Name Date Class

SECTION 1 Reinforcement

Newton's Second Law

Directions: *Use the equation* $F = m \times a$ *to solve the following problems. Show your calculations in the spaces provided.*

1. How much force is needed to accelerate a 1000-kg car at a rate of 3 m/s^2?

2. If a 70-kg swimmer pushes off a pool wall with a force of 250 N, at what rate will the swimmer accelerate from the wall?

3. A weightlifter raises a 200-kg barbell with an acceleration of 3 m/s^2. How much force does the weightlifter use to raise the barbell?

4. A dancer lifts his partner above his head with an acceleration of 2.5 m/s^2. The dancer exerts a force of 200 N. What is the mass of the partner?

Directions: *Answer the following questions on the lines provided.*

5. What does Newton's second law of motion state?

6. What two factors affect the rate of acceleration of an object?

7. What are the three types of friction and when does each apply?

Name Date Class

SECTION 2 Reinforcement

Gravity

Directions: *Answer the following questions on the lines provided.*

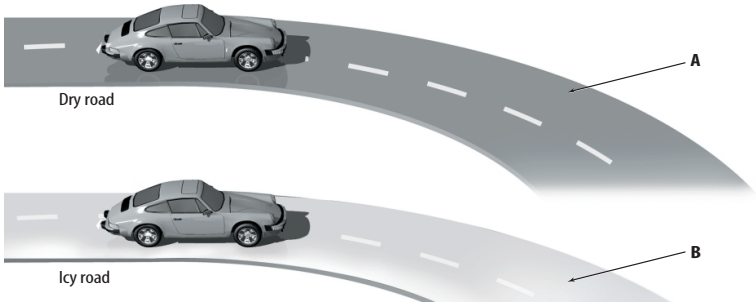
1. What is gravity?

2. What are two things that the amount of gravitational force between two objects depends on?

3. Why does Earth exert a stronger gravitational force than the Moon?

4. If an object weighs 40 N on Earth, would it weigh more than 40 N on the Moon? Explain.

Directions: *Use the diagrams below to complete the following questions.*



5. What is the centripetal force that allows a car to move around a sharp curve in a roadway?

6. Draw an arrow on the bottom diagram to show the movement of the car if the centripetal force of the road and car is not enough to overcome the car's inertia when it reaches point B.

7. Explain how you know the car is accelerating when it reaches point A in the first diagram.

Name Date Class

SECTION 3 Reinforcement

The Third Law of Motion

Directions: *Use the illustrations to answer the following questions.*

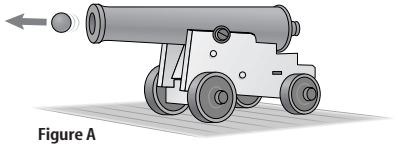


Figure A

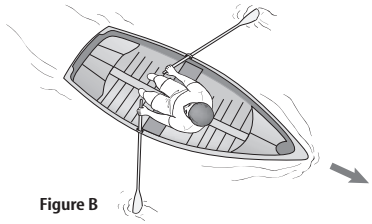


Figure B

1. Draw an arrow on Figure A to show the direction the cannon will move when the cannonball is fired.
2. Draw arrows on Figure B to show the direction the oars must move to propel the boat forward.
3. Does the arrow you drew on Figure A represent an action force or a reaction force?

_____

4. Do the arrows you drew on Figure B represent an action force or a reaction force?

_____

5. If the force that propels the cannonball forward is 500 N, how much force will move the cannon backward? Explain. _____

_____

_____

_____

Directions: *Solve the following problems.*

6. What is the momentum of a 2-kg toy truck that moves at 10 m/s?

_____

7. What is the momentum of a 2000-kg truck that moves at 10 m/s?

_____

8. Which truck has more momentum? Why? _____

_____

_____

_____

Name Date Class

SECTION 1 Enrichment

Friction and the Curve Ball

The curve ball was invented by a young pitcher named Arthur "Candy" Cummings. Although Cummings first threw the curve ball during a game while pitching for the Brooklyn Excelsiors in 1867, he actually invented his technique many years before. As a boy, Cummings loved baseball and practiced his pitching on the beach near his New England home. He threw clam shells instead of a baseball and found that by holding and releasing the shells in a certain way he could make them curve.

Did It Really Curve?

He was given the title "inventor of the curve ball" by the Baseball Hall of Fame. In his historical performance, Cummings snapped his wrist at the exact moment when he released the ball. This caused it to arch and fly past the batter to land in the catcher's mitt. People couldn't believe it. Nobody knew for sure whether the ball really curved or just looked like it did.

More than 100 years later in 1982, the Massachusetts Institute of Technology (MIT) proved once and for all that a baseball thrown like Cummings threw it does, indeed, curve. Why does it curve? It's all about friction.

The snap action of the pitcher's wrist puts a spin on the ball. And that spin changes the friction between the air and the ball. After it's thrown, parts of the ball experience more air friction and parts of the ball experience less. A curved path results from the ball moving toward the least amount of friction.

Specifically, one movement of the pitcher's wrist when the ball is released causes a top spin, making the top of the ball move forward against the air (more friction) and the bottom move in the same direction as the air (less friction). Like any curve ball, the ball curves toward the least amount of friction: downward.

Spin It Sideways

In addition to topspin, a pitcher's wrist can also produce a counter-clockwise spin or a clockwise spin. When a curveball is thrown by a right-handed pitcher the ball spins counter-clockwise. The right side of the baseball experiences less air friction, and the ball curves to the left, or away from a right handed hitter.

When a curveball is thrown by a left-handed pitcher, the ball spins clockwise. The left side of the baseball experiences less air friction, and the ball curves to the right, or away from left-handed batters.

1. What effect might the stitches on a baseball have on the path of a baseball?

_____

_____

2. Do you think a baseball curves better at the top of a high mountain or down on a flat plain? Explain.

_____

_____

3. Describe how the type of spin given to a baseball by a pitcher influences the path of the baseball.

_____

_____

_____