SI Physics - Full Discipline Demo

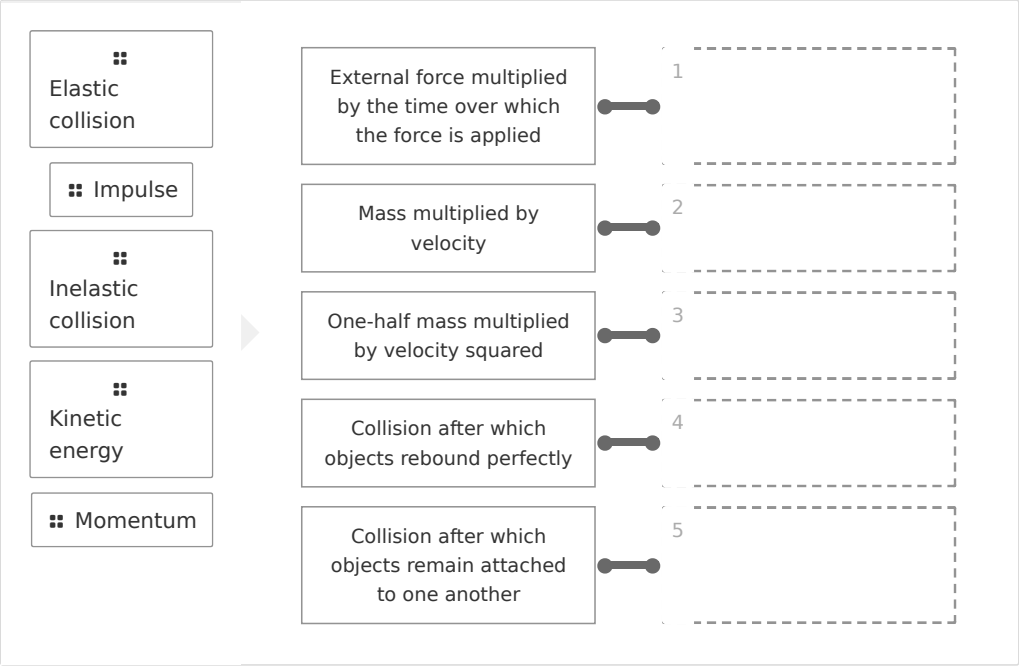
Conservation of Momentum - Digital

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Physics - Full Discipline Demo
Course	SI Physics - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.



Correct answers:

1 Impulse 2 Momentum 3 Kinetic energy 4 Elastic collision

5 Inelastic collision

Identify each statement as true or false.

An impulsive force is constant over time.

Impulse is a measurement of the change in momentum of an object.

Momentum and kinetic energy are always conserved in every collision.

Momentum is a vector quantity.

True	False
1	2

Correct answers:

1 Impulse is a measurement of the change in momentum of an object.

Momentum is a vector quantity.

2 An impulsive force is constant over time.

Momentum and kinetic energy are always conserved in every collision.

Exploration

The momentum of an object depends on the _____ of the object.

- mass
- velocity
- both mass and velocity ✔
- None of the above

The impulse is measured by finding the area under the force - time curve.

- True ✔
- False

The force experienced during an interaction can be reduced by increasing the _____ of the interaction.

- [x] time duration
- [ ] impulse
- [ ] momentum change
- [ ] All of the above

The momentum of each individual object in an isolated system is conserved.

- [ ] True
- [x] False

Elastic collisions are interactions during which the interacting objects stick together.

- [ ] True
- [x] False

Momentum is conserved in both elastic and inelastic collisions, while kinetic energy is conserved only in elastic collisions.

- [x] True
- [ ] False

Exercise 1

What is the result of colliding a moving curling stone of lower mass with a stationary curling stone of higher mass? How is this supported by your calculations?

The lower mass stone will slide backwards after the collision. This is supported by the negative vf and pf values recorded for Trial 3 in Data Table 3 of -0.56 m/s and -11.20 (kg·m/s) respectively.

How do the results of this simulation exercise support the law of conservation of momentum? Explain your answer.

The curling stones from the simulation support the law of conservation of momentum because the momentum of the colliding stones remained constant as displayed by the pi, net equaling the pf, net values in each trial.

A ball with a mass of 3 kg moving at 5 m/s collides with a 9 kg ball at rest. After the collision, the impacting (3 kg) ball bounces back at a speed of 2.5 m/s. How fast does the 9 kg ball move and in what direction?

$p_{net,i} = m_1v_{1,i} + m_2v_{2,i}$ = 3 kg * 5 m/s + 9 kg * 0 m/s = 15 kg m/s

$p_{net,i} = p_{net,f}$

$p_{net,f}$ = 3 kg * (-2.5 m/s) + 9 kg * $v_{2,f}$ = -7.5 kg•m/s + 9 kg x $v_{2,f}$ = 15 kg m/s

9 kg * $v_{2,f}$ = 22.5 kg m/s

Dividing both sides by 9 kg, this results in a velocity of 2.5 m/s moving in the original direction of the 3 kg ball's motion.

Data Table 1: Curling Ball Momentum Simulation
(SAMPLE ANSWER BELOW)

Trial	Stone Color	Mass (kg)	v_i (m/s)	p_i (kg·m/s)	$p_{i,net}$(kg·m/s)	v_f (m/s)	p_f (kg·m/s)	$p_{f,net}$ (kg·m/s)
1	Red	20	No sample answer	No sample answer	No sample answer	No sample answer	No sample answer	No sample answer
	Yellow	15	0	No sample answer		No sample answer	No sample answer	
2	Red	20	No sample answer	No sample answer	No sample answer	No sample answer	No sample answer	No sample answer
	Yellow	20	0	No sample answer		No sample answer	No sample answer	

3	Red	20	No sample answer	No sample answer	No sample answer	No sample answer	No sample answer	No sample answer
	Yellow	25	0	No sample answer		No sample answer	No sample answer	

Competency Review

The units of momentum are _____.

- kg m
- m/s
- kg m/s ✔
- All of the above

Impulse is calculated by multiplying average force by _____.

- time duration ✔
- distance traveled
- change in momentum
- All of the above

The _____ is a measurement of the change in momentum of an object.

- kinetic energy
- impulse ✔
- velocity
- All of the above

Momentum is conserved for any interaction.

- True
- False ✔

Kinetic energy is conserved for both elastic and inelastic collisions.

- True
- False ✔

An explosion a type of reverse _____ collision.

- elastic
- inelastic ✔
- interaction
- All of the above

As the mass of an impactor (such as a marble rolling down an incline) increases, the _____ of the impactor increases.

- momentum
- force
- impulse
- All of the above ✔

The mass of a marble is 0.003 kg and the velocity of the marble is 2 m/s. The momentum of the marble is _____ kg m/s.

- 0.002
- 0.006 ✔
- 700
- None of the above

Extension Questions

A ball bouncing against the ground and rebounding is an example of an elastic collision. Describe two different methods of evaluating this interaction, one for which momentum is conserved, and one for which momentum is not conserved. Explain your answer. (SAMPLE ANSWER BELOW)

Momentum is not conserved if the system consists of only the ball, because the momentum of the ball changes before and after the collision, even if the speed is the same immediately before and

after the collision. The ball changes directions of motion, so its momentum is changed. Momentum is conserved if the system consists of the ball and the Earth together, because the momentum of the Earth is slightly altered by its interaction with the ball. The change is not observed because the mass of the Earth is so much larger than that of the ball, but it occurs nonetheless.