5. If a force $\vec{\mathbf{F}}$ acts on an object such that its lever arm is zero, does it have any effect on the object's motion? Explain.
6. Why is it more difficult to do a sit-up with your hands behind your head than when your arms are stretched out in front of you? A diagram may help you to answer this.
7. A 21-speed bicycle has seven sprockets at the rear wheel and three at the pedal cranks. In which gear is it harder to pedal, a small rear sprocket or a large rear sprocket? Why? In which gear is it harder to pedal, a small front sprocket or a large front sprocket? Why?
8. Mammals that depend on being able to run fast have slender lower legs with flesh and muscle concentrated high, close to the body (Fig. 8–34). On the basis of rotational dynamics, explain why this distribution of mass is advantageous.

FIGURE 8–34 Question 8. A gazelle.

FIGURE 8–35 Question 9.

9. Why do tightrope walkers (Fig. 8–35) carry a long, narrow beam?
10. If the net force on a system is zero, is the net torque also zero? If the net torque on a system is zero, is the net force zero?
11. Two inclines have the same height but make different angles with the horizontal. The same steel ball is rolled down each incline. On which incline will the speed of the ball at the bottom be greater? Explain.
12. Two solid spheres simultaneously start rolling (from rest) down an incline. One sphere has twice the radius and twice the mass of the other. Which reaches the bottom of the incline first? Which has the greater speed there? Which has the greater total kinetic energy at the bottom?
13. A sphere and a cylinder have the same radius and the same mass. They start from rest at the top of an incline. Which reaches the bottom first? Which has the greater speed at the bottom? Which has the greater total kinetic energy at the bottom? Which has the greater rotational KE?
14. We claim that momentum and angular momentum are conserved. Yet most moving or rotating objects eventually slow down and stop. Explain.
15. If there were a great migration of people toward the Earth's equator, how would this affect the length of the day?
16. Can the diver of Fig. 8–29 do a somersault without having any initial rotation when she leaves the board?
17. The moment of inertia of a rotating solid disk about an axis through its center of mass is $\frac{1}{2}MR^2$ (Fig. 8–21c). Suppose instead that the axis of rotation passes through a point on the edge of the disk. Will the moment of inertia be the same, larger, or smaller?
18. Suppose you are sitting on a rotating stool holding a 2-kg mass in each outstretched hand. If you suddenly drop the masses, will your angular velocity increase, decrease, or stay the same? Explain.
19. Two spheres look identical and have the same mass. However, one is hollow and the other is solid. Describe an experiment to determine which is which.

* 20. In what direction is the Earth's angular velocity vector as it rotates daily about its axis?

* 21. The angular velocity of a wheel rotating on a horizontal axle points west. In what direction is the linear velocity of a point on the top of the wheel? If the angular acceleration points east, describe the tangential linear acceleration of this point at the top of the wheel. Is the angular speed increasing or decreasing?

* 22. Suppose you are standing on the edge of a large freely rotating turntable. What happens if you walk toward the center?

* 23. A shortstop may leap into the air to catch a ball and throw it quickly. As he throws the ball, the upper part of his body rotates. If you look quickly you will notice that his hips and legs rotate in the opposite direction (Fig. 8–36). Explain.

FIGURE 8–36 Question 23. A shortstop in the air, throwing the ball.

* 24. On the basis of the law of conservation of angular momentum, discuss why a helicopter must have more than one rotor (or propeller). Discuss one or more ways the second propeller can operate to keep the helicopter stable.