAL MOTION

(after yellow and blue collide)





If you followed along with the sketch on the previous page, the above graph should make sense.

CALCULATIONS

Part A: (momentum conservation--three masses in one-dimensional collision)

1.) In this section, we would like to see if momentum is anywhere close to conserved through multiple collisions. To do so, we are going to calculate the to-

tal momentum of the system at the beginning and end of the motion, then compare the two. To do this:

a.) Determine the total momentum of all three gliders (this is the sum of each momentum quantity) before any collisions took place. Blurb well, be careful of signs, and call this p_1.

NOTE: All three gliders should be assumed to be moving during the pre-collision period (even if you started one after the other two). You must include all three in this calculation.

b.) Determine the total momentum of all three gliders after all the collisions have taken place. Call this p_2.

c.) Do a % comparison between the total "before collisions momentum" and "after collisions momentum" of the system.

d.) Comment on your results (i.e., does momentum seem to be conserved and, if not, WHY NOT?).

QUESTIONS

Let's assume you found that the momentum total before the collision and the momentum total after the collision were not close. What would that tell you about the system? (This is a lot like asking what it is that can keep a system from not having momentum conserved.)