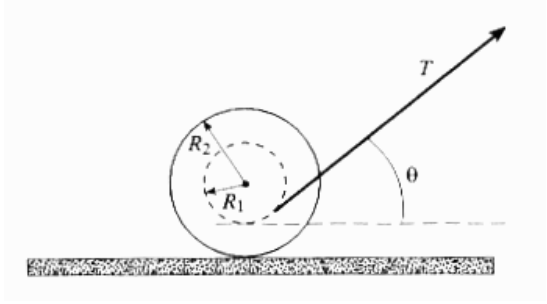


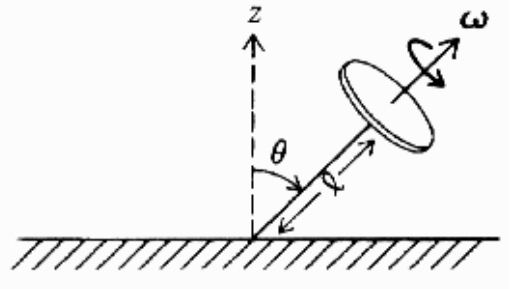
PHY820 Homework Set 10

1. [5 pts] Goldstein, Problem 5-14.
2. [10 pts] Goldstein, Problem 5-16.
3. [10 pts] Goldstein, Problem 5-17. Note that there are two rotations here at play for the cone. The angular velocities add up as vectors.

4. [5 pts] 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 .



5. [5 pts] 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 . Follow an approximate solution of the equation of motion for the system, under the assumption that ω is very large and obtain the angular frequency Ω of gyroscopic precession. Show that the approximation requires that $\omega \gg \sqrt{g/l}$, when l takes the role of an overall size scale with all moments of inertia taken to be roughly $M l^2$.



6. [5 pts] 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. Follow Euler's equations and find the force on each bearing due to rotation. Only two principal moments of inertia are relevant.

