

Lab A14: Elastic Collisions in One Dimension 11/18/03

Goal: To use the laws of conservation of momentum and kinetic energy to predict the velocities of two gliders after they collide elastically.

In this lab, you will study collisions in which one glider collides elastically with another. In a perfectly elastic collision, both momentum and kinetic energy will be conserved. Given the initial velocities and masses of the gliders, both conservation laws are necessary to predict the final velocities of the two gliders. Read the handout "Elastic Collisions: The General Solution" to see how the final velocities can be predicted.

Prelab: 1. In your lab book, make a table like the one shown below, spanning two facing pages of your journal. Include four additional columns, two for the Measured Final Velocities and two for Comparisons of Predicted and Measured Final Velocities.

2. Use the results derived on the general solutions handout to predict the final velocities of the gliders for the ten different elastic collisions listed below. In your lab book, show how you use the general formulas to obtain the results for each collision. Simplify all your answers as much as possible. Your answers will always be expressed as a fraction of the arbitrary velocity V (the initial velocities v_{Li} and v_{Ri} will also be expressed in terms of V). For consistency, always define positive to be to the direction of initial motion of the left glider. The masses of the gliders are m (gold gliders), $2m$ (red gliders) and $3m$ (blue gliders). Collisions 8, 9 and 10 involve one mass that is so large that it is virtually infinite compared to the other mass. Again use the results derived on the general solutions handout to predict the final velocities after those collisions. (hint: taking the limit as $m_2 \rightarrow \infty$ is equivalent to taking the limit as $m_1 \rightarrow 0$)

3. When you have found all the final velocities, if your instructor provides a web address for this prelab, submit your final answers to your instructor by going to that website and completing the electronic form there.

Collision #			Initial Velocities		Final Velocities	
	m_L	m_R	v_{Li}	v_{Ri}	v_{Lf}	v_{Rf}
1	m	m	V	0	_____ V	_____ V
2	$2m$	m	V	0	_____ V	_____ V
3	m	$2m$	V	0	_____ V	_____ V
4	$3m$	m	V	0	_____ V	_____ V
5	m	$3m$	V	0	_____ V	_____ V
6	$2m$	m	V	$-V$	_____ V	_____ V
7	$3m$	m	V	$-V$	_____ V	_____ V
8	0	m	V	0	_____ V	_____ V
9	m	0	V	0	_____ V	_____ V
10	m	0	V	$-V$	_____ V	_____ V

Analysis: 1. Choose one collision out of the first seven. Calculate the total initial and final momenta and kinetic energies for the system in that collision. Continue to use the units for mass and velocity that you used in the data table. Show your calculations completely.

2. Compare the total initial and final momenta for your collision. Give at least two factors that could account for any differences between your predicted and measured final momenta; justify why each factor could change the total momentum.

3. Compare the total initial and final kinetic energies for your collision. Give at least two factors that could account for any differences between your predicted and measured final kinetic energies; justify why each factor could change the total kinetic energy.

Conclusion