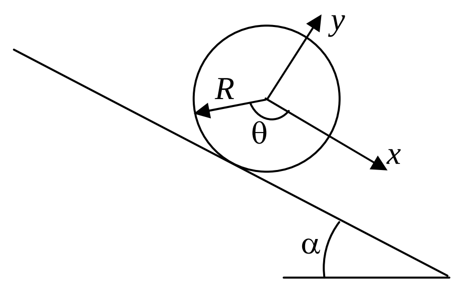
Homework 4

You may not discuss with other people problems 1 and 2. You can consult the textbook and solutions of previous homeworks.
Honor Pledge:____
Signature:_________________________

Problem 1

A buoy is dropped from an airplane from a height h = 100 m above the surface of the water. The mass of the buoy is m = 100 kg and its volume is V = 0.15 m^3. Upon entering the water (ρ = 1000 kg/m^3), the buoy experiences a resistance force given by $F = -k\ v$, where k = 10 N sec/m. What is the maximum depth to which the buoy will sink before starting to raise again? You can neglect air resistance and assume that the buoy looses negligible energy when going through the surface of the water.

Problem 2



A disk of radius R and mass m is rolling down a fixed plane inclined at an angle α. The static coefficient of friction between the disk and the plane is μ. If μ is sufficiently high, the disk rolls without slipping, however the disk will begin to slip for μ below a certain threshold.

a) Write down the Lagrangian equations of motion including the constraint forces at the point of contact assuming no slipping. Use the coordinates indicated on the figure.

b) Calculate the critical value of μ at which the disk begins to slip.

Problems that can be discussed and solved collaboratively:

Problem 3 T&M 7:28

Problem 4 T&M 5:16

Problem 5 (Finish calculations discussed in class) A thin rod of length l and mass m initially stands vertically up on a horizontal surface and begins to fall with zero initial velocity. The coefficient of static friction between the rod and surface is μ. It begins to fall with zero initial velocity. Find the angle θ relative to the vertical when the rod will begin to slip on the surface.