Lab #9
Elastic Collision in 2 dimensions

1. Objectives

To demonstrate the principle of conservation of momentum for a system of two masses that are isolated from external forces in their plane of motion, and to show that the kinetic energy of the system will also be conserved if the collision is "elastic".

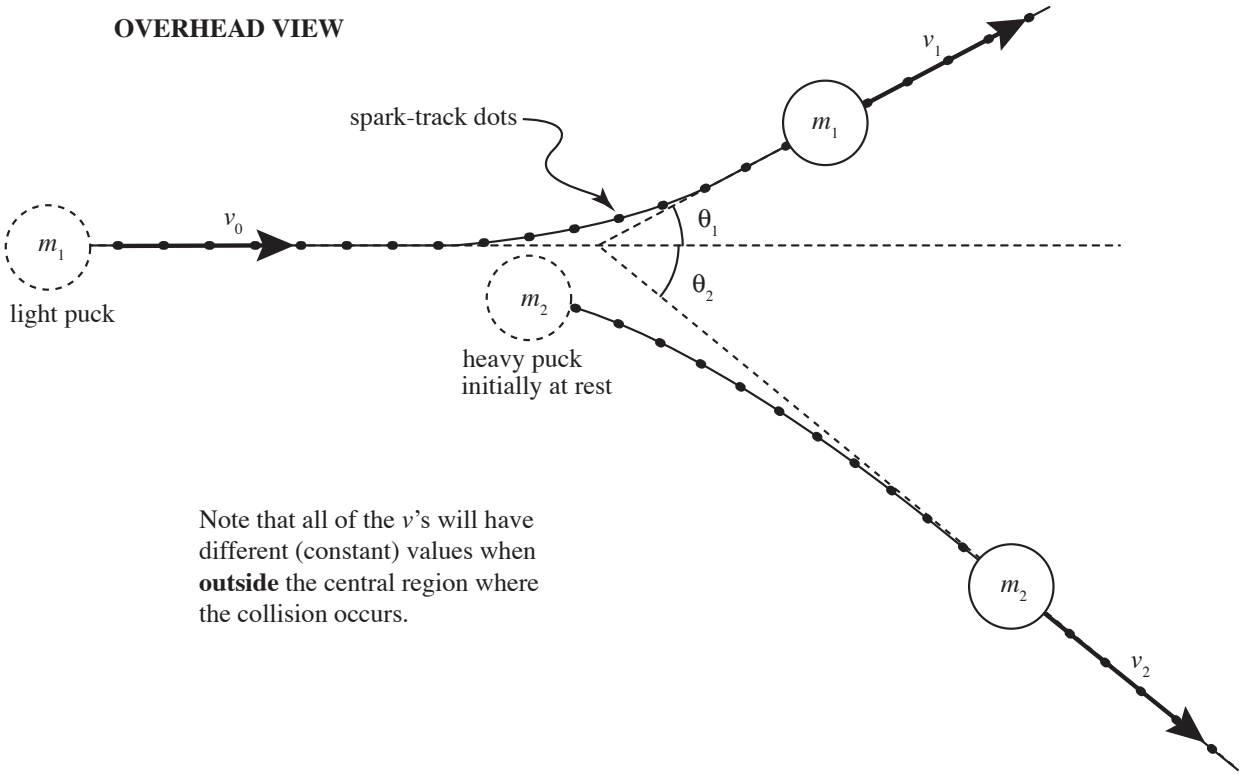
2. Equipment

- Air table
- Puck launcher
- Two magnetic pucks
- Heavy lead collar

3. Summary

If a pair of masses collide in such a way that only internal forces act between them, then the total vector momentum of the pair will be the same both before and after the collision, even though each mass will have its individual momentum changed.

Energy is usually lost during most collisions, even if momentum is not. We will try to avoid such losses by using magnetic pucks. This should permit the masses to "collide" without actually coming into contact.



4. Procedure

1) Level the air table in the usual manner before starting, and set the spark-timer to 50 ms. Add a heavy lead collar to the puck that will be initially at rest in the middle of the table (m_2). Use the lab balance to find the masses of (m_2) and of the other puck (m_1).
2) Place the mass m_2 in the center of the table, and launch m_1 towards it, so as to obtain a trajectory. You should practice this several times with the sparking device turned off, until you can produce a trajectory with fairly large (but unequal) angles for the "post-collision" motion.
3) Starting at the "outside ends" extrapolate the post-collision paths of m_1 and m_2 to a common point, as shown by the dotted line in diagram 1. The construct the x-axis by drawing a line that passes through this point and the beginning of the pre-collision path of m_1. Measure the angles θ_1 and θ_2 shown in diagram 1.
4) Keeping away from the central region, mark off an interval ΔS for each of the three "arms" of the spark tracks. Record these intervals and the corresponding time intervals Δt . These will be used to find the values of v_0, v_1 and v_2.

5. Analysis

Using ΔS and Δt found above, calculate the values for v_0, v_1 and v_2. Use these, along with the values of θ_1 and θ_2 where appropriate, to find the values for the momentum components and kinetic energy for each mass both before and after the collision.

Organize your data into a neat well-organized table. This should include the three sets of measured values for ΔS , Δt , v and θ labeled according to which mass they belong to, and for which region, as well as the values for p_x, p_y and K for each mass in each region as calculated above.

Ideally, the values of p_x and K before the collision should equal the sum of the corresponding values after the collision, and the two p_y values after the collision should be equal in magnitude (but opposite sign).

6. Lab Report

You have two weeks to submit your report (until Tuesday, December 9).