Momentum Transfer and Collisions

Name:	Teammates:

Introduction

For this lab, we will be making use of online videos showing collision carts demonstrating momentum transfer that were produced by Rutgers University. We will be using 3 separate video files, each demonstrating different configurations of the collision experiment.

Before beginning, an understanding of how to get real data from these videos must be achieved. The first piece of information needed is that all three videos show 15fps or 15 frames per second. Notice that the bottom of the video has a measurement scale in centimeters with which the positions of the gliders can be determined. By examining the video frame by frame (the Quicktime player has the ability to go frame by frame) and noting the positions for different frames, velocity can be found.

An example: The video shows the glider at 40cm. Advance the video 5 frames (there is no collision during this period) and the glider is at 30cm. What is the velocity? Using v=ΔX/ ΔT with ΔX equal to -10cm and ΔT equal to .33 seconds, the velocity is -33.3 cm/s. How is ΔT determined? If the video has 15 frames per second and 5 frames were examined, ΔT =5/15 seconds or .33 seconds. So the velocity = -10/.3=-33.3 cm/s. NB: Momentum calculations use vectors so the sign of the velocity is important.

For the momentum and energy calculations, use the equations:

$$\vec{p} = m\vec{v}$$

$$m_{1i}\vec{v}_{1i} + m_{2i}\vec{v}_{2i} = m_{1f}\vec{v}_{1f} + m_{2f}\vec{v}_{2f}$$

$$\tfrac{1}{2}m_1 v_{1i}^2 + \tfrac{1}{2}m_2 v_{2i}^2 = \tfrac{1}{2}m_1 v_{1f}^2 + \tfrac{1}{2}m_2 v_{2f}^2$$

Activity

Part 1: Collisions with gliders of equal mass
View the video located at: http://paer.rutgers.edu/pt3/experiment.php?topicid=3&exptid=51

There are 5 separate collisions in this video. Analyze each one using the equations above. Note that because the mass of the carts are the same, *m* can be canceled out of the equation.

Collision	V_{1i}	V_{2i}	V_{1f}	V_{2f}	E_i	E_f
1						
2						
3						
4						
5						

Part 2: Collisions with gliders of unequal mass
View the video located at:
http://paer.rutgers.edu/pt3/experiment.php?topicid=3&exptid=52

There are 4 separate collisions in this video. Analyze each one using the equations above. Note that because the masses of each cart are different, *m* cannot be canceled out of the equation.
m_1 = _____kg m_2 = _____kg

Trial	V_{1i}	V_{2i}	P_i	V_{1f}	V_{2f}	P_f	E_i	E_f
1								
2								
3								
4								

Part 3: Inelastic collisions with gliders of different mass
View the video located at:
http://paer.rutgers.edu/pt3/experiment.php?topicid=3&exptid=107

There are 4 separate collisions in this video. Think about each one using the equations and framework above. Note that because the masses of each cart are different, *m* cannot be canceled out of the equation.

1. For each part, was Linear Momentum conserved?

2. For each part, was Kinetic Energy conserved?

3. Do the answers to questions 1 and 2 agree with the theory discussed in class regarding elastic and inelastic collisions?