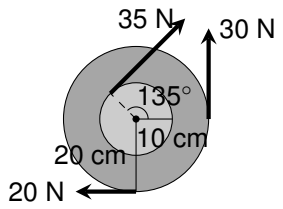
Physics 122 - Torque and Static Equilibrium

1. Can a small force exert a greater torque than a larger force? Explain.
2. 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?
3. A person exerts a force of 45 N on the end of a door 84 cm wide. What is the magnitude of the torque if the force is exerted
   (a) perpendicular to the door? (38 N·m)
   (b) at a 60° angle to the face of the door? (33 N·m)
4. Text book p. 495 # 29, 30.
5. What is the maximum torque exerted by a 55 kg person riding a bike if the rider puts all her weight on each pedal when climbing a hill? The pedals rotate in a circle of radius 17 cm. (92 N·m)
6. Calculate the net torque about the axle of the wheel shown below. Assume that a friction torque of 0.40 m·N opposes the motion. (1.1 N·m clockwise)



7. What are the two conditions for static equilibrium? Why are both conditions necessary?
8. Explain, using the concept of torques and center of mass, why it is easier to balance a sharp new wooden pencil on its eraser than on its point.
9. A child of mass 30 kg is seated 2.0 m from the pivot point on a seesaw. Where would a child of mass 35 kg need to sit in order to balance the seesaw? (1.7 m)
10. Two children of mass 20 kg and 30 kg sit balanced on a seesaw with the pivot point located at the center of the seesaw. If the children are separated by a distance of 3 m, at what distance from the pivot point is the small child sitting in order to maintain the balance? (1.8 m)
11. Text p. 501 # 31-34
12. To get up on the roof, a person (mass 70.0 kg) places a 6.00 m aluminum ladder (mass 10.0 kg) against the house on a concrete pad with the base of the ladder 2.00 m from the house. The ladder rests against a plastic rain gutter, which we can assume to be frictionless. The center of mass of the ladder is 2 m from the bottom. The person is standing 3 m from the bottom. What are the magnitudes of the forces on the ladder at the top and bottom?