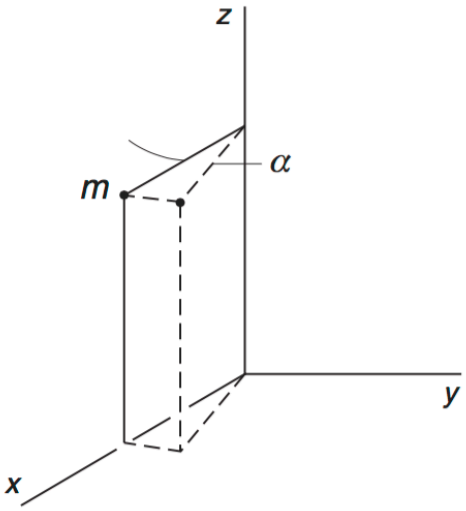
Homework 3: Rigid body motion

Due: Tuesday February 19th, 13:00

Policy: Collaboration is allowed, but every student is required to hand in his/her own version of the solutions. Please include your name and student number on the solutions.

Problem 1. (K. & K., Ex. 8.11)



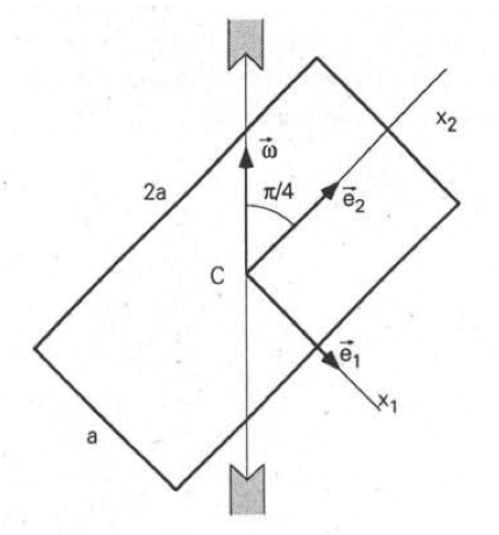
A particle of mass m is located at $x = 2$, $y = 0$, $z = 3$.

a) Find its moments and products of inertia relative to the origin.

b) The particle undergoes pure rotation about the z axis through a small angle α. Show that its moments and products of inertia are unchanged to first order in α if $\alpha \ll 1$.

Problem 2. We consider a thin, homogeneous, rectangular plate with sides a and $2a$ and mass m. The plate rotates with angular velocity $\vec{\omega}$ around a fixed axis, which is in the plane of the plate and goes through the plate's center of mass C. The angle between the rotation axis and the principal axis x_2 is $\pi/4$. The axis x_1 in the figure is also a principal axis.

1. Determine the moments of inertia with respect to the principal axes I_1, I_2 and I_3.



2. Determine the components, L_1, L_2 and L_3, of the angular momentum $\vec{L}$ with respect to C.

3. Determine the angle γ between $\vec{\omega}$ and $\vec{L}$.

4. Determine the magnitude of the torque $\vec{\tau}$.