

Physics 201 Lab 5

Air Cart Collisions

Feb 18, 2013

Equipment

- Air carts with flag
- Photogates
- Scissors
- 12" rulers
- Air tracks
- Slotted weights
- Green tape

Set Up

You will be setting up multiple collisions, adding weight to the air carts when necessary. For each one, use the photogates to measure the velocities of each cart both before and after the collision.

Remember that the photogates do not recognize direction, so you must include the appropriate signs for velocity. Also, be sure to verify the green flags clear the photogates in order to get an accurate velocity measurement (see Figure 1). You may want to replace the flags if they do not hang straight.

Measure the lengths of the flags and the masses of all the carts.

For this lab, I am using the convention that v refers to initial velocities and u refers to final velocities.

Inelastic Collisions

Use the air carts with velcro so they stick together after colliding. Input the correct lengths into the computer. Place the second cart between the photogates and slide the first into it.

When the second mass is initially at rest ($v_2 = 0$) the equation for the final velocity is:

$$u_1 = u_2 = u = \left(\frac{m_1}{m_1 + m_2} \right) v_1$$

Perform the following trials:

- A cart collides inelastically with another initially at rest having approximately the same mass.
- A cart collides inelastically with another initially at rest having approximately twice as much mass.
- A cart collides inelastically with another initially at rest having approximately half as much mass.

Verify that the total momentum before and after these collisions is conserved.

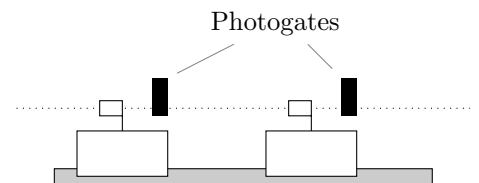


Figure 1: Air track collisions with photogate positions

Elastic Collisions

Now use the air carts with springs so they bounce after colliding. Input the correct lengths into the computer. Place the second cart between the photogates and slide the first into it.

When the second mass is initially at rest ($v_2 = 0$) the equations for the final velocities are:

$$u_1 = \left(\frac{m_1 - m_2}{m_1 + m_2} \right) v_1$$

$$u_2 = \left(\frac{2m_1}{m_1 + m_2} \right) v_1$$

Perform the following trials:

- A cart collides elastically with another initially at rest having approximately the same mass.
- A cart collides elastically with another initially at rest having approximately twice as much mass.
- A cart collides elastically with another initially at rest having approximately half as much mass.

Verify that both the total momentum and the total kinetic energy of these systems is conserved.

Explosive Fission

Continue to use the carts with springs. Place both carts in between the photogates. Tie the carts together with the thread. Release the carts by cutting the thread and measure the resulting velocities.

Perform the following trials:

- A cart separates explosively from another having approximately the same mass.
- A cart separates explosively from another having approximately twice as much mass.
- A cart separates explosively from another having approximately half as much mass.

What is the total initial momentum in all three trials? Confirm that momentum is conserved after the collision. Where is the kinetic energy of the system coming from?