Chapter 6: Torques and Center of Mass

1. The Achilles tendon inserts on the calcaneus at a distance of 8 cm from the axis of the ankle joint. If the force generated by the muscles attached to the Achilles tendon is 3000 N and the moment arm of this force about the ankle joint axis is 5 cm, what torque is created by these muscles about the ankle joint?

2. An athlete is doing a knee extension exercise using a 100-N dumbbell strapped to her ankle 40 cm from her knee joint. She holds her leg so that the horizontal distance from her knee joint to the dumbbell is 30 cm.
   
   a. For this position, what torque is created by the dumbbell about the axis through her knee joint?
   
   b. If the moment arm of the knee extensor muscles is 4 cm about the knee joint axis, what amount of force must these muscles produce to hold the leg in the position described? Ignore the weight of the leg.

3. What can a hurdler do to minimize the amount of vertical effort in clearing a hurdle?

4. A hurdler’s knee is 0.97 m above ground level. The ankle is 0.91 m above ground level. What is the height of the center of mass of the shank (lower leg)? The length percent for the shank is 47.5%.

5. What could a gymnast do to increase her stability when she is landing on the balance beam from a flip.