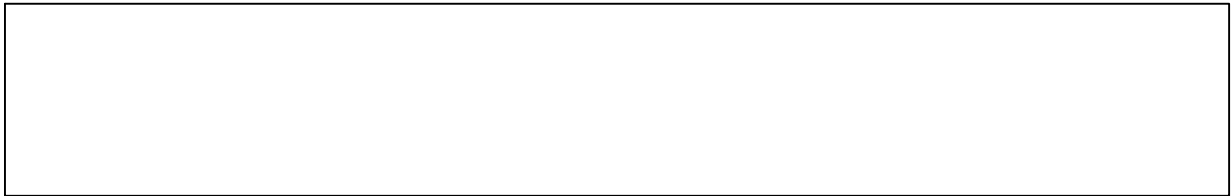# COLLISIONS

Activity 1: One-dimensional collisions

According to the law of conservation of momentum, the total momentum of an isolated system remains constant. If the collision is elastic, the kinetic energy is also conserved. The kinetic energy is not conserved in an inelastic collision.

Cars on the air track will collide, and we will determine their velocities before and after a collision from the time required for their flags to pass through photogates.

1. In Data Studio, open the activity Momentum.ds found in My Documents. Double click on the photogate icon and make sure the length of your cards is entered as the object length.

2. Measure the masses of both cars. We'll treat them as exact since their relative uncertainties are quite small.

3. You will set up a collision where the cars begin "outside" the photogates. The collision will occur "between" the photogates. The cars must then return to "outside" the photogates. That way the photogates can measure the time for each car before and after the collision.

Draw before and after pictures of this collision, emphasizing the direction of the velocity of each car in each picture.
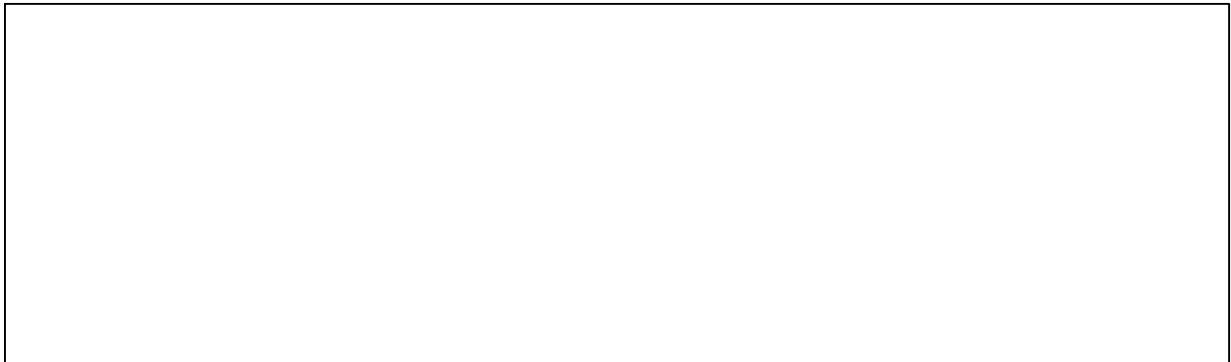
It may take a few attempts to get a useable set of data. Press Start to begin data collection and Stop after the cars have returned to "outside" the photogates. Go for it.

