Name: _____ Date: _____

Collisions and Conservation of Momentum

READ

- There are two main types of collisions: elastic and inelastic.
- As long as there are no outside forces (such as friction), momentum is conserved in both elastic and inelastic collisions.
- Conservation of momentum makes it possible to determine the motion of objects before and after colliding.
- The steps from the text for using momentum to solve collision problems are provided in the graphic below. Use these problem-solving steps and the problem-solving table to complete this skill sheet. Keep in mind that bounces have greater momentum change.

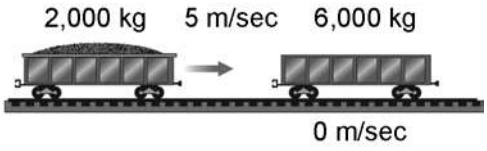
Problem Solving Steps

1. Draw a diagram
2. Decide whether the collision is elastic or inelastic
3. Assign variables to represent the masses and velocities of the objects before and after the collision.
4. Use momentum conservation to write an equation stating that the total momentum before the collision equals the total after. Then solve it.

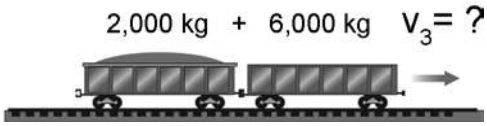
EXAMPLE

A 2,000-kilogram railroad car moving at 5 m/sec collides with a 6,000-kilogram railroad car at rest. If the cars coupled together, what is their velocity after the is inelastic collision?

Before collision



After collision



Looking for

m_3 = the velocity of the combined railroad cars after an inelastic collision

Given

Initial speed and mass of both cars:

m_1 = 2,000 kg, v_1 = 5 m/sec

m_2 = 6,000 kg, v_2 = 0 m/sec

Combined mass of the two cars:

$m_1 + m_2$ = 8,000 kg

Relationship

$m_1v_1 + m_2v_2 = (m_1 + m_2)m_3$

Solution

$$(2000 \text{ kg})(5 \text{ m/sec}) + (6000 \text{ kg})(0 \text{ m/sec}) = (2000 \text{ kg} + 6000 \text{ kg})v_3$$

$$10{,}000 \text{ kg-m/sec} = (8000 \text{ kg})v_3$$

$$\frac{10{,}000 \text{ kg-m/sec}}{8000 \text{ kg}} = v_3$$

$$10 \text{ m/sec} = v_3$$

The velocity of the two combined cars after the collision is 10 m/sec.

PRACTICE 112m / 4 sec 3.3

PRACTICE

1. What is the momentum of a 100-kilogram fullback carrying a football on a play at a velocity of 3.5 m/sec.
2. What is the momentum of a 75.0-kilogram defensive back chasing the fullback at a velocity of 5.00 m/sec.
3. A 2,000-kilogram railroad car moving at 5 m/sec to the east collides with a 6,000-kilogram railroad car moving at 3 m/sec to the west. If the cars couple together, what is their velocity after the collision?
4. A 4-kilogram ball moving at 8 m/sec to the right collides with a 1-kilogram ball at rest. After the collision, the 4-kilogram ball moves at 4.8 m/sec to the right. What is the velocity of the 1-kilogram ball?
5. A 0.0010-kg pellet is fired at a speed of 50.0m/s at a motionless 0.35-kg piece of balsa wood. When the pellet hits the wood, it sticks in the wood and they slide off together. With what speed do they slide?
6. Terry, a 70-kilogram tailback, runs through his offensive line at a speed of 7.0 m/sec. Jared, a 100-kilogram linebacker, running in the opposite direction at 6.0m/s, meets Jared head-on and "wraps him up." What is the result of this tackle?
7. Snowboarding cautiously down a steep slope at a speed of 7.0 m/sec, Sarah, whose mass is 50. kilograms, is afraid she won't have enough speed to travel up a slight uphill grade ahead of her. She extends her hand as her friend Trevor, having a mass of 100. kilograms is about to pass her traveling at 16 m/sec. If Trevor grabs her hand, calculate the speed at which the friends will be sliding.
8. Tex, an 85.0 kilogram rodeo bull rider is thrown from the bull after a short ride. The 520. kilogram bull chases after Tex at 13.0 m/sec. While running away at 3.00 m/sec, Tex jumps onto the back of the bull to avoid being trampled. How fast does the bull run with Tex aboard?
9. Identical twins Kate and Karen are rowing their boat on a hot Summer afternoon when they decide to go for a swim. Kate, whose mass is 45 kilograms, jumps off the front of the boat at a speed of 3.00 m/sec. Karen jumps off the back at a speed of 4.00 m/sec. If the 70-kilogram rowboat is moving at 1.00m/s when the girls jump, what is the speed of the rowboat after the girls jump?
10. A 0.10-kilogram piece of modeling clay is tossed at a motionless 0.10-kilogram block of wood and sticks. The block slides across a frictionless table at 15 m/sec.
    a. At what speed was the clay tossed?
    b. The clay is replaced with a "bouncy" ball tossed with the same speed. The bouncy ball rebounds from the wooden block at a speed of 10 meters per second. What effect does this have on the wooden block? Why?