Problem 1 (Mechanics)

Three cylinders with the same mass, the same length and the same external radius are initially resting on an inclined plane. The coefficient of sliding friction on the inclined plane, μ, is known and has the same value for all the cylinders. The first cylinder is empty (tube) , the second is homogeneous filled, and the third has a cavity exactly like the first, but closed with two negligible mass lids and filled with a liquid with the same density like the cylinder's walls. The friction between the liquid and the cylinder wall is considered negligible. The density of the material of the first cylinder is n times greater than that of the second or of the third cylinder.

Determine:

a) The linear acceleration of the cylinders in the non-sliding case. Compare all the accelerations.

b) Condition for angle α of the inclined plane so that no cylinders is sliding.

c) The reciprocal ratios of the angular accelerations in the case of roll over with sliding of all the three cylinders. Make a comparison between these accelerations.

d) The interaction force between the liquid and the walls of the cylinder in the case of sliding of this cylinder, knowing that the liquid mass is m_l.