CHAPTER REVIEW

Concept Items

8.1 Linear Momentum, Force, and Impulse

1. What is impulse?
   a. Change in velocity
   b. Change in momentum
   c. Rate of change of velocity
   d. Rate of change of momentum

2. In which equation of Newton's second law is mass assumed to be constant?
   a. $\mathbf{F} = m\mathbf{a}$
   b. $\mathbf{F} = \frac{\Delta \mathbf{p}}{\Delta t}$
   c. $\mathbf{F} = \Delta \mathbf{p} \Delta t$
   d. $\mathbf{F} = \frac{\Delta m}{\Delta a}$

3. What is the SI unit of momentum?
   a. N
   b. $\mathrm{kg \cdot m}$
   c. $\mathrm{kg \cdot m/s}$
   d. $\mathrm{kg \cdot m/s^2}$

4. What is the equation for linear momentum?
   a. $\mathbf{p} = m\mathbf{v}$
   b. $\mathbf{p} = m/\mathbf{v}$
   c. $\mathbf{p} = \mathrm{m}\mathbf{v}^2$
   d. $\mathbf{p} = \frac{1}{2}\mathrm{m}\mathbf{v}^2$

8.2 Conservation of Momentum

6. What is an isolated system?
   a. A system in which the net internal force is zero
   b. A system in which the net external force is zero
   c. A system in which the net internal force is a nonzero constant
   d. A system in which the net external force is a nonzero constant

8.3 Elastic and Inelastic Collisions

7. In the equation $\mathbf{p}_1 + \mathbf{p}_2 = \mathbf{p}'_1 + \mathbf{p}'_2$ for the collision of two objects, what is the assumption made regarding the friction acting on the objects?
   a. Friction is zero.
   b. Friction is nearly zero.
   c. Friction acts constantly.
   d. Friction before and after the impact remains the same.

8. What is an inelastic collision?
   a. when objects stick together after impact, and their internal energy is not conserved
   b. when objects stick together after impact, and their internal energy is conserved
   c. when objects stick together after impact, and always come to rest instantaneously after collision
   d. when objects stick together after impact, and their internal energy increases

Critical Thinking Items

8.1 Linear Momentum, Force, and Impulse

9. Consider two objects of the same mass. If a force of $100\ \text{N}$ acts on the first for a duration of $1\ \text{s}$ and on the other for a duration of $2\ \text{s}$, which of the following statements is true?

a. The first object will acquire more momentum.
b. The second object will acquire more momentum.
c. Both objects will acquire the same momentum.
d. Neither object will experience a change in momentum.

10. Cars these days have parts that can crumple or collapse in the event of an accident. How does this help protect the passengers?

a. It reduces injury to the passengers by increasing the time of impact.
b. It reduces injury to the passengers by decreasing the time of impact.
c. It reduces injury to the passengers by increasing the change in momentum.
d. It reduces injury to the passengers by decreasing the change in momentum.

11. How much force would be needed to cause a $17\ \text{kg} \cdot \text{m/s}$ change in the momentum of an object, if the force acted for 5 seconds?

a. 3.4 N
b. 12 N
c. 22 N
d. 85 N

8.2 Conservation of Momentum

12. A billiards ball rolling on the table has momentum $\mathbf{p}_1$. It hits another stationary ball, which then starts rolling. Considering friction to be negligible, what will happen to the momentum of the first ball?

a. It will decrease.
b. It will increase.
c. It will become zero.
d. It will remain the same.

13. A ball rolling on the floor with momentum $\mathbf{p}_1$ collides with a stationary ball and sets it in motion. The momentum of the first ball becomes $\mathbf{p}'_1$, and that of the second becomes $\mathbf{p}'_2$. Compare the magnitudes of $\mathbf{p}_1$ and $\mathbf{p}'_2$.

a. Momenta $\mathbf{p}_1$ and $\mathbf{p}'_2$ are the same in magnitude.
b. The sum of the magnitudes of $\mathbf{p}_1$ and $\mathbf{p}'_2$ is zero.
c. The magnitude of $\mathbf{p}_1$ is greater than that of $\mathbf{p}'_2$.
d. The magnitude of $\mathbf{p}'_2$ is greater than that of $\mathbf{p}_1$.

