Exercises

7.1 Forces and Interactions (page 107)

1. A force is always part of a(n) _____ that involves another force.
2. Define **interaction.** _____
3. Describe the interaction forces between a nail and a hammer that hits it.

_____

_____

7.2 Newton's Third Law (page 108)

4. State Newton's third law.

_____

_____

5. Is the following sentence true or false? It doesn't matter which force we call *action* and which we call *reaction.* _____
6. Action and reaction forces are equal in _____ and opposite in _____.
7. Is the following sentence true or false? In every interaction, the forces always occur in pairs. _____
8. Complete the table by writing the reaction for each action.

Action	Reaction
When you walk, you push against the floor.	
The tires of a car push against the road.	
When swimming, you push the water backward.	
A dog wags its tail.	
You push on a wall.	
When a batter swings, the bat exerts a force on the ball.	

9. Use the idea of action and reaction forces to explain why a person trying to walk on ice may not have any forward motion.

_____

_____

_____

7.3 Identifying Action and Reaction (pages 108–109)

10. What are the two steps you can take to identify a pair of action-reaction forces?

a. _____

b. _____

11. Identify the action–reaction forces of a boulder falling off a cliff by answering the following questions.

a. What are the two interacting objects? _____

b. What is the action of A on B? _____

c. What is the action of B on A? _____

12. Complete the table by identifying the reaction forces. In each case, specify the direction of the reaction force.

Action	Reaction
As a car moves along a road, the tires of the car push backward against the road.	
As a spaceship moves through space, it pushes gas out behind.	
A ball rolls across a table and exerts a force against a second ball.	

7.4 Action and Reaction on Different Masses (pages 110–111)

13. Is the following sentence true or false? If you drop a pencil, the pencil pulls Earth upward with a much smaller force than that with which Earth pulls the pencil downward. _____

14. State Newton's second law.

_____

_____

15. When a boulder falls off a cliff toward the ground, Earth accelerates toward the boulder. Circle the letter that explains why we don't sense this acceleration.

a. The boulder's pull on Earth is much smaller than Earth's pull on the boulder.

b. Earth's huge mass causes its acceleration to be infinitesimally small.

c. Earth's acceleration is in the same direction as the boulder's acceleration.

d. The boulder's acceleration is much smaller than the Earth's acceleration.

16. When a cannonball is fired from a cannon, the force the cannon exerts on the cannonball is exactly _____ and _____ to the force the cannonball exerts on the cannon.

17. Name the three factors that you must consider in order to understand why a cannonball moves much faster than the cannon when the cannonball is shot from the cannon.

_____

18. The picture above shows a cannonball being shot from a cannon. Explain why the change in velocity of the cannonball is much greater than the change in velocity of the cannon.

_____

_____

_____

19. How is the acceleration of a rocket similar to the acceleration of a cannonball that is fired from a cannon?

_____

_____

_____

_____

20. Is the following sentence true or false? A rocket is propelled by the impact of exhaust gases against the atmosphere. _____

21. The upward force that causes helicopters, birds, and airplanes to fly is called _____.

22. A helicopter has a lifting force because its blades are shaped to force air particles _____, and the air forces the blades _____.

Match each condition on the left to the result on the right.

Condition	Result
_____ **23.** Lift equals the helicopter's weight.	a. The helicopter moves downward.
_____ **24.** Lift is greater than the helicopter's weight.	b. The helicopter moves upward.
_____ **25.** Lift is less than the helicopter's weight.	c. The helicopter hovers in midair.

26. Describe the action and reaction forces that cause a bird to fly.

_____

_____

27. Describe two action–reaction pairs that cause an airplane to move upward and forward.

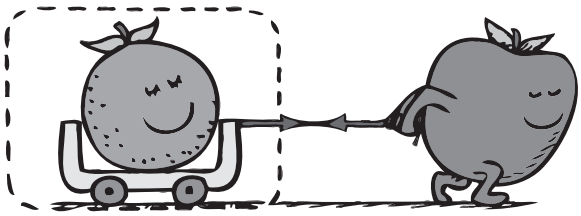
a. _____

b. _____

7.5 Defining Systems (pages 112–113)

28. In order to understand why action and reaction forces don't cancel to zero, you must consider the _____ involved.

For questions 29 and 30, refer to the figure below.



29. The figure shows a force exerted by an apple. The dashed line identifies the system that accelerates because of this force. Explain why the force that the orange exerts on the apple doesn't cancel the force that the apple exerts on the orange.

_____

_____

30. Suppose the system includes both the orange and the apple. Explain why the force of the orange on the apple cancels the force of the apple on the orange.

_____

_____

31. Is the following sentence true or false? The trillions and trillions of interatomic forces that hold a baseball together do play a role in accelerating the ball. _____

32. Is the following sentence true or false? If the action–reaction forces are internal to a system, then the forces cancel and the system does not accelerate. _____

33. When a football player kicks a ball, the player's foot exerts a force on the ball, and the ball exerts a force on the player's foot. Why does the ball accelerate, even though the forces are equal and opposite?

_____

7.6 The Horse–Cart Problem (pages 114–115)

34. Describe the horse–cart problem.

_____

_____

_____

35. Name the three points of view from which you can consider the horse–cart problem.

a. _____

b. _____

c. _____

36. The farmer is only concerned with the force that is exerted on the _____.

37. According to the farmer, the _____ on the cart, divided by the _____ of the cart, will produce a(n) _____.

38. The horse believes that the reaction force by the _____ on the horse restrains the horse.

39. From the horse's point of view, the horse moves forward by interacting with _____.

40. If the horse in the horse–cart system pushes the ground with a greater force than it pulls on the cart, then _____, and the horse–cart system accelerates.

41. Consider the horse–cart system as a whole.

a. Which action–reaction pair contributes nothing to the acceleration of the system?

_____

b. Which interaction is responsible for moving the system?

_____

7.7 Action Equals Reaction (page 116)

42. Is the following sentence true or false? You cannot hit a wall any harder than the wall can hit you back. _____

43. Explain why it is impossible to strike a sheet of paper that is held in midair with a force of 200 N.

_____

_____

44. For every interaction between things, there is always a pair of oppositely directed forces that are _____.