

## Chapter 12 Rotational Motion

**Exercises****12.1 Rotational Inertia (pages 213–215)**

1. Is the following sentence true or false? Newton's first law does not apply to rotating objects. \_\_\_\_\_
2. Is the following sentence true or false? According to the law of inertia, rotating objects tend to keep rotating. \_\_\_\_\_
3. A \_\_\_\_\_ is required to change the rotational state of motion of an object.
4. Circle the letter of each statement that is true of rotational inertia.
  - a. Rotational inertia depends on the force of gravity.
  - b. Rotational inertia depends on the mass of an object.
  - c. Rotational inertia depends on the distribution of mass in the object.
  - d. Rotational inertia is always constant.
5. Is the following sentence true or false? As the distance between an object's mass concentration and its axis of rotation increases, its rotational inertia increases. \_\_\_\_\_
6. Explain why a tightrope walker might hold a long pole in the horizontal position while performing.  
\_\_\_\_\_  
\_\_\_\_\_
7. Circle the letter of the sequence that correctly ranks, from lowest to highest, the rotational inertia of the following: (A) a baseball bat held at its narrow end; (B) a baseball bat held at its more massive end; (C) a meter stick held at its midpoint.
 

a. C, B, A	b. B, C, A
c. C, A, B	d. A, B, C
8. A \_\_\_\_\_ pendulum swings back and forth more rapidly than a \_\_\_\_\_ pendulum because the \_\_\_\_\_ pendulum's rotational inertia is smaller.
9. Is the following sentence true or false? The rotational inertia of an object is constant and cannot change. \_\_\_\_\_
10. What happens to the rotational inertia of an object if its mass is extended farther away from the axis of rotation?  
\_\_\_\_\_  
\_\_\_\_\_
11. Circle the letter of the equation that is used to determine the rotational inertia,  $I$ , of a solid sphere spinning about its axis of rotation.
 

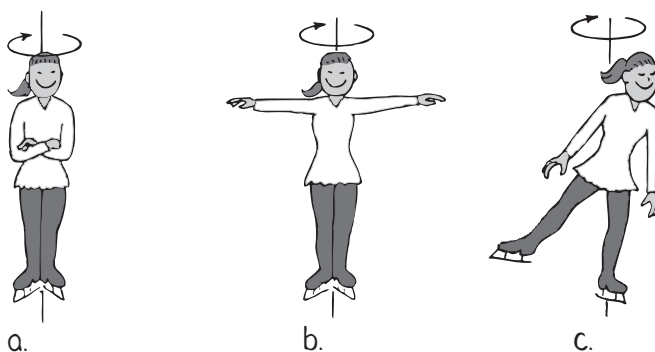
a. $I = (1/12)mL^2$	b. $I = mr^2$
c. $I = (2/5)mr^2$	d. $I = (1/3)mL^2$

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**12.2 Rotational Inertia and Gymnastics (pages 216–217)**

12. The major axes of rotation of the human body are the \_\_\_\_\_ axis, the \_\_\_\_\_ axis, and the \_\_\_\_\_ axis.
13. Is the following sentence true or false? The three major axes of rotation of the human body are at right angles to one another and pass through the center of gravity. \_\_\_\_\_
14. Circle the letter of each statement that is true.
- The human body’s longitudinal axis runs from head to toe.
  - The human body’s longitudinal axis passes through the center of gravity.
  - Much of the body’s mass is concentrated along the longitudinal axis.
  - The human body’s longitudinal axis has the least rotational inertia of the three body axes.

Use the figure of a skater in various poses to answer questions 15 and 16.



