24-261 Statics October 30, 2001
Problem Set #10 Due: November 6, 2001

1. Problem 3.2-3 (Gere, Mechanics of Materials)

2. Problem 3.3-4 (Gere, Mechanics of Materials)

3. Problem 3.4-3 (Gere, Mechanics of Materials)

4. Problem 3.4-4 (Gere, Mechanics of Materials)

5. This problem deals with the wing corkscrew shown in
http://www.andrew.cmu.edu/course/24-261/images/corkscrew.html

The following describes how a wing corkscrew works:

The wing corkscrew consists essentially of four separate bodies: two arms, the screw, which is attached to a shaft that has regular indentations, which is attached in turn to the handle at the top, and the main body. The arms can pivot about two points on the main body, and the shaft carrying the screw translates vertically in the main body. Near the two pivot points, the arms have gear-like teeth. These teeth engage the indentations on the main shaft. Together the main shaft and the arms act like a rack and pinion (two pinions).

To get set up, the corkscrew is screwed into the cork with the handle at the top. As the screw is turned, the lower edge of the main body of the corkscrew is drawn towards and gets pressed against the upper surface of the bottle. Once the lower edge of the main body presses against the bottle, turning of the handle causes the screw to go deeper into the cork and, because the screw is advancing relative to the main body, the arms to pivot upward. Once the arms point nearly upward, the screw has been embedded in the cork to its the maximum depth.

To remove the cork, the bottle is set on a table, and the arms are pressed near their ends so as to pivot. Because of the engagement between the gear teeth and the indentations on the shaft (the rack), the pivoting of the arms causes the center shaft to be drawn upward relative to the main body pulling the cork from the bottle. This results in a large force acting to extract the cork.

Problem Statement Consider the configuration shown in the image. Say that a 5lb force acting downward is applied to the far ends of each of the arms (10 lb altogether). The bottle is standing up on the table. Break up the corkscrew as appropriate, and draw the free body diagrams. Make clear the dimensions you extracted from the image.

Determine the force of the main body of the corkscrew on the upper rim of the bottle and the force of the screw on the cork. A drawing should make clear both the magnitudes and directions for these forces.