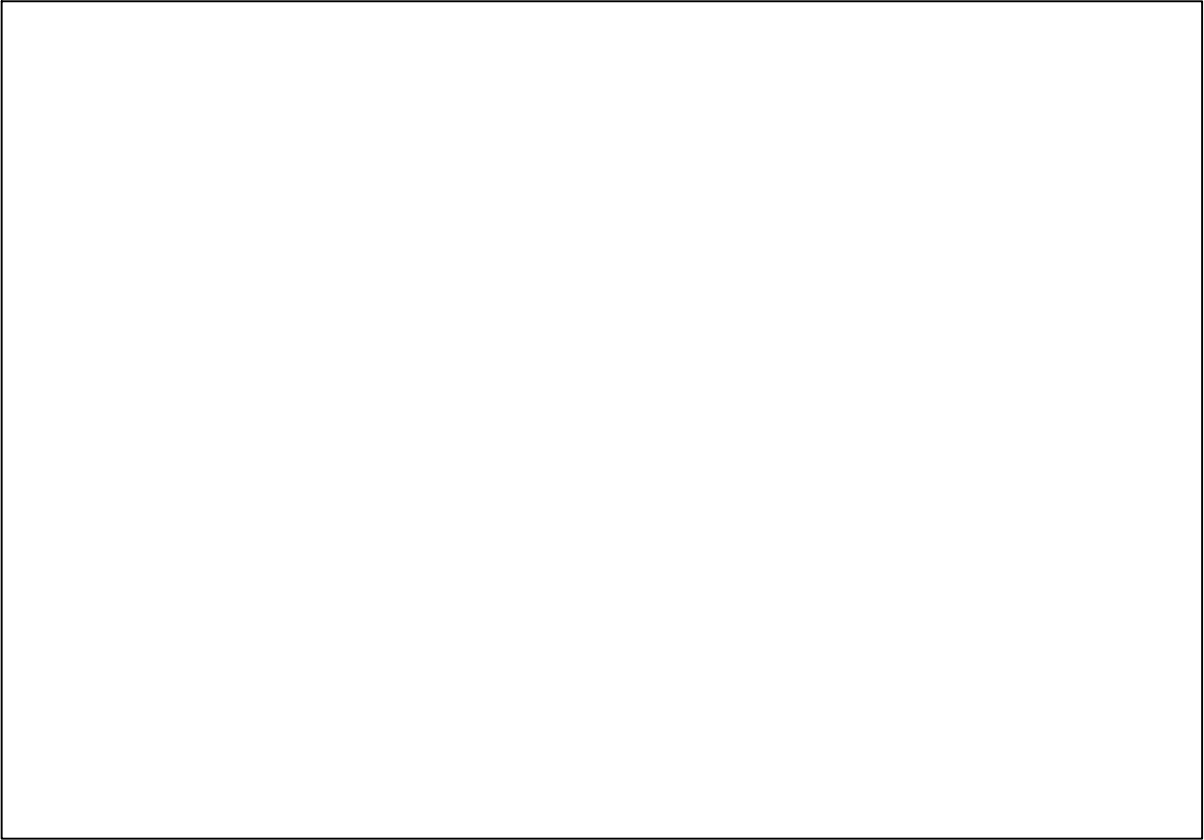4. For the data set you use, enter the times for each car to traverse its photogate in and out.

5. Choose a coordinate system and calculate the velocity of each car, with appropriate sign, before and after the collision.
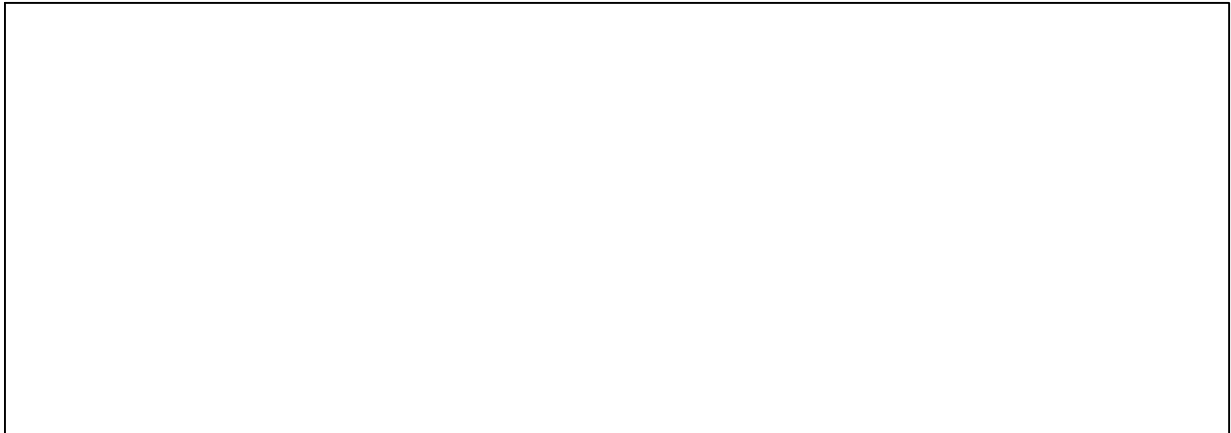
6. Is momentum conserved within uncertainty?

