Collisions in 2-D!

In this lab you will experimentally determine if the momentum and/or kinetic energy of two motion carts on a track is conserved during four different collisions.

Materials and equipment: track, motion carts, motion detectors, cones for carts, scale, metal bars

Four collisions:
In all four collisions the mass of cart 2 should be around 500 g greater than the mass of cart 1. You can achieve this by adding a metal bar to the cart.
(1 & 2) The conditions before collisions 1 and 2 are:

cart 1 moving at speed v_{1i} and cart 2 at rest ($v_{2i} = 0$)

(3 & 4) The conditions before collisions 3 and 4 are:

cart 1 moving at v_{1i} and cart 2 moving at v_{2i} yet $v_{2i} < v_{1i}$

(cart 1 moves in same direction as cart 2 - cart 1 "rear ends" cart 2)

(1 & 3) Collisions 1 and 3 should be elastic collisions. This type of collision is achieved by orienting the carts so that in the collision the magnetic ends of the carts are facing each other.
(2 & 4) Collisions 2 and 4 should be perfectly inelastic collisions. This type of collision is achieved by orienting the carts so that in the collision the Velcro ends of the carts contact each other.

Step 1
Two lab groups will work together to make the measurements for each collision. One track is used but two computers are needed to record the motion; each lab group is responsible for recording the motion of one of the carts in the collision. This, of course, will require some coordination and cooperation. Decide which lab group will monitor which cart. Mount a motion detector on each end of the track and then measure the speeds of the carts by finding the slopes of their position versus time graphs.

Step 2
For each collision record, in a data table, the masses and initial and final velocities of both carts. Make sure that you pay attention to the direction of motion of each cart when recording the velocities in the table. The two lab groups will need to agree on which direction represents positive motion.

Step 3
Using this data, determine whether total momentum is conserved in each of the four collisions. Be sure to show your calculations for each collision including a percent difference. Have you verified the law of conservation of linear momentum? Why or why not?

Step 4
Using this data, determine whether kinetic energy is conserved in each of the four collisions. Calculate the total kinetic energies before and after each collision and compare them by finding their percent difference. Is energy conserved for each collision, is this what you expected?

Step 5
Now that you have completed this lab, reflect on exactly what it was that you did today and why. Please write up a clear description of the purpose of this lab that a fellow student can easily understand.