Tutorial 5

Problem 1. A solid rectangular box, of dimensions 100 mm × 60 mm × 20 mm, is spinning freely with angular velocity 240 r.p.m. Determine the frequency of small oscillations of the axis, if the rotation axis is parallel to (a) the longest and (b) the shortes side of the box.

Problem 2. (K. & K., Ex. 8.12) If you spin a coin or solid uniform disk about a vertical axis on a hard surface, it will eventually lose energy and begin to wobble and perhaps make a buzzing sound as it rolls. Consider a thin disk of radius R and mass M that is executing the rapidly buzzing motion. The plane of the disk is at an angle α with respect to the table. The axis of the disk precesses around the vertical at rate $\vec{\Omega}_p$. The disk also spins around its own axis with spin angular velocity $\vec{\Omega}_0$. See the figure below. The result of the two motions is for the contact point on the table to be momentarily at rest.

1. (25%) Find $\vec{\Omega}_p$ for a given small angle α.
2. (25%) Find the rate at which the disk appears to rotate as viewed from above, when α is very small.