Key 2020

Elastic Collisions

Purpose: To gather evidence that can be used to support a claim that total system momentum is or is not conserved in an elastic collision.

Background: The objects involved in a collision are often considered as a system. Provided that the system of two objects is not experiencing a net external impulse, there would be no change in momentum of the system. If one object within the system loses momentum, it is gained by the other object within the system. The combined momentum of both objects would be conserved.

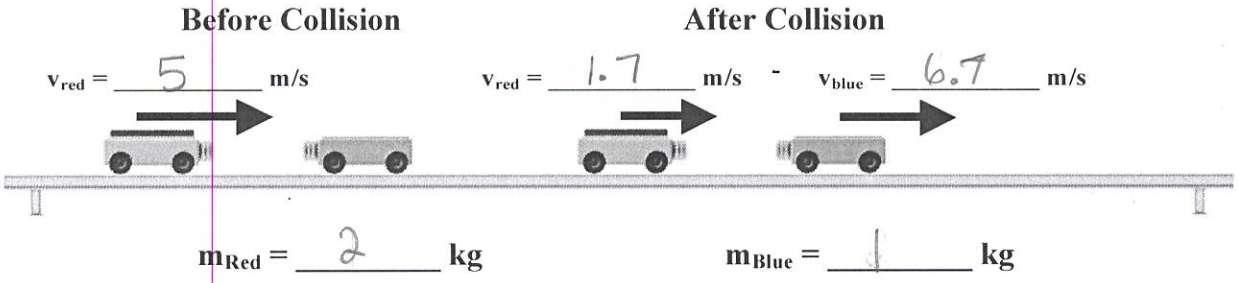
Getting Ready: Navigate to the Collision Carts Interactive in the Physics Interactives section of The Physics Classroom website:

http://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts

Path:
physicsclassroom.com => Physics Interactives => Momentum and Collisions => Collision Carts

Once the Interactive opens, resize it as desired. Select the **Elastic Collisions** option. Experiment with changing the **Mass** and the **Initial Velocity** of the two carts. Observe how the position of the carts along the track can be changed by dragging. Learn to **Start**, **Pause**, and **Reset** the animation.

Collision 1: Blue Cart Initially at Rest
Set the initial blue cart velocity to 0 m/s. Set the mass values to different values. Run the simulation and record the mass and velocity values.



Use mass and velocity values to complete the following momentum table.

	Before Collision	After Collision	ΔMomentum
Red Cart	2 kg x 5 m/s = 10 kg•m/s	2 kg x 1.7 m/s = 3.4 kg•m/s	$P_f - P_i$ 3.4 - 10 = -6.6
Blue Cart	1 kg x 0 m/s = 0 kg•m/s	1 kg x 6.7 m/s = 6.7 kg•m/s	$P_f - P_i$ 6.7 - 0 = 6.7
System Total	10 kg•m/s	= 10.1 kg•m/s	.1 almost 0

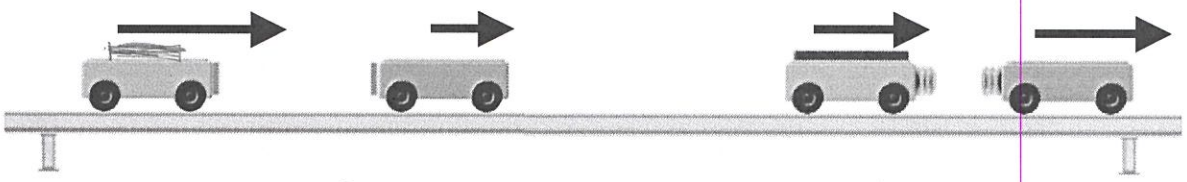
almost...

Collision 2: Blue Cart Moving Slower than the Red Cart

Set the initial blue cart velocity to less than the red cart velocity. Position the blue cart near the red cart so that the collision occurs near the middle of the track. Give the blue cart a smaller mass. Run the simulation and record the post-collision mass and velocity values.

Before Collision **After Collision**

v_{red} = 5 m/s v_{blue} = 2 m/s v_{red} = 3 m/s v_{blue} = 6 m/s



m_{Red} = 2 kg m_{Blue} = 1 kg

Use mass and velocity values to complete the following momentum table.

	Before Collision	After Collision	ΔMomentum
Red Cart	2 kg x 5 m/s = 10 kg•m/s	2 kg x 3 m/s = 6 kg•m/s	6-10 = -4
Blue Cart	1 kg x 2 m/s = 2 kg•m/s	1 kg x 6 m/s = 6 kg•m/s	6-2 = 4
System Total	12	= 12	0

Conclusion

Make a **Claim** as to whether momentum is conserved or not conserved. Identify the **Evidence** that supports your claim; refer to specific sets of values in each data table. Write a paragraph or more of sound **Reasoning** to argue why the evidence logically lead to the claim you are making. Write well. Write logically. Write thoroughly. Use a separate page of paper if necessary.

