KLUB NAUKOWY FENIX

Problems 5

22 October, 2021

For all problems assume vertical gravitational field.

1. N identical cuboid blocks are placed on a table forming a tower (rys 1). Each block can be displaced horizontally with respect to the block beneath it. What is maximal displacement of the block on the top (N-th block) with respect to the base block ($N = 1$) such that the tower remains stable?

2. Three blocks, of mass: m_1, m_2, m_3, are connected by a string and placed on a horizontal table, whose one side can be inclined (rys 2). The side of the table where block m_1 was places is being lowered. At what point will the system of blocks start to move? Assume identical coefficient of friction for all blocks (μ).

3. Block m_1 was place on an inclined plane (α). Block m_2 was placed on the block m_1. The system is initially at rest (rys 3). The coefficient of friction between block m_1 and the inclined plane is μ_1. The coefficient of friction between blocks m_1 and m_2 is μ_2. Determine the conditions required for:

   (a) Blocks to remain at rest

   (b) Block m_1 to remain at rest and block m_2 to start to move.

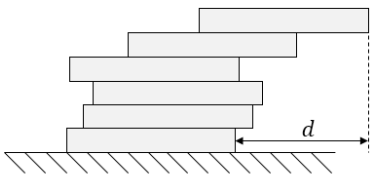
   (c) Both blocks to move with respect to the inclined plane, but to remain at rest with respect to each other.

   (d) Both blocks to move with respect to the inclined plane and with respect to each other.

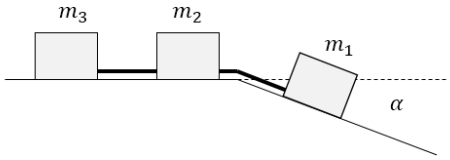
   Draw a diagram with axes μ_1, μ_2 and mark the respective regions for situations a), b), c), and d).

4. Determine if it is possible to place a ball in a corner of a symmetric roof whose opening angle is β and the coefficient of friction between the ball and the roof is μ (rys 4).

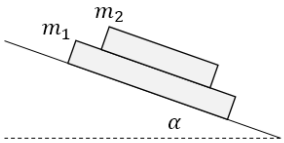
5. A toy has a shape of a semi-sphere (of radius r) with a cylinder on top of it (with same radius) (rys 5). The center of mass of the toy, when it is placed vertically, is placed at the height h above the ground. Find the expression for the potential energy of the toy with respect to the inclination angle θ. For what values of r and h the toy is stable in a vertical position ($\theta = 0$).



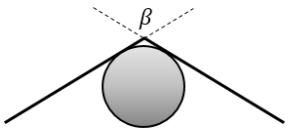
rys 1.



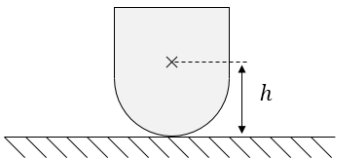
rys 2.



rys 3.



rys 4.



rys 5.