Reading: Chapter 5

Problems:

1. Goldstein, Problem 5-14.

2. A spool rests on a rough table as shown. A thread wound on the spool is pulled with force T at angle θ. (a) If $\theta = 0$, will the spool move to the left or right? (b) Show that there is an angle θ for which the spool remains at rest. (c) At this critical angle find the maximum T for equilibrium to be maintained. Assume a coefficient of friction μ.
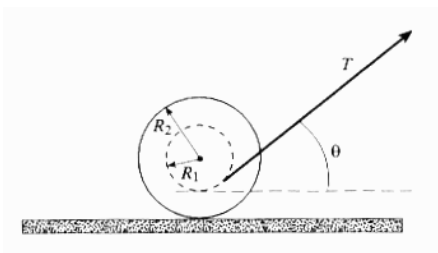
3. Goldstein 5-24.

4. A heavy axially symmetric gyroscope is supported at a pivot, as shown. The mass of the gyroscope is M, and the moment of inertia about its symmetry axis is I. The initial angular velocity about its symmetry axis is ω. Give a suitable approximate equation of motion for the system, assuming that ω is very large. Find the angular frequency of the gyroscopic precession. Show that the above approximation is justified for $\omega \gg \sqrt{g/\ell}$, where all moments of inertia are taken to be roughly $M\ell^2$.
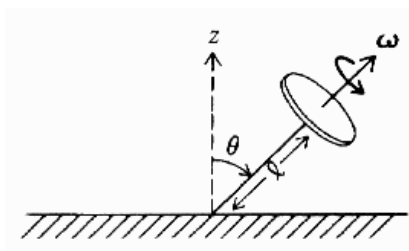
5. A flat rectangular plate of mass M and sides a and $2a$ rotates with angular velocity ω about an axle through two diagonal corners, as shown. The bearings supporting the plate are mounted just at the corners. Find the force on each bearing due to rotation.