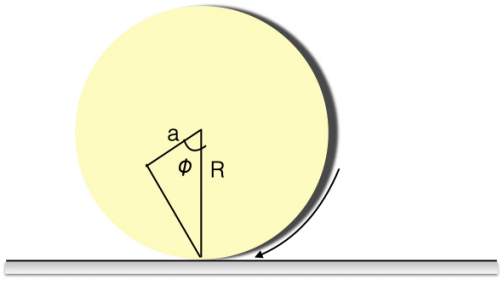
PHYS 5310
CLASSICAL MECHANICS - 2023

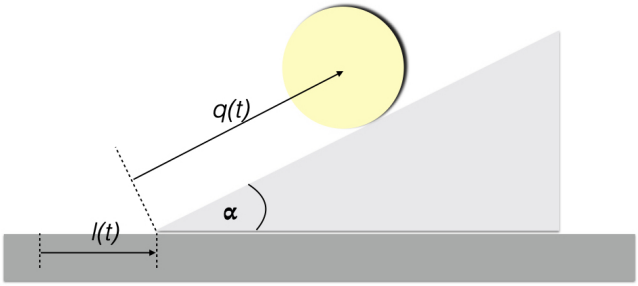
HOMEWORK 5

Exercise 1.
Determine the principal moments of inertia for the following homogeneous bodies:
a) A thin rod of length l,
b) A sphere of radius R,
c) A circular cylinder of radius R and height h,
d) A rectangular parallelepiped of sides a, b and c,
e) A circular cone of height h and base radius R,
f) An ellipsoid of semiaxis a, b and c.

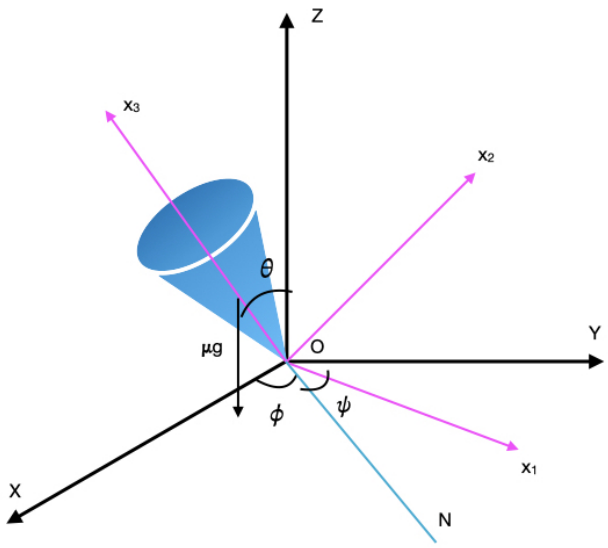
Exercise 2.
Find the kinetic energy of a non-homogeneous cylinder of radius R rolling on a plane, if the mass of the cylinder is distributed such that one of the axis of inertia is parallel to the axis of the cylinder and at a distance a from it, and the moment of inertia of that principal axis is I.



Exercise 3.
A disc is able to roll down an inclined plane without slipping under the influence of gravity. Describe the motion of the disc for a horizontal displacement imparted to the inclined plane.



Exercise 4.
Integrate the equations of motion of a heavy symmetrical top whose contact point with the ground is fixed (see figure).



Exercise 5.
Find the condition for the rotation of the top about a vertical axis to be stable.

Exercise 6.
Fast top.
Determine the motion of. a top when the kinetic energy of its rotation about its axis is large compare with its energy in the gravitational field.