Name ______________________________ Hour ________

Elastic Collisions

http://www.walter-fendt.de/ph11e/collision.htm

A look at Velocity, Momentum and Kinetic Energy in Elastic Collisions

This Java applet deals with the extreme cases of a collision process illustrated by two wagons: For an *elastic collision* it is characteristic that the sum of the kinetic energies of the involved bodies is constant.
The linear kinetic energy is calculated using the formula: K.E. = $0.5mv^2$, where "m" is the objects mass and "v" is the velocity of the object.
After a *perfectly inelastic collision*, however, both bodies have the same velocity; the sum of their kinetic energies is reduced, compared with the initial value, because a part of it has changed into internal energy (warming up).
The total momentum of the involved bodies is conserved, regardless whether the collision is elastic or inelastic. The momentum (P) of a body is the product of body mass (m) times its velocity (v) or P = mv. The total momentum in a system is the sum of each body's momentum that is found within the system.

Operational Procedure for the Simulation: Log-on to the simulation URL above.

You can choose the simulation of an elastic or an inelastic collision by using the appropriate radio button on the top right. The "Reset" button brings the wagons to their initial positions; the animation is started by a mouse click on the "Start" button. If you select the option "Slow motion", the movement will be ten times slower.

You can write the values of mass and initial velocity into the text fields. Positive (negative) values of velocity mean a motion to the right (left) side. Extreme inputs are automatically changed.

Dependent on the selected radio button (on the bottom right), the applet will illustrate the velocities, the momenta or the kinetic energies of the wagons. These values can be changed after starting a simulation for data collection.

Collecting Simulation Data for Analysis:

You will investigate elastic collisions by completing the data table provided below. Recall that an elastic collision the bodies do not "stick together" they are free to bounce off of each other.

Elastic Collision #1. Bodies of equal mass with one body at rest.

Simulation Set-up:
Radio button: Elastic Collision
Mass (red body) = 0.5 kg, Mass (blue body) = 0.5 kg
Initial Velocity (red body) = +0.2 m/s, Initial Velocity (blue body) = 0.0 m/s
Press the start button. Observe the collision and describe the interaction between the two bodies.

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Elastic Collision #1. Bodies of equal mass with one body at rest.

Initial Data:

Wagon 1	Wagon 1	Wagon 1	Wagon 2	Wagon 2	Wagon 2	Total	Total
Initial Velocity	Initial Momentum	Kinetic Energy	Initial Velocity	Initial Momentum	Kinetic Energy	Initial Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Final Data:

Wagon 1	Wagon 1	Wagon 1	Wagon 2	Wagon 2	Wagon 2	Total	Total
Final Velocity	Final Momentum	Kinetic Energy	Final Velocity	Final Momentum	Kinetic Energy	Final Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Collision Summary:

1. What type of collision was observed? ____________________. What visual evidence from the simulation supports your answer? ____

2. What change in velocity (ΔV) occurred to Wagon #1? _________________________________

What change in velocity (ΔV) occurred to Wagon #2? _________________________________

3. What change in momentum (ΔP) occurred to Wagon #1? ______________________________

What change in momentum (ΔP) occurred to Wagon #2? ______________________________

4. Compare the initial and final total momentum in this collision. __________________________

5. Compare the initial and final kinetic energy in this collision. ____________________________

6. Do elastic collisions conserve momentum? ________ Kinetic energy? __________

Elastic Collision #2. Bodies of unequal mass with one body at rest.

Simulation Set-up:
Radio button: Elastic Collision
Mass (red body) = 0.5 kg, Mass (blue body) = 0.2 kg
Initial Velocity (red body) = +0.2 m/s, Initial Velocity (blue body) = 0.0 m/s
Press the start button. Observe the collision and describe the interaction between the two bodies.

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Elastic Collision #2. Bodies of unequal mass with one body at rest.

