

PHY 181: Summer 2023

Conservation of Momentum.

Name: _____ Group Name: _____ Date: _____

1 Instructions

You will need the following items: one air track, two track cars, one scale, one set of weights, two chemistry stands, two clamps, two smart timers, two photo-gates, two picket fences and two paper towels. Be gentle with the cars and fences.

1. Fold the paper towel and use it as a spacer to hold the picket fences in the top of the cars. The two little bars need to be facing up.
2. Weight the two cars and record their masses. Make sure that you don't get them confused.
3. Place the photo-gates near the ends of the track. Ensure the 2 off-set stripes will pass between the little bulbs in the gate when the cart moves through them. Also ensure the plastic bar will not knock into the gate.
4. Connect the photo-gate to the Smart Timer in port 1. Place the timer in "Speed: One Gate" mode. Note its output will be in cm/s.
5. Once the air track is on, gently place a car onto the track.
6. Adjust the leveling stud until the car on the track stays at rest. The stud is very sensitive, so take your time.
7. The exact details of the experiments will be explained in the next section. However, here is a general methodology to be followed.
8. Decide which direction is positive.
9. To measure the initial momentum, have the moving car(s) pass through the gate and measure the velocity (see step 8). Important, the car going through the gate should coast through the photo-gate (it should not be forced through)! Then compute the momentum of each car. Finally compute the total initial momentum.
10. When the car(s) rebound, record the new velocities. To do this, the smart timers will need to be reset. This can be done by pressing "3" again. This may need to be done quickly, so you may need two people per timer. One to reset the timer and the other to record the initial velocity.
11. Using this new velocity data, compute the final total momentum and compare it to the initial total momentum.

2 Analysis

Mass of car 1: _____

Mass of car 2: _____

2.1 Experiment 1

Place a car at rest on the track between the two photo-gates and then place the other car on the track between the end of the track and the photo-gate. Have the two bare springs face each other. Firmly nudge the second car through the photo-gate so that it impacts the stationary car (see step 9). Measure the velocities after impact. You may have to remove a car (gently, but quickly) to make room for the other car to pass through the photo-gate. Repeat this three times.

2.1.1 Initial

Trial	\vec{v}_1 ()	\vec{p}_1 ()	\vec{v}_2 ()	\vec{p}_2 ()	\vec{p}_{Total} ()
1					
2					
3					

2.1.2 Final

Trial	\vec{v}_1 ()	\vec{p}_1 ()	\vec{v}_2 ()	\vec{p}_2 ()	\vec{p}_{Total} ()
1					
2					
3					

Trial	$\vec{p}_{Initial}$ ()	\vec{p}_{Final} ()	$\Delta\vec{p}$ ()
1			
2			
3			

2.2 Experiment 2

Repeat experiment 1 except have the hook and loop fasteners facing each other so that the cars will stick together upon impact. Repeat this three times.

2.2.1 Initial measurements

Trial	\vec{v}_1 ()	\vec{p}_1 ()	\vec{v}_2 ()	\vec{p}_2 ()	\vec{p}_{Total} ()
1					
2					
3					

2.2.2 Final measurements

Trial	\vec{v}_{Total} ()	\vec{p}_{Total} ()
1		
2		
3		

Trial	$\vec{p}_{Initial}$ ()	\vec{p}_{Final} ()	$\Delta\vec{p}$ ()
1			
2			
3			

See back for conceptual question.

3 Conceptual question

You likely recorded a change in momentum. Where did the momentum come from or go to?