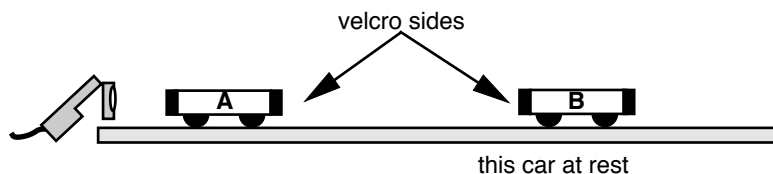


Lab 7-3: Inelastic Collisions

Purpose: To determine if momentum is conserved in a collision in which two objects stick to each other after the collision.

Materials: 1 track 1 cart with plunger 1 cart with no plunger 2 500 gram bars

Procedure:

1. Make sure the track is level, start up Logger Pro and open the file "02 Cart."
2. Arrange the empty carts so that the velcro ends face each other as shown in the diagram. Start the motion detector and give the cart closest to the motion detector (A) a little push. Make sure the resulting graph shows the velocity both *before* and *after* the collision.
2. Record the velocity of cart A alone, and the velocity of the carts combined. Measure the velocities by measuring the slope of the position vs time graphs just *before* the collision and just *after* the collision.
3. Place a 500 gram bar in cart A (the pushed cart) and repeat.
4. Remove the 500 gram bar from cart A, and put it in cart B (the target cart) and repeat.
5. Place the second 500 gram bar in cart A and repeat.

Calculations:

1. For each trial, calculate the momentum of the individual carts and then the momentum of the carts when they are stuck together. Show an example of your calculations here, and record all the results in the table below.

Data:

Trial 1			
Cart	Mass (kg)	Velocity (m/s)	Momentum (kg•m/s)
A (initial)	0.5		
B (initial)	0.5	0	
A&B (final)			

Trial 2		
Mass (kg)	Velocity (m/s)	Momentum (kg•m/s)
1.0		
0.5	0	

Trial 3			
Cart	Mass (kg)	Velocity (m/s)	Momentum (kg•m/s)
A (initial)	0.5		
B (initial)	1.0	0	
A&B (final)			

Trial 4		
Mass (kg)	Velocity (m/s)	Momentum (kg•m/s)
1.0		
1.0	0	

Conclusions:

1. In general, how did the total momentum before the carts crashed compare to the total momentum after the carts crashed?

(Hopefully) The total initial momentum was the same as the total final momentum.

Momentum is conserved, so $\sum p_i = \sum p_f \rightarrow m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f} \therefore$

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Follow-up Questions:

1. A 1 kg cart traveling at 3 m/s crashes and sticks to another 1 kg cart initially at rest. How fast are the two carts going when they are stuck together?

$m_1 = 1 \text{ kg}$ $m_2 = 1 \text{ kg}$
 $v_{1i} = 3 \text{ m/s}$ $v_{2i} = 0 \text{ m/s}$
 $v_{1f} = ?$ $v_{2f} = ?$

$\sum p_i = \sum p_f \quad \& \quad v_{1f} = v_{2f} \text{ (because they are stuck together.)}$

$(1)(3) + (1)(0) = (1)(v_f) + (1)v_f$

$3 = 2 v_f$

$v_f = 1.5 \text{ m/s}$

2. A 2 kg cart traveling at 4 m/s crashes and sticks to a 1 kg cart initially at rest. How fast are the two carts going when they are stuck together?

$m_1 = 2 \text{ kg}$ $m_2 = 1 \text{ kg}$
 $v_{1i} = 4 \text{ m/s}$ $v_{2i} = 0 \text{ m/s}$
 $v_{1f} = ?$ $v_{2f} = ?$

$\sum p_i = \sum p_f \quad \& \quad v_{1f} = v_{2f}$

$(2)(4) + 0 = (2)v_f + (1)v_f$

$8 = 3 v_f$

$v_f = 2.67 \text{ m/s}$

3. A 2 kg cart traveling at 2.5 m/s crashes and sticks to a 3 kg cart initially at rest. How fast are the two carts going when they are stuck together?

$m_1 = 2 \text{ kg}$ $m_2 = 3 \text{ kg}$
 $v_{1i} = 2.5 \text{ m/s}$ $v_{2i} = 0 \text{ m/s}$
 $v_{1f} = ?$ $v_{2f} = ?$

$\sum p_i = \sum p_f \quad \& \quad v_{1f} = v_{2f}$

$(2)(2.5) + 0 = (2)v_f + (3)v_f$

$5 = 5 v_f$

$v_f = 1 \text{ m/s}$

4. A 1 kg cart crashes and sticks to another 1 kg cart initially at rest. If they are going at 2 m/s when they are stuck together, how fast was the first cart going by itself?

$m_1 = 1 \text{ kg}$ $m_2 = 1 \text{ kg}$
 $v_{1i} = ?$ $v_{2i} = 0 \text{ m/s}$
 $v_{1f} = 2 \text{ m/s}$ $v_{2f} = 2 \text{ m/s}$

$\sum p_i = \sum p_f \quad \& \quad v_{1f} = v_{2f}$

$(1)v_{1i} + (1)(0) = (1)(2) + (1)(2)$

$v_{1i} = 4$

$v_{1i} = 4 \text{ m/s}$

5. A 2 kg cart crashes and sticks to a 1 kg cart initially at rest. If they are going at 2 m/s when they are stuck together, how fast was the first cart going by itself?

$m_1 = 2 \text{ kg}$ $m_2 = 1 \text{ kg}$
 $v_{1i} = ?$ $v_{2i} = 0 \text{ m/s}$
 $v_{1f} = 2 \text{ m/s}$ $v_{2f} = 2 \text{ m/s}$

$\sum p_i = \sum p_f \quad \& \quad v_{1f} = v_{2f}$

$(2)v_{1i} + 0 = (2)(2) + (1)(2)$

$2v_{1i} = 6$

$v_{1i} = 3 \text{ m/s}$

6. A 2 kg cart crashes and sticks to a 3 kg cart initially at rest. If they are going at 1.75 m/s when they are stuck together, how fast was the first cart going by itself?

$m_1 = 2 \text{ kg}$ $m_2 = 3 \text{ kg}$
 $v_{1i} = ?$ $v_{2i} = 0 \text{ m/s}$
 $v_{1f} = 1.75 \text{ m/s}$ $v_{2f} = 1.75 \text{ m/s}$

$\sum p_i = \sum p_f \quad \& \quad v_{1f} = v_{2f}$

$(2)v_{1i} + 0 = (2)(1.75) + (3)(1.75)$

$2v_{1i} = 8.75$

$v_{1i} = 4.38 \text{ m/s}$