Initial Data:

Wagon 1	**Wagon 1**	**Wagon 1**	**Wagon 2**	**Wagon 2**	**Wagon 2**	Total	Total
Initial Velocity	Initial Momentum	Kinetic Energy	Initial Velocity	Initial Momentum	Kinetic Energy	Initial Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Final Data:

Wagon 1	**Wagon 1**	**Wagon 1**	**Wagon 2**	**Wagon 2**	**Wagon 2**	Total	Total
Final Velocity	Final Momentum	Kinetic Energy	Final Velocity	Final Momentum	Kinetic Energy	Final Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Collision Summary:

1. What type of collision was observed? ____________________ What visual evidence from the simulation supports your answer? ____

2. What change in velocity (ΔV) occurred to Wagon #1? ________________________________

What change in velocity (ΔV) occurred to Wagon #2? ________________________________

3. What change in momentum (ΔP) occurred to Wagon #1? ______________________________

What change in momentum (ΔP) occurred to Wagon #2? ______________________________

4. Compare the initial and final total momentum in this collision. __________________________

5. Compare the initial and final kinetic energy in this collision. ____________________________

6. Do elastic collisions conserve momentum? ________ Kinetic energy? __________

Elastic Collision #3. Bodies of equal mass with both in motion.

Simulation Set-up:
Radio button: Elastic Collision
Mass (red body) = 0.5 kg, Mass (blue body) = 0.5 kg
Initial Velocity (red body) = +0.2 m/s, Initial Velocity (blue body) = -0.2 m/s
Press the start button. Observe the collision and describe the interaction between the two bodies.

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Elastic Collision #3. Bodies of equal mass with both in motion.

Initial Data:

Wagon 1	Wagon 1	Wagon 1	Wagon 2	Wagon 2	Wagon 2	Total	Total
Initial Velocity	Initial Momentum	Kinetic Energy	Initial Velocity	Initial Momentum	Kinetic Energy	Initial Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Final Data:

Wagon 1	Wagon 1	Wagon 1	Wagon 2	Wagon 2	Wagon 2	Total	Total
Final Velocity	Final Momentum	Kinetic Energy	Final Velocity	Final Momentum	Kinetic Energy	Final Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Collision Summary:

1. What type of collision was observed? ____________________ What visual evidence from the simulation supports your answer?
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2. What change in velocity (ΔV) occurred to Wagon #1? _________________________________

What change in velocity (ΔV) occurred to Wagon #2? _________________________________

3. What change in momentum (ΔP) occurred to Wagon #1? ______________________________

What change in momentum (ΔP) occurred to Wagon #2?

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4. Compare the initial and final total momentum in this collision. __________________________

5. Compare the initial and final kinetic energy in this collision. ____________________________

6. Do elastic collisions conserve momentum? ________ Kinetic energy? __________

Elastic Collision #4. Bodies of unequal mass with both in motion.

Simulation Set-up:
Radio button: Elastic Collision
Mass (red body) = 0.5 kg, Mass (blue body) = 0.2 kg
Initial Velocity (red body) = +0.2 m/s, Initial Velocity (blue body) = -0.2 m/s
Press the start button. Observe the collision and describe the interaction between the two bodies.

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Elastic Collision #4. Bodies of unequal mass with both in motion.

Initial Data:

Wagon 1	Wagon 1	Wagon 1	Wagon 2	Wagon 2	Wagon 2	Total	Total
Initial Velocity	Initial Momentum	Kinetic Energy	Initial Velocity	Initial Momentum	Kinetic Energy	Initial Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Final Data:

Wagon 1	Wagon 1	Wagon 1	Wagon 2	Wagon 2	Wagon 2	Total	Total
Final Velocity	Final Momentum	Kinetic Energy	Final Velocity	Final Momentum	Kinetic Energy	Final Momentum	Kinetic Energy
(m/s)	(kg-m/s)	(J)	(m/s)	(kg-m/s)	(J)	(kg-m/s)	(J)

Collision Summary:

1. What type of collision was observed? ______________________ What visual evidence from the simulation supports your answer? ____

2. What change in velocity (ΔV) occurred to Wagon #1? ____________________________________

What change in velocity (ΔV) occurred to Wagon #2? ____________________________________

3. What change in momentum (ΔP) occurred to Wagon #1? ________________________________

What change in momentum (ΔP) occurred to Wagon #2?

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4. Compare the initial and final total momentum in this collision. ____________________________

5. Compare the initial and final kinetic energy in this collision. ______________________________

6. Do elastic collisions conserve momentum? ________ Kinetic energy? __________

Simulation Summary:

1. In terms of total momentum what observation was noticed in all the elastic collisions?

2. In terms of total kinetic energy what observation was noticed in all the elastic collisions?