INDIAN INSTITUTE OF TECHNOLOGY PATNA

PH103 : Physics
Tutorial 7

1. A gyroscope wheel is at one end of an axle of length l. The other end of the axle is suspended from a string of length L. The wheel is set into motion so that it executes uniform precession in the horizontal plane with a precessional frequency Ω. The wheel has mass M and moment of inertia about its center of mass I_0. Its spin angular velocity is ω_s. Neglect the mass of the shaft and of the string. Find the angle β that the string makes with the vertical. Assume that β is so small that approximations like $\sin\beta \approx \beta$ are justified.

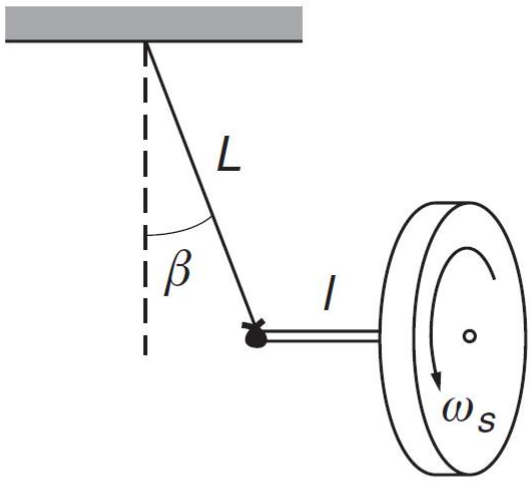
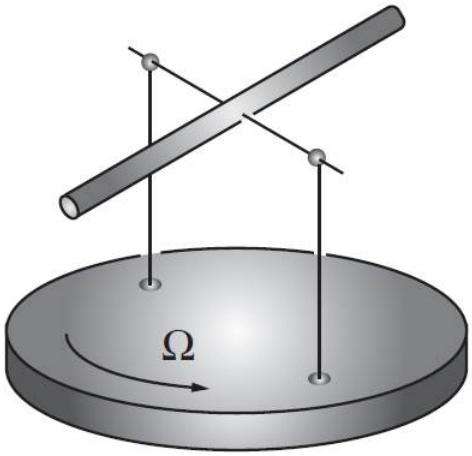


Figure 1: Gyroscope wheel

2. Consider a uniform rod mounted on a horizontal frictionless axle through its center. The axle is carried on a turntable revolving with constant angular velocity Ω, with the center of the rod over the axis of the turn-table. Let θ be the angle shown in the sketch. A small perturbation is given to the system and released instantaneously. Using Euler's equation find θ as a function of time. Detailed figure is given in the next page.



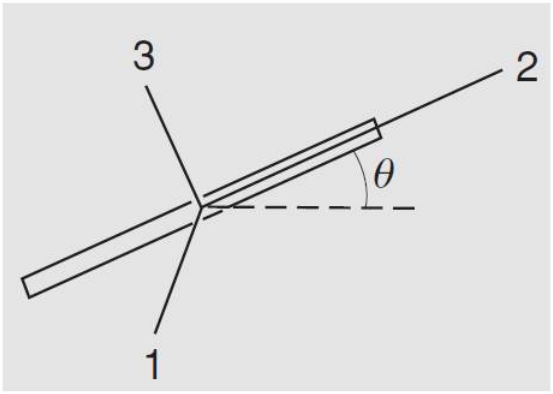


Figure 2: The rotating rod