PHYSICS IN MOTION
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Unit 4C
Collisions
Analyzing Collisions Lab

Name:

Date:

In this activity, you will be conducting a virtual laboratory experiment to analyze both elastic and inelastic collisions. The virtual lab conducted will be the PhET Collision Lab.

Here is the link to the simulation: *https://phet.colorado.edu/sims/collision-lab/collision-lab_en.html*

Part One

Inelastic Collisions:

- Open the simulation, and make sure the Introduction tab is clicked.
- Click on the box next to Kinetic Energy so that the total value for the system is shown.
- Click and drag the Elasticity scale to 0%, making the collision inelastic.

Set the mass of the two objects to the same value, and click on More Data below the mass values. You should now see the position, velocity, and momentum values. Set the initial velocities of objects 1 and 2 to the same value, but give object 2 a negative sign. Add these initial values to the data table below.

Initial Values (pre-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

After the two objects collide, again note the mass, velocity, and momentum values.
Add these final values to the data table below.

Final Values (post-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Next, triple the mass of object 1 compared to its initial value. Use the same velocity values as previously. Conduct the experiment again, completing the tables with values from before and after the collision.

Initial Values (pre-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

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Final Values (post-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Next, return the mass of object 1 back to its initial value and instead triple the mass of object 2. Use the same velocity values as previously. Conduct the experiment again, completing the tables with values from before and after the collision.

Initial Values (pre-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Final Values (post-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Questions to Consider for Part One

1. **How does the total momentum of the system before and after the collision compare in each scenario, even if the objects are moving?**

2. **Does this support the law of conservation of momentum?**

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3. When the two objects have equal masses and equal but opposite velocities, what is the final motion of the two objects? Why?

4. When object 1, which is initially moving to the right, has more mass, how does the final velocity of the two objects compare to the initial velocity of object 1? Discuss both speed and direction in your answer.

5. When object 2, which is initially moving to the left, has more mass, how does the final velocity of the two objects compare to the initial velocity of object 2? Discuss both speed and direction in your answer.

6. How does the initial kinetic energy of the system compare to the final kinetic energy of the system in each case?

7. Is kinetic energy conserved in inelastic collisions?

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Part Two

Elastic Collisions:

- Click and drag the Elasticity scale to 100%, making the collision elastic.

Set the mass of the two objects to the same value, and click on More Data below the mass values. You should now see the position, velocity, and momentum values. Set the initial velocities of objects 1 and 2 to the same value, but give object 2 a negative sign. Add these initial values to the data table below.

Initial Values (pre-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

After the two objects collide, again note the mass, velocity, and momentum values. Add these final values to the data table below.

Final Values (post-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Next, increase the mass of object 1 to four times its initial value. Use the same velocity values as previously. Conduct the experiment again, completing the tables with values from before and after the collision.

Initial Values (pre-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

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Final Values (post-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Finally, change the mass of object 1 back to its initial value, and set the mass of object 2 to nine times its initial value. Use the same velocity values as previously. Conduct the experiment again, completing the tables with values from before and after the collision.

Initial Values (pre-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Final Values (post-collision)

Object	Mass (kg)	Velocity (m/s)	Momentum (kg m/s)	Kinetic Energy (J)
1				
2				
TOTAL				

Questions to Consider for Part Two

1. How does the total momentum of the system before and after the collision compare in each scenario?

2. Does this support the law of conservation of momentum?

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3. When the two objects have equal masses and equal but opposite velocities, how do their final velocities compare to their initial velocities?

4. Do the two objects experience an equal change in velocity when their masses are unequal? If not, which object experiences a greater change in velocity?

5. How does the initial kinetic energy of the system compare to the final kinetic energy of the system in each scenario?

6. Is kinetic energy conserved in elastic collisions?

Courtesy of:
PhET Interactive Simulations
University of Colorado Boulder
https://phet.colorado.edu