1. a) Calculate the moments of inertia $I_1$, $I_2$ and $I_3$ for a homogenous cone of mass $M$, with height $h$ and base with diameter $D$. The $z$ axis is the axis of symmetry for the cone, with the apex of the cone at the origin.

(b) Now calculate the moments for the origin at the center of mass of the cone.

2. Consider a thin rod of length $L$ and mass $m$ pivoted about one end. Calculate the moment of inertia. Find the point at which, if all the mass were concentrated there, the moment of inertia about the pivot point would be the same. This point is called the radius of gyration.

3. Find the height at which a billiard ball of radius $R$ should be struck in order that it roll without slipping.

4. A homogeneous disk of radius $R$ and mass $M$ rolls without slipping on a horizontal surface, and is attracted to a point a distance $d$ below the plane. If the force of attraction is proportional to the distance from the disk’s center of mass to the force center, find the frequency of oscillations about the equilibrium point.

5. A homogeneous slab of thickness $a$ is placed on top of a fixed cylinder of radius $R$ whose axis is horizontal. Show that the condition for stable equilibrium of the slab, assuming no slipping, is $R > a/2$. What is the frequency of small oscillations in that case?