Physics I Honors: Chapter 6 Practice Test - Momentum and Collisions

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 1. Which of the following equations can be used to directly calculate an object's momentum, **p**?
a. $\mathbf{p} = m\mathbf{v}$
b.
c. $\mathbf{p} = \mathbf{F}\Delta t$
d. $\Delta\mathbf{p} = \mathbf{F}\Delta t$

____ 2. When comparing the momentum of two moving objects, which of the following is correct?
a. The object with the higher velocity will have less momentum if the masses are equal.
b. The more massive object will have less momentum if its velocity is greater.
c. The less massive object will have less momentum if the velocities are the same.
d. The more massive object will have less momentum if the velocities are the same.

____ 3. A roller coaster climbs up a hill at 4 m/s and then zips down the hill at 30 m/s. The momentum of the roller coaster
a. is greater up the hill than down the hill.
b. is greater down the hill than up the hill.
c. remains the same throughout the ride.
d. is zero throughout the ride.

____ 4. A rubber ball moving at a speed of 5 m/s hit a flat wall and returned to the thrower at 5 m/s. The magnitude of the momentum of the rubber ball
a. increased.
b. decreased.
c. remained the same.
d. was not conserved.

____ 5. If a force is exerted on an object, which statement is true?
a. A large force always produces a large change in the object's momentum.
b. A large force produces a large change in the object's momentum only if the force is applied over a very short time interval.
c. A small force applied over a long time interval can produce a large change in the object's momentum.
d. A small force always produces a large change in the object's momentum.

____ 6. The change in an object's momentum is equal to
a. the product of the mass of the object and the time interval.
b. the product of the force applied to the object and the time interval.
c. the time interval divided by the net external force.
d. the net external force divided by the time interval.

____ 7. Which of the following situations is an example of a significant change in momentum?
a. A tennis ball is hit into a net.
b. A helium-filled balloon rises upward into the sky.
c. An airplane flies into some scattered white clouds.
d. A bicyclist rides over a leaf on the pavement.

____ 8. A ball with a momentum of 4.0 kg•m/s hits a wall and bounces straight back without losing any kinetic energy. What is the change in the ball's momentum?
a. –8.0 kg•m/s
b. –4.0 kg•m/s
c. 0.0 kg•m/s
d. 8.0 kg•m/s

____ 9. The impulse experienced by a body is equivalent to the body's change in
a. velocity.
b. kinetic energy.
c. momentum.
d. force.

____ 10. A 75 kg person walking around a corner bumped into an 80 kg person who was running around the same corner. The momentum of the 80 kg person

a. increased.
b. decreased.
c. remained the same.
d. was conserved.

____ 11. Two objects with different masses collide and bounce back after an elastic collision. Before the collision, the two objects were moving at velocities equal in magnitude but opposite in direction. After the collision,

a. the less massive object had gained momentum.
b. the more massive object had gained momentum.
c. both objects had the same momentum.
d. both objects lost momentum.

____ 12. Two swimmers relax close together on air mattresses in a pool. One swimmer's mass is 48 kg, and the other's mass is 55 kg. If the swimmers push away from each other,

a. their total momentum triples.
b. their momenta are equal but opposite.
c. their total momentum doubles.
d. their total momentum decreases.

____ 13. In a two-body collision,

a. momentum is always conserved.
b. kinetic energy is always conserved.
c. neither momentum nor kinetic energy is conserved.
d. both momentum and kinetic energy are always conserved.

____ 14. Which of the following statements about the conservation of momentum is *not* correct?

a. Momentum is conserved for a system of objects pushing away from each other.
b. Momentum is not conserved for a system of objects in a head-on collision.
c. Momentum is conserved when two or more interacting objects push away from each other.
d. The total momentum of a system of interacting objects remains constant regardless of forces between the objects.

____ 15. Two objects move separately after colliding, and both the total momentum and total kinetic energy remain constant. Identify the type of collision.

a. elastic
b. nearly elastic
c. inelastic
d. perfectly inelastic

____ 16. Two objects stick together and move with a common velocity after colliding. Identify the type of collision.

a. elastic
b. nearly elastic
c. inelastic
d. perfectly inelastic

____ 17. In an inelastic collision between two objects with unequal masses,

a. the total momentum of the system will increase.
b. the total momentum of the system will decrease.
c. the kinetic energy of one object will increase by the amount that the kinetic energy of the other object decreases.
d. the momentum of one object will increase by the amount that the momentum of the other object decreases.

____ 18. A billiard ball collides with a stationary identical billiard ball in an elastic head-on collision. After the collision, which of the following is true of the first ball?

a. It maintains its initial velocity.
b. It has one-half its initial velocity.
c. It comes to rest.
d. It moves in the opposite direction.

Short Answer

19. As a bullet travels through the air, it slows down due to air resistance. How does the bullet’s momentum change as a result?

20. A baseball pitcher’s first pitch is a fastball, moving at high speed. The pitcher’s second pitch—with the same ball—is a changeup, moving more slowly. Which pitch is harder for the catcher to stop? Explain your answer in terms of momentum.

