Vocabulary and Section Summary

SECTION: GRAVITY AND MOTION

1. terminal velocity: the constant velocity of a falling object when the force of air resistance is equal in magnitude and opposite in direction to the force of gravity
2. free fall: the motion of a body when only the force of gravity is acting on the body
3. projectile motion: the curved path that an object follows when thrown, launched, or otherwise projected near the surface of Earth

SECTION: NEWTON'S LAWS OF MOTION

1. inertia: the tendency of an object to resist being moved or, if the object is moving, to resist a change in speed or direction until an outside force acts on the object

SECTION: MOMENTUM

1. momentum: a quantity defined as the product of the mass and velocity of an object

Section Review

SECTION: GRAVITY AND MOTION

1. Sample answers: The sky diver stopped accelerating downward because she reached her terminal velocity. A feather dropped on the moon is in free fall.
2. B
3. Air resistance reduces the acceleration of falling objects and causes them to fall more slowly.
4. Gravity has no effect on the horizontal component of projectile motion. Gravity changes the vertical component of projectile motion by accelerating an object downward.
5. The acceleration due to gravity is the same for all objects. (Note: This is true only near the surface of Earth and when no air resistance acts on the objects.) Also acceptable: The force of gravity causes the acceleration of falling objects.
6. A heavier object experiences a greater gravitational force than a lighter object does. But a heavier object is also harder to accelerate because it has more mass. The greater gravitational force is exactly balanced by the greater mass. So all objects fall with the same acceleration.
7. $3.5 \text{ s} \times 9.8 \text{ m/s}^2 = 34.3 \text{ m/s}$
8. Sample answer: Basketball: a player jumping to dunk the ball, a ball passed between players, a ball shot toward the basket, and a ball bounced on the floor before it hits the floor
9. The feather and the hammer would hit the moon's surface at the same time because there is no air resistance. The feather and the hammer are in free fall.
10. Jon should either aim higher when throwing the newspaper or he should throw the newspaper with a greater horizontal velocity.

SECTION: NEWTON'S LAWS OF MOTION

1. Sample answer: Inertia is the tendency of an object to resist changes in motion.
2. D
3. Accept all reasonable answers. Students should list three examples of force pairs. Partial sample answer: using a pencil or pen (action: hand pushing on pencil; reaction: pencil pushing back on hand OR action: pencil pushing on paper; reaction: paper pushing on pencil).
4. Newton's first law states that objects at rest stay at rest and objects in motion stay in motion unless acted on by an unbalanced force.
5. Newton's second law states that the acceleration of an object increases as the force acting on it increases but the acceleration decreases as the mass of the object increases.
6. $F = 70 \text{ kg} \times 4.2 \text{ m/ s}^2 = 294 \text{ N}$
7. The action and reaction forces do not balance each other because the forces are acting on two different objects. Because they act on two different objects, you cannot combine them to determine a net force.

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8. Sample answer: During a head-on collision, an unbalanced force stops the motion of the car. But no unbalanced force immediately acts on the people inside the car. The people continue to move forward. Airbags are important because they provide unbalanced forces to stop the motion of the people in the car. The airbags prevent the people from hitting the dashboard and windshield of the car.
9. Your hand hit the table with a certain amount of force. According to Newton's third law of motion, the table exerts an equal and opposite force on your hand. The force exerted by the table causes your hand to hurt.

SECTION: MOMENTUM

1. Sample answer: To calculate the momentum of an object, multiply the mass of the object by its velocity.
2. C
3. The law of conservation of momentum states that any time objects collide, the total amount of momentum stays the same. The law of conservation of momentum is true when no other forces act on the objects.
4. Newton's third law can explain the law of conservation of momentum. Because the action and reaction forces are equal and opposite, momentum is neither gained nor lost.
5. p = 2.5 kg x 4.8 m/s south = 12 kg•m/s south
6. No, although the train and the car have the same velocity, the train has more mass than the car, so the train has greater momentum.
7. The softball has momentum as it travels toward your glove. When the ball hits your glove, some of its momentum is transferred to your glove and your hand. As a result, your glove and hand move in the direction that the ball was moving before the catch.

Chapter Review

1. inertia
2. terminal velocity
3. Projectile motion
4. Momentum
5. Free fall
6. B
7. D
8. D
9. B
10. B
11. Accept all reasonable answers. Sample answers: A feather falling inside a vacuum chamber is in free fall. An object dropped on the moon is in free fall.
12. Gravity and air resistance combine to give a net force on a falling object. When gravity and air resistance are the same size but in opposite directions, the object stops accelerating downward and has reached its terminal velocity.
13. Friction is a force that opposes the motion of objects. Friction slows the motion of moving objects so you don't see objects moving forever in a straight line.
14. a. $\Delta\upsilon = g \times t = 9.8\ m/s^2 \times 1.5\ s = 14.7\ m/s$
    b. p=5 m x v 5 12 kg x 14.7 m/s = 176.4 kg•m/s
15. The answer to this exercise can be found at the end of the Teacher Edition.
16. Newton's second law: $a = F/m$. During takeoff, the shuttle burns fuel and therefore loses mass. However, the forward force on the shuttle remains the same. So, the shuttle's acceleration increases because its mass constantly decreases during takeoff.
17. When the hammer hits the nail, the hammer stops. Its momentum is transferred to the nail, driving it into the wood. Momentum is also transferred from the hammer to your hand and from the nail to the wood and to the work bench or table top.

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