14. Two cars are moving in the same direction. One car with momentum $\mathbf{p}_1$ collides with another, which has momentum $\mathbf{p}_2$. Their momenta become $\mathbf{p}'_1$ and $\mathbf{p}'_2$ respectively. Considering frictional losses, compare $(\mathbf{p}'_1 + \mathbf{p}'_2)$ with $(\mathbf{p}_1 + \mathbf{p}_2)$.

a. The value of $(\mathbf{p}'_1 + \mathbf{p}'_2)$ is zero.
b. The values of $(\mathbf{p}_1 + \mathbf{p}_2)$ and $(\mathbf{p}'_1 + \mathbf{p}'_2)$ are equal.
c. The value of $(\mathbf{p}_1 + \mathbf{p}_2)$ will be greater than $(\mathbf{p}'_1 + \mathbf{p}'_2)$.
d. The value of $(\mathbf{p}'_1 + \mathbf{p}'_2)$ will be greater than $(\mathbf{p}_1 + \mathbf{p}_2)$.

8.3 Elastic and Inelastic Collisions

15. Two people, who have the same mass, throw two different objects at the same velocity. If the first object is heavier than the second, compare the velocities gained by the two people as a result of recoil.

a. The first person will gain more velocity as a result of recoil.
b. The second person will gain more velocity as a result of recoil.
c. Both people will gain the same velocity as a result of recoil.
d. The velocity of both people will be zero as a result of recoil.

Problems

8.1 Linear Momentum, Force, and Impulse

16. If a force of $50\ \text{N}$ is applied to an object for $0.2\ \text{s}$, and it changes its velocity by $10\ \text{m/s}$, what could be the mass of the object?

a. $1\ \text{kg}$
b. $2\ \text{kg}$
c. $5\ \text{kg}$
d. $250\ \text{kg}$

17. For how long should a force of 130 N be applied to an object of mass 50 kg to change its speed from 20 m/s to 60 m/s?

a. 0.031 s
b. 0.065 s
c. 15.4 s
d. 40 s

8.3 Elastic and Inelastic Collisions

18. If a man with mass 70 kg, standing still, throws an object with mass 5 kg at 50 m/s, what will be the recoil velocity of the man, assuming he is standing on a frictionless surface?

a. –3.6 m/s
b. 0 m/s
c. 3.6 m/s
d. 50.0 m/s

19. Find the recoil velocity of a $65\ \text{kg}$ ice hockey goalie who catches a $0.15\ \text{kg}$ hockey puck slapped at him at a velocity of $50\ \text{m/s}$. Assume that the goalie is at rest before catching the puck, and friction between the ice and the puck-goalie system is negligible.

a. $-0.12\ \text{m/s}$
b. $0\ \text{m/s}$
c. $0.12\ \text{m/s}$
d. $7.5\ \text{m/s}$

TEST PREP

Multiple Choice

8.1 Linear Momentum, Force, and Impulse

21. What kind of quantity is momentum?

a. Scalar
b. Vector

22. When does the net force on an object increase?

a. When $\Delta\mathbf{p}$ decreases
b. When Δt increases
c. When Δt decreases

23. In the equation $\Delta\mathbf{p} = m(\mathbf{v}_f - \mathbf{v}_i)$, which quantity is considered to be constant?

a. Initial velocity
b. Final velocity
c. Mass
d. Momentum

24. For how long should a force of $50\ \text{N}$ be applied to change the momentum of an object by $12\ \text{kg} \cdot \text{m/s}$?

a. $0.24\ \text{s}$
b. $4.15\ \text{s}$
c. $62\ \text{s}$
d. $600\ \text{s}$

8.2 Conservation of Momentum

26. Give an example of an isolated system.

a. A cyclist moving along a rough road
b. A figure skater gliding in a straight line on an ice rink
c. A baseball player hitting a home run
d. A man drawing water from a well

8.3 Elastic and Inelastic Collisions

27. In which type of collision is kinetic energy conserved?

a. Elastic
b. Inelastic

28. --

29. Two objects having equal masses and velocities collide with each other and come to a rest. What type of a collision is this and why?

a. Elastic collision, because internal kinetic energy is conserved
b. Inelastic collision, because internal kinetic energy is not conserved
c. Elastic collision, because internal kinetic energy is not conserved
d. Inelastic collision, because internal kinetic energy is conserved

30. Two objects having equal masses and velocities collide with each other and come to a rest. Is momentum conserved in this case?

a. Yes
b. No

Short Answer

8.1 Linear Momentum, Force, and Impulse

31. If an object's velocity is constant, what is its momentum proportional to?

a. Its shape
b. Its mass
c. Its length
d. Its breadth

32. If both mass and velocity of an object are constant, what can you tell about its impulse?

a. Its impulse would be constant.
b. Its impulse would be zero.
c. Its impulse would be increasing.
d. Its impulse would be decreasing.

