

**AP Physics – Worksheet: Impulse and Momentum**  
**Conservation of Momentum in Collisions, Elastic and Inelastic Collisions**

Name \_\_\_\_\_ Box # \_\_\_\_\_ Score \_\_\_\_\_ Date \_\_\_\_\_

**Purpose:** To understand Impulse and Momentum of collisions.

$$F \Delta t = \Delta p = p_f - p_i = m(v_f - v_i)$$

$$p_{1i} + p_{2i} = p_{1f} + p_{2f}$$

1. A 2.00 kg cart (cart #1) moving to the right at 12.0 m/s collides with a 1.20 kg cart (cart #2) moving to the right at 2.00 m/s. The two carts stick together and move to the right after the collision.
  - A. What is the initial momentum of cart #1?
  - B. What is the initial momentum of cart #2?
  - C. What is the total momentum of both carts after the collision?
  - D. What is the final velocity of both carts after the collision?
  - E. What is the final momentum of cart #1?
  - F. What is the final momentum of cart #2?
  - G. If the total time for the collision was 0.015 s, what was the average impulsive force exerted by cart #1 on cart #2?
  - H. What was the average impulsive force exerted by cart #2 on cart #1?
  - I. Was total momentum conserved in this collision? Was total mechanical energy conserved in this collision? Explain.

$$p_{1i} + p_{2i} = p_{1f} + p_{2f}$$

$$v_{2f} - v_{1f} = v_{1i} - v_{2i} \quad (\text{elastic collision only})$$

2. 2.00 kg cart (cart #1) moving to the right at 12.0 m/s collides with a 1.20 kg cart (cart #2) moving to the right at 2.00 m/s. The two carts collide elastically.
- A. What is the initial momentum of cart #1?
  - B. What is the initial momentum of cart #2?
  - C. What is the total momentum of both carts after the collision?
  - D. What is the final velocity of cart #1 after the collision?
  - E. What is the final velocity of cart #2 after the collision?
  - F. What is the final momentum of cart #1?
  - G. What is the final momentum of cart #2?
  - H. If the total time for the collision was 0.015 s, what was the average impulsive force exerted by cart #1 on cart #2?
  - I. What was the average impulsive force exerted by cart #2 on cart #1?
  - J. Was total momentum conserved in this collision? Was total mechanical energy conserved in this collision? Explain.

3. A 5.00 g (0.00500 kg) bullet is fired into a 1.00 kg wooden pendulum bob and becomes embedded in it. After the collision, the pendulum and bullet swing upward and reach a maximum height of 12.0 cm (0.120 m). Determine the initial speed of the bullet by doing the following steps.

While the pendulum bob and bullet are swinging upwards by 12 cm, mechanical energy is conserved in the system.

- A. What is the final potential energy of the bob/bullet system?
- B. What is the final kinetic energy of the bob/bullet system?
- C. What is the initial potential energy of the bob/bullet system?
- D. What is the initial kinetic energy of the bob/bullet system?
- E. What is the initial velocity of the bob/bullet system?

While the bullet is colliding with the bob, momentum is conserved in the system.

- F. What is the final momentum of the system (before the bob starts swinging upward)?
- G. What is the initial momentum of the bullet before the collision?
- H. What is the initial velocity of the bullet before the collision?