Conserved! $P_B = P_A$

$\Delta P = 0$!

Key 2020

Inelastic Collisions

Purpose: To gather evidence that can be used to support a claim that total system momentum is or is not conserved in an inelastic collision.

Background: The objects involved in a collision are often considered as a system. Provided that the system of two objects is not experiencing a net external impulse, there would be no change in momentum of the system. If one object within the system loses momentum, it is gained by the other object within the system. The combined momentum of both objects would be conserved.

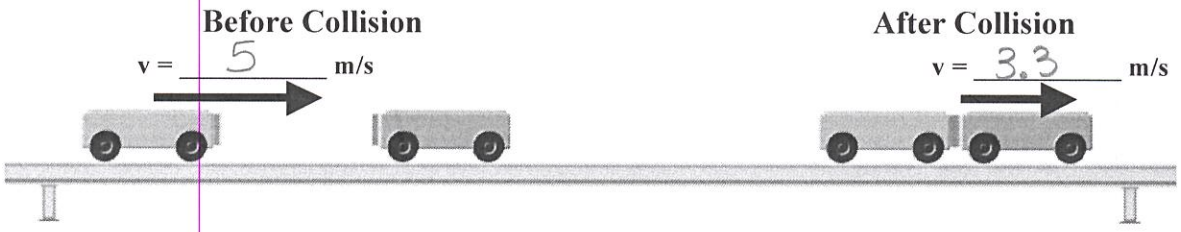
Getting Ready: Navigate to the Collision Carts Interactive in the Physics Interactives section of The Physics Classroom website:

http://www.physicsclassroom.com/Physics-Interactives/Momentum-and-Collisions/Collision-Carts

Path:
physicsclassroom.com => Physics Interactives => Momentum and Collisions => Collision Carts

Once the Interactive opens, resize it as desired. Select the **Inelastic Collisions** option. Experiment with changing the **Mass** and the **Initial Velocity** of the two carts. Observe how the position of the carts along the track can be changed by dragging. Learn to **Start**, **Pause**, and **Reset** the animation.

Collision 1: Blue Cart Initially at Rest
Set the initial blue cart velocity to 0 m/s. Set the mass values to different values. Run the simulation and record the mass and velocity values.



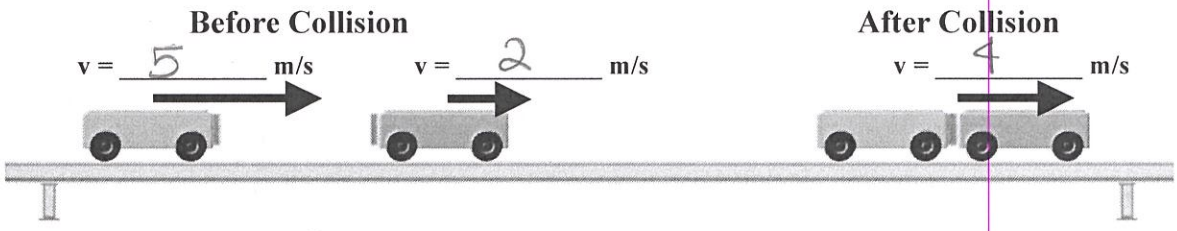
m_{Red} = 2 kg m_{Blue} = 1 kg

Use mass and velocity values to complete the following momentum table.

	Before Collision	After Collision	ΔMomentum
Red Cart	2 kg x 5 m/s = 10 kg•m/s	2 kg x 3.3 m/s = 6.6 kg•m/s	6.6 - 10 = -3.4
Blue Cart	1 kg x 0 m/s = 0 kg•m/s	1 kg x 3.3 m/s = 3.3 kg•m/s	3.3 - 0 = 3.3
System Total	10	= 9.9 almost	-.1 almost 0

Collision 2: Blue Cart Moving Slower than the Red Cart

Set the initial blue cart velocity to less than the red cart velocity. Position the blue cart in the middle of the track. Use different mass values. Run the simulation and record the mass and velocity values.



m_{Red} = 2 kg m_{Blue} = 1 kg

Use mass and velocity values to complete the following momentum table.

	Before Collision	After Collision	ΔMomentum
Red Cart	2 kg x 5 m/s = 10 kg•m/s	2 kg x 4 m/s = 8 kg•m/s	8-10 = -2
Blue Cart	1 kg x 2 m/s = 2 kg•m/s	1 kg x 4 m/s = 4 kg•m/s	4-2 = 2
System Total	12	= 12	0

Conclusion

Make a **Claim** as to whether momentum is conserved or not conserved. Identify the **Evidence** that provides support for your claim; refer to specific sets of values in each data table that serve as credible evidence. Write a paragraph or more of sound **Reasoning** to argue why the evidence logically lead to the claim you are making. Write well. Write logically. Write thoroughly. Use a separate page of paper if necessary.

Conserved! $P_B = P_A$

$\Delta p = 0$