Assessment

Momentum and Collisions

Test Review

MULTIPLE CHOICE

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

_____ 1. Which of the following has the greatest momentum?
a. a tortoise with a mass of 275 kg moving at a velocity of 0.55 m/s
b. a hare with a mass of 2.7 kg moving at a velocity of 7.5 m/s
c. a turtle with a mass of 91 kg moving at a velocity of 1.4 m/s
d. a roadrunner with a mass of 1.8 kg moving at a velocity of 6.7 m/s

_____ 2. A person sitting in a chair with wheels stands up, causing the chair to roll backward across the floor. The momentum of the chair
a. was zero while stationary and increased when the person stood.
b. was greatest while the person sat in the chair.
c. remained the same.
d. was zero when the person got out of the chair and increased while the person sat.

_____ 3. A 0.2 kg baseball is pitched with a velocity of 40 m/s and is then batted to the pitcher with a velocity of 60 m/s. What is the magnitude of change in the ball's momentum?
a. 2 kg•m/s
b. 4 kg•m/s
c. 8 kg•m/s
d. 20 kg•m/s

_____ 4. Which of the following statements properly relates the variables in the equation $\mathbf{F}\Delta t = \Delta\mathbf{p}$?
a. A large constant force changes an object's momentum over a long time interval.
b. A large constant force acting over a long time interval causes a large change in momentum.
c. A large constant force changes an object's momentum at various time intervals.
d. A large constant force does not necessarily cause a change in an object's momentum.

_____ 5. 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.

_____ 6. 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.

_____ 7. 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.

_____ 8. Two balls of dough collide and stick together. Identify the type of collision.
   a. elastic
   b. perfectly elastic
   c. inelastic
   d. perfectly inelastic

_____ 9. Which of the following best describes the momentum of two bodies after a two-body collision if the kinetic energy of the system is conserved?
   a. must be less
   b. must also be conserved
   c. might also be conserved
   d. is doubled in value

SHORT ANSWER

10. 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.

_____

_____

11. Is it possible for a spaceship traveling with constant velocity to experience a change in momentum? Explain your answer.

_____

_____

12. Each croquet ball in a set has a mass of 0.50 kg. The green ball travels at 10.5 m/s and strikes a stationary red ball. If the green ball stops moving, what is the final speed of the red ball after the collision?

_____

13. A moderate force will break an egg. Using the concepts of momentum, force, and time interval, explain why an egg is more likely to break when it is dropped on concrete than if it is dropped on grass.

_____

_____

_____

14. Why is the sound produced by a collision evidence that the collision is not perfectly elastic?

_____

_____

_____

PROBLEM

15. What velocity must a 1340 kg car have in order to have the same momentum as a 2680 kg truck traveling at a velocity of 15 m/s to the west?

16. A 6.0×10^{-2} kg tennis ball moves at a velocity 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?

17. A train with a mass of 1.8×10^3 kg is moving at 15 m/s when the engineer applies the brakes. If the braking force is constant at 3.5×10^4 N, how long does it take the train to stop? How far does the train travel during this time?

18. An astronaut with a mass of 85 kg is outside a space capsule when the tether line breaks. To return to the capsule, the astronaut throws a 2.0 kg wrench away from the capsule at a speed of 14 m/s. At what speed does the astronaut move toward the capsule?

19. A 0.10 kg object makes an elastic head-on collision with a 0.15 kg stationary object. The final velocity of the 0.10 kg object after the collision is –0.045 m/s, and the final velocity of the 0.15 kg object after the collision is 0.16 m/s. What was the initial velocity of the 0.10 kg object?

20. 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.