Chapter Assessment

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Ch-6 - Newton's 3rd Law

Concept Summary

Action - Reaction

An interaction between two things produces a pair of forces.

- Interacting things exert forces on each other.
- The two interacting forces are called the action force and the reaction force.
- Action and reaction forces are equal in strength and opposite in direction.

Key Terms

action force (6.2)
interaction (6.1)
Newton's third law (6.2)
reaction force (6.2)

Review Questions *Check Concepts*

1. In the interaction between a hammer and the nail it hits, is a force exerted on the nail? On the hammer? How many forces occur in this interaction? (6.1)
2. When a hammer exerts a force on a nail, how does the amount of force compare with that of the nail on the hammer? (6.1)
3. When you walk along a floor, what pushes you along? (6.2)
4. When swimming, you push the water backward—call this *action*. What is the reaction force? (6.2)
5. If the action is a bowstring acting on an arrow, identify the reaction force. (6.3)
6. When you jump up, the world really does recoil downward. Why can't this motion of the world be noticed? (6.4)
7. When a cannon is fired, how does the size of the force of the cannon on the cannonball compare with the force of the cannonball on the cannon? How does the acceleration of the cannon compare with that of the cannonball? Defend your answer. (6.4)
8. How can a rocket be propelled above the atmosphere where there is no air to "push against"? (6.4)

Questions 9–11 refer to the apple–orange system in Figure 6.10. Consider only horizontal forces.

9. In the interaction between an apple and an orange, how many forces are exerted on the apple? On the orange? Are these forces equal in strength? Are these forces opposite in direction? (6.5)
10. Consider the orange system. Do action and reaction forces cancel each other in the orange system? Does the orange system accelerate? (6.5)
11. Consider the orange–apple system. Do action and reaction forces cancel each other in this system? Do the orange and apple accelerate away from each other, or do they remain together? (6.5)

Questions 12–15 refer to the horse–cart system in Figure 6.13. Consider only horizontal forces.

12. **a.** In the horizontal direction, how many forces are exerted on the cart?

    b. What is the net horizontal force on the cart? (6.6)

13. **a.** How many horizontal forces are exerted on the horse?

    b. What is the net horizontal force on the horse?

    c. How many horizontal forces are exerted by the horse on other objects? (6.6)

14. **a.** How many horizontal forces are exerted on the horse–cart system?

    b. What is the net horizontal force on the horse–cart system? (6.6)

15. In order to increase its speed, why must the horse push harder against the ground than it pulls on the wagon? (6.6)

16. If you hit a wall with a force of 200 N, how much force is exerted on you? (6.7)

17. Why can't you hit a feather in midair with a force of 200 N? (6.7)

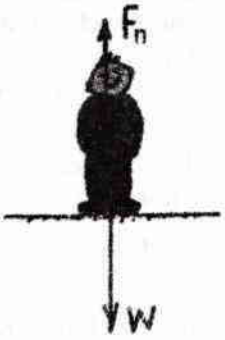
18. How does the saying "You get what you give" relate to Newton's third law? (6.7)

Think and Explain *Think Critically*

19. Your weight is the result of the gravitational force of Earth on your body. What is the corresponding reaction force?

20. Why can you exert greater force on the pedals of a bicycle if you pull up on the handlebars?

21. Consider the two forces acting on a person who stands still, namely, the downward pull of gravity and the upward support of the floor. Are these forces equal and opposite? Do they comprise an action–reaction pair? Why or why not?

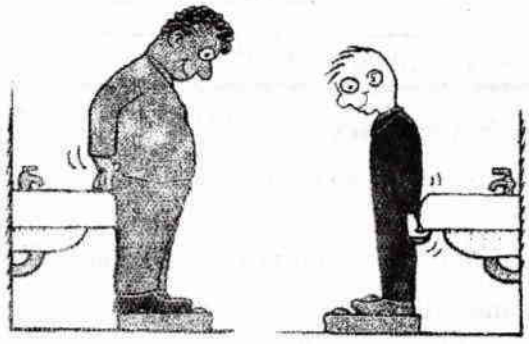


22. If you walk on a log that is floating in the water, the log moves backward. Why?

23. Why is it easier to walk on a carpeted floor than on a smooth, polished floor?

24. If you step off a ledge, you accelerate noticeably toward Earth because of the gravitational interaction between you and Earth. Does Earth accelerate toward you as well? Explain.

