

7

Momentum

TRUE OR FALSE QUESTIONS

Circle the correct answer.

T

F

1. If the net external force acting on a system is zero, then the total momentum of the system is zero.

T

F

2. Impulses are smaller when bouncing takes place.

T

F

3. After a firecracker falling through the air explodes, the net momentum of its fragments decreases.

T

F

4. The padding on car dashboards lengthens the time of a passenger's impact during a collision.

T

F

5. If a net force acts on a system, the system's momentum will change.

MULTIPLE CHOICE QUESTIONS

Choose the best answer to each question and write the appropriate letter in the space provided.

A

6. Which has more momentum, a large truck moving at 30 miles per hour or a small truck moving at 30 miles per hour?

A) The large truck
B) The small truck
C) Both have the same momentum.

B

7. Compared to a sports car moving at 30 miles per hour, the same sports car moving at 60 miles per hour has

A) the same momentum.
B) twice as much momentum.
C) four times as much momentum.

D

8. If the momentum of an object changes and its mass remains constant

A) its velocity is changing.
B) it is accelerating (or decelerating).
C) there is a force acting on it.
D) All of the above

C

9. The momentum change of an object is equal to the

A) force acting on it.
B) velocity change of the object.
C) impulse acting on it.
D) object's mass times the force acting on it.

B

10. If Superman at rest in free space throws an asteroid that has more mass than Superman, then which moves faster?

A) The asteroid.
 B) Superman.
 C) They both move at the same speed.

D

11. Skelly the skater traveling at high speed needs a certain amount of force to stop him. More stopping force will be needed if he has

A) more mass.
 B) more momentum.
 C) less stopping distance.
 D) all of these.

C

12. A Ping-Pong® ball launcher is fired. Compared to the impulse on the ball, the amount of impulse on the launcher is

A) larger.
 B) smaller.
 C) the same.

B

13. The cannonball launched from a cannon with a long barrel will be faster because the cannonball receives a greater

A) force.
 B) impulse.
 C) both of these.
 D) neither of these.

MATH PROBLEMS

Solve the following problems in the space provided. Show all work.

14. What is the average momentum of a 70-kg runner who covers 400 m in 50 s?

$$V = \frac{d}{t} = \frac{400\text{m}}{50\text{s}} = 8\text{m/s}$$

$$P = M \cdot V = 70\text{kg}(8\text{m/s}) = 560 \frac{\text{kg} \cdot \text{m}}{\text{s}}$$

15. A 30-kg girl and a 25-kg boy face each other on friction-free roller skates. The girl pushes the boy, who moves away at a speed of 1.0 m/s. What is the girl's speed?

$$F = F \text{ (Newton's 3rd Law)}$$

$$m_a = m_a$$

$$30\text{kg}(x\text{m/s}) = 25\text{kg}(1.0\text{m/s})$$

$$x = 0.83\text{m/s}$$

ESSAY QUESTION

On a separate sheet of paper, answer the following question:

16. A railroad diesel engine coasting at 10 km/h runs into a stationary flatcar. The diesel weighs 4 times as much as the flatcar. Assuming the cars couple together, how fast are they moving after the collision?



Chapter Assessment

Momentum and Its Conservation

Understanding Concepts Part A

Write the letter of the choice that best completes the statement or answers the question.

- B 1. The linear momentum of an object can be calculated by multiplying the mass of the object by its ____.
- a. acceleration c. impulse
b. velocity d. time
- A 2. The greatest change in momentum will be produced by a ____.
- a. large force acting over a long time
b. small force acting over a short time
c. large force acting over a short time
- B 3. Impulse can be represented by ____.
- a. $\Delta v / \Delta t$ c. mv
b. $F \Delta t$ d. m/v
- A 4. When a golf club hits a golf ball, the change in momentum of the ball is ____ the change in momentum of the club.
- a. equal to b. greater than c. less than
- C 5. A system is closed if ____.
- a. no net external force acts on it
b. the momentum of each object in the system remains constant
c. the system does not gain or lose mass
d. objects can enter, but not leave, the system
- C 6. An internal force ____ the total momentum of a closed system.
- a. increases b. decreases c. does not change
- B 7. A person is standing on roller blades and is holding a heavy medicine ball. If he throws the medicine ball horizontally to the right, what will be his resulting motion?
- a. to the right c. backward
b. to the left d. no motion
- 8. Two moving objects collide and move on paths that are 120° apart. The total momentum of the objects after the collision is ____ the total momentum before the collision.
- a. equal to b. greater than c. less than

Chapter Assessment

Understanding Concepts Part B

Answer the following questions, showing your calculations.

1. What is the momentum of a 145-g baseball traveling at +40.0 m/s?

$$p = m \cdot v$$

2. What impulse is needed to stop a 45-g mass traveling at a velocity of -42 m/s?

$$F \Delta t = m \Delta v$$

$$= 0.045 \text{ kg} (42 \text{ m/s})$$

$$= 1.9 \text{ N}\cdot\text{s}$$

3. A force with a magnitude of 540 N is used to stop an object with a mass of 65 kg moving at a velocity of +175 m/s. How long will it take to bring the object to a full stop?

$$F \Delta t = m \Delta v$$

$$\Delta t = \frac{m \Delta v}{F}$$

$$= \frac{m(v_2 - v_1)}{F}$$

$$= \frac{65 \text{ kg} (0 \text{ m/s} - 175 \text{ m/s})}{-540 \text{ N}}$$

$$= 21 \text{ s}$$

4. In hitting a stationary hockey puck having a mass of 180 g, a hockey player gives the puck an impulse of 6.0 N·s. At what speed will the puck move toward the goal?

$$F \Delta t = m \Delta v$$

$$\Delta v = \frac{F \Delta t}{m}$$

$$v_2 - 0 = \Delta v = \frac{6.0 \text{ N}\cdot\text{s}}{0.18 \text{ kg}} = \frac{6 \text{ kg}\cdot\text{m/s}}{0.18 \text{ kg}}$$

$$v_2 = 33 \text{ m/s}$$