Problem Set 5 – momentum & impulse

1. A 6-kg ball is rolling right at 10 m/s. The ball strikes a stationary 4-kg ball. After the collision, the 6-kg ball is moving right at 2 m/s. What is the speed and direction of the 4-kg ball after the collision?

2. A 2-kg ball is rolling right at 10 m/s. It strikes a stationary 6-kg ball. After the collision the 6-kg ball is moving right at 4 m/s. What is the speed and direction of the 2-kg ball after the collision?

3. A 6-kg magnet is moving right at 10 m/s. It strikes a stationary 4-kg magnet. The two magnets stick together. What is the speed and direction of the magnets after the collision?

4. A 6-kg ball is rolling right at 10 m/s. It collides with a 4-kg ball. Both balls stop as a result of the collision. What was the speed and direction of the 4-kg ball before the collision?

5. A force of 10 N in the positive direction acts on a 25-kg object for 8 seconds.

(a) What is the size and direction of the impulse produced by the force on the object?

 (b) What change in the object’s momentum does the force produce?

 (c) What change in the object’s velocity does the force produce?

6. A tennis ball has a mass of 0.1 kg and is moving right at 24 m/s. A player hits the ball with a 0.5–kg racquet. The ball leaves the racquet at 40 m/s along its original line but in the opposite direction. Assign right as positive direction. The ball is in contact with the racquet for 0.4 seconds.

 (a) What was the change in velocity of the ball?

 (b) What was the change in momentum of the ball?

 (c) What impulse is impressed on the ball by the racquet?

 (d) What impulse is impressed on the racquet by the ball?

 (e) What was the change in momentum of the racquet?

 (f) What was the change in velocity of the racquet?

 (g) What average force did the racquet exert on the ball?

7. A grocery cart has a mass of 3 kg and is rolling at 2 m/s. As the cart rolls past me I place a bag of groceries into the cart. The cart slows to a speed of 0.5 m/s. What was the mass of the bag of groceries?

8. A 2-kg object is moving at +12 m/s across a level, frictionless surface. The object hits a horizontal spring which stops the object in 1.4 seconds.

(a) What is the change in velocity of the object?

(b) What is the change in momentum of the object?

(c) What impulse did the object experience?

(d) What is the magnitude and direction of the average force the spring exerted on the object while stopping

 the object?

Answers

1. 12 m/s right 5. (a) +80 N●s 6. (a) - 64 m/s 7. 9 kg

2. 2 m/s left (b) +80 kgm/s (b) - 6.4 kg•m/s

3. 6 m/s right (c) +3.2 m/s (c) - 6.4 kg•m/s 8. (a) -12 m/s

4. 15 m/s left (d) + 6.4 kg•m/s (b) -24 kg-m/s

 (e) + 6.4 kg•m/s (c) -24 kg-m/s

 (f) + 12.8 m/s (d) 17.1 N in the

 (g) -16 N neg. direction