25. Suppose you're weighing yourself while standing next to the bathroom sink. Using the idea of action and reaction, explain why the scale reading will be less when you push down on the top of the sink. Why will the scale reading be more if you pull up on the bottom of the sink?



26. When a high jumper leaves the ground, what is the source of the upward force that accelerates her? What force acts after her feet are no longer in contact with the ground?

27. What is the reaction force to an action force of 1000 N exerted by Earth on an orbiting communications satellite?

28. If action equals reaction, why isn't Earth pulled into orbit around a communications satellite?

29. If a bicycle and a massive truck have a head-on collision, upon which vehicle is the impact force greater? Which vehicle undergoes the greater change in its motion? Defend your answers.

30. A speeding bus makes contact with a bug the splatters onto the windshield. Because of the sudden force, the unfortunate bug undergoes a sudden deceleration. Is the corresponding force that the bug exerts against the windshield greater, less, or the same? Is the resulting deceleration of the bus greater than, less than, or the same as that of bug?

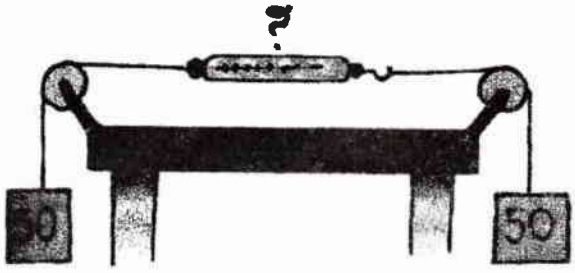
31. Some people used to think that a rocket could not travel to the moon because it would have no air to push against once it left Earth's atmosphere. We now know that idea was mistaken. What force propels a rocket when it is in a vacuum?

32. Since the force that acts on a cannonball when a cannon is fired is equal and opposite to the force that acts on the cannon, does this imply a zero net force and therefore the impossibility of an accelerating cannonball? Explain.

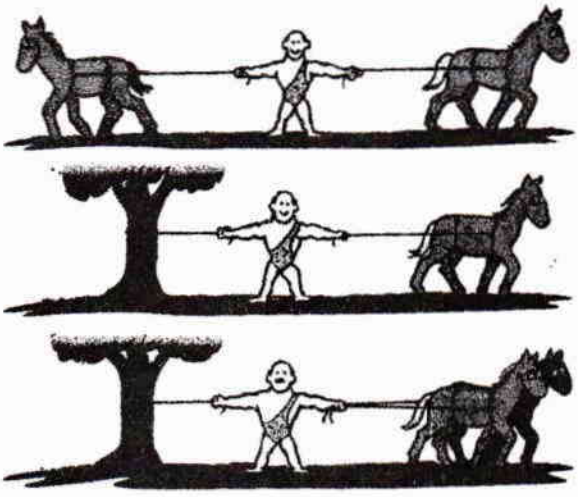
33. Suppose you exert 200 N on your refrigerator and push it across the kitchen floor at constant velocity. What friction force acts between the refrigerator and the floor? Is the friction force equal and opposite to your 200-N push? Does the friction force make up the reaction force to your push?

34. Your teacher challenges you and your best friend to each pull on a pair of scales attached to the ends of a horizontal rope, in tug-of-war fashion, so that the readings on the scales will differ. Can this be done? Explain.

35. A pair of 50-N weights are attached to a spring scale as shown. Does the spring scale read 0, 50, or 100 N? *(Hint:* Would it read any differently if one of the strings were held by your hand instead of being attached to the 50-N weight?)



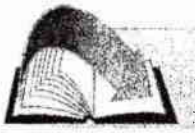
36. The strong man can withstand the tension force exerted by the two horses pulling in opposite directions. How would the tension compare if only one horse pulled and the left rope were tied to a tree? How would the tension compare if the two horses pulled in the same direction, with the left rope tied to the tree?



37. A balloon floats motionless in the air. A balloonist begins climbing up the supporting cable. In which direction does the balloon move as the balloonist climbs? Explain.

38. When you get up from a sitting position, do your feet push against the floor with a force equal to, more than, or less than your weight? Explain.

39. When a weightlifter jerks a barbell over his head, is the force exerted on the barbell more than, less than, or equal to the barbell's weight? Explain.



More Problem-Solving Practice
Appendix F