15. The figure skater has the least amount of rotational inertia in position \_\_\_\_\_.
16. Circle the letter of the position that most easily allows the figure skater to spin with a high rate of rotation.
- a
  - b
  - c
  - d
17. During a somersault, a person rotates about her \_\_\_\_\_ axis.
18. Is the following sentence true or false? It is easier to spin when your body is in a tucked position than when it is outstretched. \_\_\_\_\_
19. When a gymnast goes from an outstretched position into a tuck, her rate of rotation \_\_\_\_\_.
20. Is the following sentence true or false? When doing a cartwheel, a person rotates about his or her transverse axis. \_\_\_\_\_

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### 12.3 Rotational Inertia and Rolling (page 218)

21. Is the following sentence true or false? An object with a great rotational inertia will roll down an incline more quickly than one with a small rotational inertia. \_\_\_\_\_
22. Inertia can be thought of as a measure of \_\_\_\_\_.
23. Is the following sentence true or false? Any hollow cylinder will roll down an incline with more acceleration than any solid cylinder.  
\_\_\_\_\_
24. Two solid disks with the same shape but different sizes are rolled down an incline. Which disk reaches the bottom first? Explain.  
\_\_\_\_\_  
\_\_\_\_\_

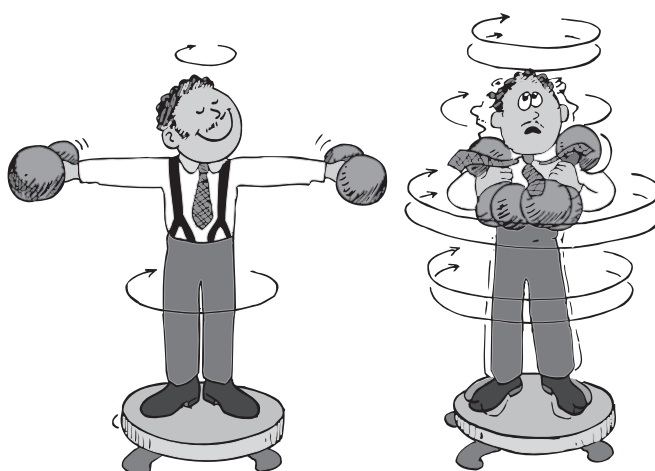
### 12.4 Angular Momentum (pages 219–220)

25. Is the following sentence true or false? Any moving object has momentum. \_\_\_\_\_
26. In equation form, angular momentum is written as  
\_\_\_\_\_
27. Angular momentum is a \_\_\_\_\_ quantity.
28. Is the following sentence true or false? When rotational speed is assigned a direction, it is known as rotational velocity. \_\_\_\_\_
29. Circle the letter of each true statement.
- a. Rotational velocity is a vector quantity.
  - b. Rotational velocity has the same direction as angular momentum.
  - c. Rotational velocity lies along the axis of rotation of an object.
  - d. An object's rotational velocity is equal in magnitude to its angular momentum.
30. Is the following sentence true or false? The angular momentum of a small object rotating at a very large radial distance is equal to its linear momentum. \_\_\_\_\_
31. What happens to a rotating object that is not acted on by an external torque?  
\_\_\_\_\_  
\_\_\_\_\_
32. Explain how angular momentum makes a moving bicycle easier to balance than a bicycle at rest.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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**12.5 Conservation of Angular Momentum (pages 221–222)**

33. Does the angular momentum of a rotating system change when no unbalanced external torques act on it?  
\_\_\_\_\_
34. Is the following sentence true or false? The angular momentum of a rotating system is conserved if no external torque acts on it.  
\_\_\_\_\_
35. The illustration below shows a man spinning on a low-friction turntable. Explain what is happening in the two sketches. Be sure to explain how angular momentum and the quantities  $I$  and  $\omega$  are involved.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



36. Is the following sentence true or false? A cat dropped upside down will twist and land on its feet while maintaining a state of zero angular momentum. \_\_\_\_\_

**12.6 Simulated Gravity (pages 223–225)**

37. Is the following sentence true or false? Objects in a rotating reference frame seem to experience an outwardly directed centrifugal force.  
\_\_\_\_\_
38. Circle the letter of the phrase that describes the “up” direction sensed by a person in a large rotating space.
- a. radially outward
  - b. tangent to the direction of rotation
  - c. toward the center of rotation
  - d. parallel to the direction of rotation