

Objective

The goals of this exercise are to

- verify the theoretical prediction that momentum is conserved in a collision
- verify the theoretical prediction that kinetic energy is not conserved in an inelastic collision
- give you experience with the experimental apparatus

Materials

- Vernier [Lab pro](#), range finder(s)
- Blue and red Pasco carts & extra weights, tracks

Theoretical model

The Law of Conservation of Momentum claims that when two carts collide, the total momentum of the system before the collision is equal to the total momentum of the system after the collision. That is, that

$$p_i = p_f$$

or

$$m_{\text{red}}v_{\text{red},i} + m_{\text{blue}}v_{\text{blue},i} = m_{\text{red}}v_{\text{red},f} + m_{\text{blue}}v_{\text{blue},f}$$

A collision is considered to be 'inelastic' if the two carts involved collide and bind together, so that only a single final velocity for both carts together is predicted. A collision is 'elastic' if the two carts bounce off each other, and 'perfectly elastic' if they do so in such a way that none of the kinetic energy is dissipated to sound, heat, deformation, etc. In other words:

$$K_i \neq K_f \text{ (for inelastic collisions)}$$

$$\frac{1}{2}m_{\text{red}}v_{\text{red},i}^2 + \frac{1}{2}m_{\text{blue}}v_{\text{blue},i}^2 \neq \frac{1}{2}m_{\text{red}}v_{\text{red},f}^2 + \frac{1}{2}m_{\text{blue}}v_{\text{blue},f}^2$$

$$K_i = K_f \text{ (for elastic collisions)}$$

$$\frac{1}{2}m_{\text{red}}v_{\text{red},i}^2 + \frac{1}{2}m_{\text{blue}}v_{\text{blue},i}^2 = \frac{1}{2}m_{\text{red}}v_{\text{red},f}^2 + \frac{1}{2}m_{\text{blue}}v_{\text{blue},f}^2$$

Procedure

- The procedure was demonstrated in class: use the range finder to measure the velocities of the carts before and after the collision. Work an inelastic collision first – use the Velcro on the carts to get them to stick. Measure the total (net) momentum before and after the collision and find a % discrepancy between these. Then try to make *as elastic a collision as possible* using the magnet or springs. Find % discrepancies for the momentum before & after *and* the kinetic energy (total) before & after.

Measurements & results:

Post-lab

- Turn in this single sheet for your group.
- This sheet will replace your writeup.
- Include a photo or careful sketch of your experimental apparatus.