33. When the momentum of an object increases with respect to time, what is true of the net force acting on it?

a. It is zero, because the net force is equal to the rate of change of the momentum.
b. It is zero, because the net force is equal to the product of the momentum and the time interval.
c. It is nonzero, because the net force is equal to the rate of change of the momentum.
d. It is nonzero, because the net force is equal to the product of the momentum and the time interval.

34. How can you express impulse in terms of mass and velocity when neither of those are constant?

a. $\Delta \mathbf{p} = \Delta(m\mathbf{v})$
b. $\frac{\Delta \mathbf{p}}{\Delta t} = \frac{\Delta(m\mathbf{v})}{\Delta t}$
c. $\Delta \mathbf{p} = \Delta(\frac{m}{\mathbf{v}})$
d. $\frac{\Delta \mathbf{p}}{\Delta t} = \frac{1}{\Delta t} \cdot \Delta(m\mathbf{v})$

35. How can you express impulse in terms of mass and initial and final velocities?

a. $\Delta \mathbf{p} = m(\mathbf{v}_f - \mathbf{v}_i)$
b. $\frac{\Delta \mathbf{p}}{\Delta t} = \frac{m(\mathbf{v}_f - \mathbf{v}_i)}{\Delta t}$
c. $\Delta \mathbf{p} = \frac{(\mathbf{v}_f - \mathbf{v}_i)}{m}$
d. $\frac{\Delta \mathbf{p}}{\Delta t} = \frac{1}{m}\frac{(\mathbf{v}_f - \mathbf{v}_i)}{\Delta t}$

36. Why do we use average force while solving momentum problems? How is net force related to the momentum of the object?

a. Forces are usually constant over a period of time, and net force acting on the object is equal to the rate of change of the momentum.
b. Forces are usually not constant over a period of time, and net force acting on the object is equal to the product of the momentum and the time interval.
c. Forces are usually constant over a period of time, and net force acting on the object is equal to the product of the momentum and the time interval.
d. Forces are usually not constant over a period of time, and net force acting on the object is equal to the rate of change of the momentum.

8.3 Elastic and Inelastic Collisions

40. Two objects collide with each other and come to a rest. How can you use the equation of conservation of momentum to describe this situation?

a. $m_1\mathbf{v}_1 + m_2\mathbf{v}_2 = 0$
b. $m_1\mathbf{v}_1 - m_2\mathbf{v}_2 = 0$
c. $m_1\mathbf{v}_1 + m_2\mathbf{v}_2 = m_1\mathbf{v}_1'$
d. $m_1\mathbf{v}_1 + m_2\mathbf{v}_2 = m_1\mathbf{v}_2$

41. What is the difference between momentum and impulse?

a. Momentum is the sum of mass and velocity. Impulse is the change in momentum.
b. Momentum is the sum of mass and velocity. Impulse is the rate of change in momentum.
c. Momentum is the product of mass and velocity. Impulse is the change in momentum.
d. Momentum is the product of mass and velocity. Impulse is the rate of change in momentum.

Extended Response

8.1 Linear Momentum, Force, and Impulse

44. Can a lighter object have more momentum than a heavier one? How?

a. No, because momentum is independent of the velocity of the object.
b. No, because momentum is independent of the mass of the object.
c. Yes, if the lighter object's velocity is considerably high.
d. Yes, if the lighter object's velocity is considerably low.

45. Why does it hurt less when you fall on a softer surface?

a. The softer surface increases the duration of the impact, thereby reducing the effect of the force.
b. The softer surface decreases the duration of the impact, thereby reducing the effect of the force.
c. The softer surface increases the duration of the impact, thereby increasing the effect of the force.
d. The softer surface decreases the duration of the impact, thereby increasing the effect of the force.

46. Can we use the equation $\mathrm{F}_{\mathrm{net}} = \frac{\Delta p}{\Delta t}$ when the mass is constant?

a. No, because the given equation is applicable for the variable mass only.
b. No, because the given equation is not applicable for the constant mass.
c. Yes, and the resultant equation is $\mathrm{F} = m\mathbf{v}$
d. Yes, and the resultant equation is $\mathrm{F} = ma$

8.3 Elastic and Inelastic Collisions

48. A driver sees another car approaching him from behind. He fears it is going to collide with his car. Should he speed up or slow down in order to reduce damage?

a. He should speed up.
b. He should slow down.
c. He should speed up and then slow down just before the collision.
d. He should slow down and then speed up just before the collision.