The Collision Test

Use cart data to track momentum and energy.

P.3.e "Obtain, evaluate, and interpret data related to collisions (both elastic and inelastic) and their effects on both linear momentum and energy conservation."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle each kinetic-energy value in the table, underline the sentence about total momentum, and number the two collision outcomes so you can compare them.

Two Ways to Collide

1. On a smooth track, two 1 kg carts move along a straight line. Cart A rolls right at 2 m/s toward cart B, which is still. Treat right as positive. Just before impact, their combined momentum is 2 kg·m/s and their combined kinetic energy is 2 J. Track friction is small enough to ignore during the brief collision.

2. First, the carts meet with spring bumpers. The bumpers compress and then push the carts apart. In a second trial with the same starting motion, hook pads make the carts stick together. The table reports signed velocities, which show both speed and direction, and total kinetic energy for each stage. Compare each outcome with the shared starting row.

CART COLLISION DATA

Stage	Cart A velocity (m/s)	Cart B velocity (m/s)	Total kinetic energy (J)
Before either collision	+2	0	2
After spring-bumper collision	0	+2	2
After hook-pad collision	+1	+1	1

3. A camera records a short click when the hook pads lock, while the spring bumpers briefly compress and rebound. When outside forces are negligible, a collision keeps the system's total momentum. Total kinetic energy may remain the same or decrease as energy shifts into sound, heating, and deformation. Scientists call these outcomes elastic and inelastic, respectively.

2 ANSWER WITH EVIDENCE

Use the passage

1. Calculate the carts' total momentum after the spring-bumper collision. How does it compare with their momentum before impact?

2. Calculate the carts' total momentum after the hook-pad collision. Does this mean they also kept all their kinetic energy? Use the table to explain.

3. Which collision is elastic, and which is inelastic? Support each choice with kinetic-energy data.

4. In the hook-pad collision, how much kinetic energy changed into other forms? Name one form supported by an observation in the passage.

3 YOUR TURN

Your own words

Invent a different possible outcome for these carts in which they separate after impact and some kinetic energy changes into other forms. Give both final signed velocities, calculate total momentum and kinetic energy, and explain where the lost kinetic energy could go.

The Collision Test

PART 1 · READ AND MARK

Circle each kinetic-energy value in the table, underline the sentence about total momentum, and number the two collision outcomes so you can compare them. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Calculate the carts' total momentum after the spring-bumper collision. How does it compare with their momentum before impact?	**(1 kg)(0 m/s) + (1 kg)(2 m/s) = 2 kg·m/s, the same as before impact.**
2	Calculate the carts' total momentum after the hook-pad collision. Does this mean they also kept all their kinetic energy? Use the table to explain.	**(1 kg)(1 m/s) + (1 kg)(1 m/s) = 2 kg·m/s. No. Total kinetic energy fell from 2 J to 1 J.**
3	Which collision is elastic, and which is inelastic? Support each choice with kinetic-energy data.	**The spring-bumper collision is elastic because kinetic energy stays at 2 J. The hook-pad collision is inelastic because kinetic energy falls from 2 J to 1 J.**
4	In the hook-pad collision, how much kinetic energy changed into other forms? Name one form supported by an observation in the passage.	**1 J changed into other forms. The recorded click supports sound as one form.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Cart A ends at +0.5 m/s and cart B at +1.5 m/s, so they separate. Their total momentum is (1 kg)(0.5 m/s) + (1 kg)(1.5 m/s) = 2 kg·m/s, unchanged. Their total kinetic energy is $0.5(1\text{ kg})(0.5\text{ m/s})^2 + 0.5(1\text{ kg})(1.5\text{ m/s})^2 = 1.25$ J. The lost 0.75 J could become sound, heat, or deformation.

For Your Turn, accept different velocities if cart B moves faster than cart A, total momentum is 2 kg·m/s, and total kinetic energy is less than 2 J. Calculations must match the proposed velocities.