

**1. Exercise:**

A rigid body with mass  $m = 1$  kg is fixed at one point  $O$ . However, it can rotate around this point with a moment of inertia of  $\Theta = 5$  kg m<sup>2</sup>. Its center of mass is at a distance of  $\ell = 2$  m from the point  $O$ . Gravity is acting on the body with  $g = 10 \frac{\text{m}}{\text{s}^2}$

- What is the moment of torque  $|\vec{M}|$  at its vertical position below  $O$ .
- Determine the moment of torque at an angle  $\alpha = 30^\circ$  with respect to the vertical.
- State the equation of motion. (Do not attempt solve it!)
- Determine the angular velocity  $\omega$  at the vertical position if the body was released at an angle  $\alpha = 30^\circ$ .
- What would be the velocity  $v'$  of the rigid body (again formerly released at the angle  $\alpha = 30^\circ$ ) after it elastically hits another body with mass  $m_2 = 100$  kg at the vertical position? (The second mass should formerly be at rest.)

**2. Exercise:**

Consider two masses  $m$  separated by a rod with length  $\ell$  and edge length  $d$ . However, the coordinates along the edge length should be neglected against the one along the length  $\ell$ . The system is rotated around an axis perpendicular to the rod. At first neglect the mass  $m_r$  of the uniform rod.

- What is the moment of inertia of the two masses regarding the center of mass?
- Determine the moment of inertia if it is rotated around the position of one mass.
- Calculate the moment of inertia of the rod if it would be rotated around its center of mass.
- What is the moment of inertia regarding the center of mass if the mass of the rod is considered?
- Which value does the moment of inertia possess regarding the position of one mass if again the mass  $m_r$  of the rod is considered?

**3. Exercise:**

Consider a body with mass  $m$  attached to a rope which is wound around a spool with radius  $r$  and moment of inertia  $\Theta$ . The spool can rotate around the axis  $O$  through its center of mass. Neglect friction and assume that the rope pulls without slipping.

- State the equation of motion of the system.

- (b) What is the acceleration  $a$  of the mass  $m$ ?
- (c) Find the tension force  $F_T$  in the rope.