7. Is the collision elastic?

Activity 2: Two-dimensional collisions

1. Open the video Activity2_TwoDimColl.mov in LoggerPro.

2. Collect data from the motion of one of the balls in the video. Don't forget to set the scale.
Don't take any data beyond 0.6 seconds into the movie. (Visible in upper right corner of the
movie window.)

3. To collect data from the motion of the other ball, click the button with a red dot and a green
dot and select Add Point Series. Now you can return to the first frame of the movie and click
through all the positions of the second ball. Don't take any data beyond 0.6 seconds into the
movie.

4. LoggerPro will automatically make a graph of the x- and y-components of the position of
both the first and the second ball. We want to just see one component at a time. So to change
what's plotted in the graph, left click the axis labels on the vertical axis and select more from the
menu. Uncheck the boxes for the y-components, leaving only the x-components.

5. Use LoggerPro's curve fitting capabilities to get the x-component of velocity for each ball
before and after the collision. (How can you get velocity from the position curve…?)

6. What is the x-component of the total momentum before and after the collision? Is it plausible
that this component was conserved?

7. Now change the graph to show the y-components of position for both the first ball and the second ball. Use LoggerPro's curve fitting capabilities to get the y-component of velocity for each ball before and after the collision.
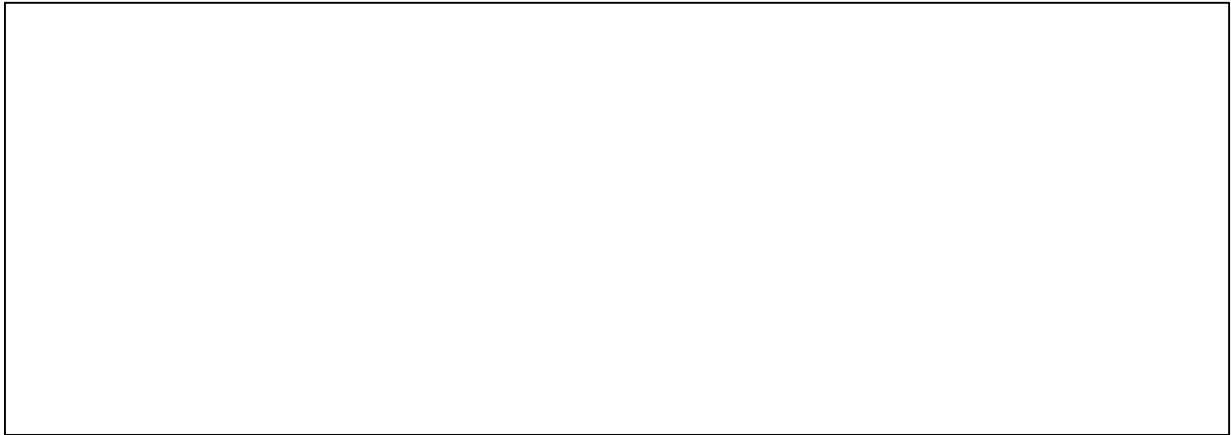
8. What is the y-component of the total momentum before and after the collision? Is it plausible that this component was conserved?