1) [12pts] A high-school pitcher is employing a ballistic pendulum to determine the speed of his fastball. A 3.3-kg lump of clay is suspended from a cord 2.0-m long. When the pitcher throws his fastball aimed at the clay, the ball becomes embedded in the clay and the two swing up to a maximum height of 0.11 m. If the mass of the baseball is 0.21 kg, find the speed of the pitch.

2) [12pts] A force of 5.3 N is needed to hold on to an umbrella in a strong wind. If the air molecules each have a mass of $4.7 \times 10^{-26}$ kg, and each strikes the umbrella (without rebounding) with a speed of 2.0 m/s in the same direction, how many atoms strike the umbrella each second? Assume that the wind blows horizontally so that the gravity can be neglected.
3) [12pts] A bicycle wheel has an initial angular velocity of 7.9 rad/s. After turning through one-half of a revolution, the angular velocity is reduced to 1.6 rad/s. If the angular acceleration of the wheel is constant during the motion, how long will it take the wheel to make the one-half revolution?

![Figure 9.6](image)

4) [14pts] In Fig. 9.6, a weightlifter's barbell consists of two identical spherical masses each with radius 0.17 m and mass of 50 kg. The weights are connected by a 0.96-m steel rod with mass of 12 kg. Find the moment of inertia of the barbell through the axis at the center.
5) [14pts] A bicycle wheel is rotating with an angular velocity of 3.1 rev/s. If the coefficient of kinetic friction between the wheel and the brakes is 0.87, find the number of revolutions the wheel makes in coming to rest. The moment of inertia of the wheel is 0.24 kg \cdot m and its radius is 0.32 m.

6) [12pts] A uniform hollow spherical ball of mass 1.75 kg and radius 40.0 cm rolls without slipping up a ramp that rises at 30.0° above the horizontal. The speed of the ball at the base of the ramp is 2.63 m/s. While the ball is moving up the ramp, find the acceleration (magnitude and direction) of its center of mass and the friction force (magnitude and direction) acting on it due to the surface of the ramp.
7) [12pts] A 5.00- m beam is suspended horizontally about its ends by two very light cables $A$ and $B$ as shown in Fig. 11.10. The angles these cables make with the horizontal ceiling are shown, and the tension in cable $A$ is measured to be 875 N. Find: (a) the tension in cable $B$, (b) the weight of the beam, and (c) the location of the center of gravity of the beam.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) [12pts] At a given point above the surface of the earth, the gravitational acceleration is equal to 6.4 m/s². The altitude of this point, above the surface of the earth, in km, is closest to:
   A) 1900  B) 2800  C) 1500  D) 3900  E) 4700