21. How can a small force produce a large change in momentum?

22. State, in words, the law of conservation of momentum for an isolated system.

Problem

23. Which has a greater momentum—a truck with a mass of 2250 kg moving at a speed of 25 m/s or a car with a mass of 1210 kg moving at a speed of 51 m/s?
24. A 6.0×10^{-2} kg tennis ball moves at a speed of 12 m/s. The ball is struck by a racket, causing it to rebound in the opposite direction at a speed of 18 m/s. What is the change in the ball’s momentum?
25. A baseball bat strikes a baseball with a force of 35 N. The bat is in contact with the ball for 0.12 s. What is the magnitude of the change in momentum of the ball?
26. A swimmer with a mass of 75 kg dives off a raft with a mass of 500 kg. If the swimmer’s speed is 4 m/s immediately after leaving the raft, what is the speed of the raft?
27. A bowling ball with a mass of 7.0 kg strikes a pin that has a mass of 2.0 kg. The pin flies forward with a velocity of 6.0 m/s, and the ball continues forward at 4.0 m/s. What was the original velocity of the ball?
28. A 90 kg halfback runs north and is tackled by a 120 kg opponent running south at 4 m/s. The collision is perfectly inelastic. Just after the tackle, both players move at a velocity of 2 m/s north. Calculate the velocity of the 90 kg player just before the tackle.

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Answer Section

MULTIPLE CHOICE

1. ANS: A DIF: I OBJ: 6-1.1
2. ANS: C DIF: I OBJ: 6-1.1
3. ANS: B DIF: I OBJ: 6-1.2
4. ANS: C DIF: I OBJ: 6-1.3
5. ANS: C DIF: I OBJ: 6-1.3
6. ANS: B DIF: I OBJ: 6-1.3
7. ANS: A DIF: I OBJ: 6-1.3
8. ANS: A

   Given

   $p_i = 4.0\ \text{kgm/s}$

   $p_f = -4.0\ \text{kgm/s}$

   Solution

   $\Delta p = p_f - p_i = \left(-4.0\ \text{kgm/s}\right) - 4.0\ \text{kgm/s} = -8.0\ \text{kgm/s}$

   DIF: II OBJ: 6-1.3
9. ANS: C DIF: I OBJ: 6-1.4
10. ANS: B DIF: II OBJ: 6-2.1
11. ANS: A DIF: II OBJ: 6-2.1
12. ANS: B DIF: II OBJ: 6-2.2
13. ANS: A DIF: I OBJ: 6-2.3
14. ANS: B DIF: I OBJ: 6-2.3
15. ANS: A DIF: I OBJ: 6-3.1
16. ANS: D DIF: I OBJ: 6-3.1
17. ANS: D DIF: I OBJ: 6-3.3
18. ANS: C DIF: I OBJ: 6-3.3

SHORT ANSWER

19. ANS:
    The bullet's momentum decreases as its speed decreases.

    DIF: I OBJ: 6-1.2
20. ANS:
    The first pitch is harder to stop. The first pitch has greater momentum because it has a greater velocity, so the change in momentum to zero is greater.

    DIF: II OBJ: 6-1.2
21. ANS:
    A small force can produce a large change in momentum if the force acts on an object for a long period of time.

DIF: II OBJ: 6-1.4

22. ANS:
The total momentum of all objects interacting with one another remains constant regardless of the nature of the forces between the objects.

DIF: I OBJ: 6-2.3

PROBLEM

23. ANS:
The car has a greater momentum.

Given

$m_1 = 2250 \text{ kg}$

$v_1 = 25 \text{ m/s}$

$m_2 = 1210 \text{ kg}$

$v_2 = 51 \text{ m/s}$

Solution

$p_1 = m_1 v_1 = (2250 \text{ kg})(25 \text{ m/s}) = 5.6 \times 10^4 \text{ kgm/s}$

$p_2 = m_2 v_2 = (1210 \text{ kg})(51 \text{ m/s}) = 6.2 \times 10^4 \text{ kgm/s}$

$p_2 > p_1$

DIF: IIIA OBJ: 6-1.1

24. ANS:
–1.8 kg•m/s

Given

$m = 6.0 \times 10^{-2} \text{ kg}$

$v_i = 12 \text{ m/s}$

$v_f = -18 \text{ m/s}$

Solution

$\Delta p = m(v_f - v_i) = (6.0 \times 10^{-2} \text{ kg})(-18 \text{ m/s} - 12 \text{ m/s}) = -1.8 \text{ kgm/s}$

DIF: IIIA OBJ: 6-1.3

25. ANS:
4.2 kg•m/s

Given

$F = 35 \text{ N}$

$\Delta t = 0.12 \text{ s}$

Solution
$\Delta p = F\Delta t = (35 \text{ N})(0.12 \text{ s}) = 4.2 \text{ kgm/s}$

DIF: IIIA OBJ: 6-1.4

26. ANS:
0.6 m/s

Given
$m_1 = 75 \text{ kg}$

$m_2 = 500 \text{ kg}$
$v_{1,i} = v_{2,i} = 0 \text{ m/s}$

$v_{1,f} = -4 \text{ m/s}$

Solution

$$v_{2,f} = -\frac{m_1 v_{1,f}}{m_2} = -\frac{(75 \text{ kg})(-4 \text{ m/s})}{500 \text{ kg}} = 0.6 \text{ m/s}$$

DIF: IIIB OBJ: 6-2.4

27. ANS:
5.7 m/s forward

Given
$m_1 = 7.0 \text{ kg}$

$m_2 = 2.0 \text{ kg}$

Solution

forward

DIF: IIIC OBJ: 6-3.4

28. ANS:
10 m/s to the north

Given
$m_1 = 90\ \text{kg}$

$m_2 = 120\ \text{kg}$

Solution

DIF: IIIC OBJ: 6-3.4