Chapter 8
Exercises

6. According to $v = r\omega$, if the radius r is larger, the speed is larger. Since the arm and the swatter rotate together, ω is the same for both. So the swatter, with its longer radius, moves faster.

16. Lighter tires have less rotational inertia and therefore are easier to get moving.

26. The long drooping pole lowers the CG of the balanced system – the tightrope walker and the pole. The rotational inertia of the pole contributes to the stability of the system also.

36. The CG of Truck 1 is not above its support base; the CGs of Trucks 2 and 3 are above their support bases. Therefore, only Truck 1 will tip.

59. If POLAR ice melts, the mass moves further from the axis of rotation. (Note that this would not be true for melting ice in general.) In accord with the conservation of angular momentum, if mass moves farther from the axis of rotation, rotational speed decreases. So the Earth would slow in its daily rotation.

59. Gravitational force acting on every particle by every other particle causes the cloud to condense. The decreased radius of the cloud is then accompanied by an increased angular speed because of angular momentum conservation. The increased speed results in many stars being thrown out into a dish-like shape.

Problems

1. Since the bicycle moves 2 m with each turn of the wheel, and the wheel turns once each second, the linear speed of the bicycle is **2 m/s**.

3. The center of mass of the two weights is where a fulcrum would balance both – where the torques about the fulcrum would balance to zero. Call the distance (lever arm) from the 1-kg weight to the fulcrum x. Then the distance (lever arm) from the fulcrum to the 3-kg weight is (100 — x). Equating torques:

$1x = (100 - x)3$

$x = 300 - 3x$

x = 75. So the center of mass of the system is just below the **75-cm** mark. Then the three-times-as-massive weight is one-third as far from the fulcrum.

5. The mass of the stick is 1 kg. Here is how to reason it out. The left half of the stick is balanced by itself, given the fulcrum position. The right half of the stick has to balance the rock. The center of mass of the right half of the stick is twice as far from the fulcrum as the rock is, so it needs to have half the mass of the rock to balance the rock. If half the stick has half the mass of the rock, the whole stick has the mass of the rock: **1 kg.**

9. The artist will rotate **3 times per second**. By the conservation of angular momentum, the artist will increase rotation rate by 3. That is

$I\omega$ before = $I\omega$ after

$I\omega$ before = $[(I/3)(3\omega)]$ after