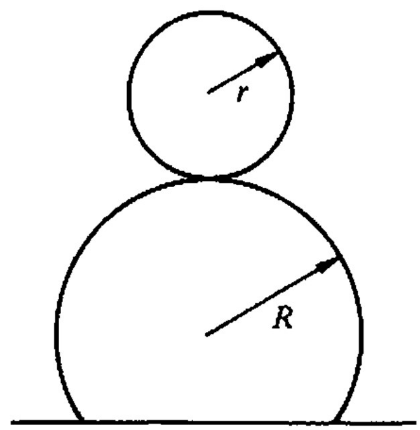
(Due Friday, Oct. 9)

Problems

Solve the following problems from Goldstein, 3rd Ed.

- (2.14) A uniform hoop of mass m and radius r rolls without slipping on a fixed cylinder of radius R as shown in the figure. The only external force is that of gravity.
    - If the smaller cylinder starts rolling from rest on top of the bigger cylinder, use the method of Lagrange multipliers to find the point at which the hoop falls off the cylinder.



- (2.18) A point mass is constrained to move on a massless hoop of radius a fixed in a vertical plane that rotates about its vertical symmetry axis with constant angular speed ω.
    - Obtain the Lagrange equations of motion assuming the only external forces arise from gravity.
    - What are the constants of motion?
    - Show that if ω is greater than a critical value ω_0, there can be a solution in which the particle remains stationary on the hoop at a point other than at the bottom, but that if $\omega < \omega_0$, the only stationary point for the particle is at the bottom of the hoop.
    - What is the value of ω_0 ?
- (2.20) A particle of mass m slides without friction on a wedge of angle α and mass M that can move without friction on a smooth horizontal surface, as shown in the figure. Treating the constraint of the particle on the wedge by the method of Lagrange multipliers;
    - Find the equations of motion for the particle and wedge.
    - Obtain an expression for the forces of constraint.
    - Calculate the work done in time t by the forces of constraint acting on the particle and on the wedge.
    - What are the constants of motion for the system?

- ○ Contrast the results you have found with the situation when the wedge is fixed. [*Suggestion:* For the particle you may either use a Cartesian coordinate system with y vertical, or one with y normal to the wedge.]