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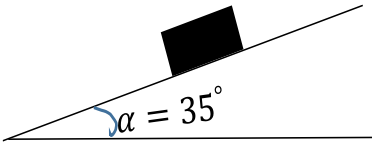
Series N°3: Dynamics of material point

Exercise 1

The figure opposite represents a body whose weight is 5N and which rests on a rough plane inclined by $\alpha = 35^{\circ}$. The coefficient of static friction is 0.80.



We take $g = 10ms^{-2}$.

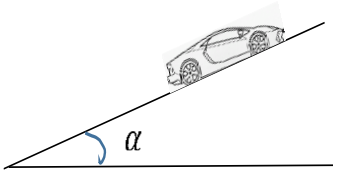
b) What is the normal force?

c) What is the friction force?

a) What must be the angle of inclination α_0 so that the body begin to slide?

Exercise 2

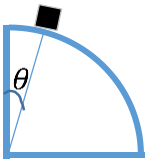
A car with a mass of 1,000 kg goes up a street inclined at 20°. Determine the force that the engine must produce for the car to move and the force exerted on the automobile by the street:



1. With uniform motion.
2. With an acceleration of 0.2 ms^{-2}.

Exercise 3

At time t_0 a body of mass M slides without friction on a quarter of circle of radius R from an angle θ (figure). Find:

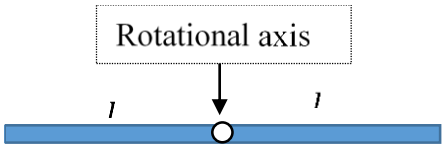


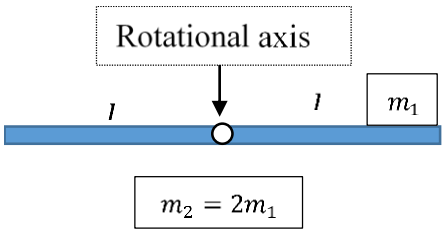
- The differential equation of motion (motion is represented by $\theta(t)$),
- The solution to the differential equation in the case where θ is small
- find the linear velocity v in function of θ.
- The angle θ_f where the body will leave the circle.

Exercise 4

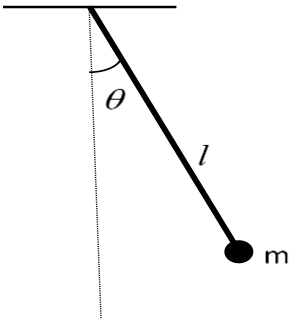
Find the moment of forces (torques) for the two cases represented by the figures below.

For the second case, where should m_2 be placed for equilibrium to be achieved?





Exercise 5



A simple pendulum (l, m) was shifted by an angle θ from its equilibrium position and allowed to oscillate.

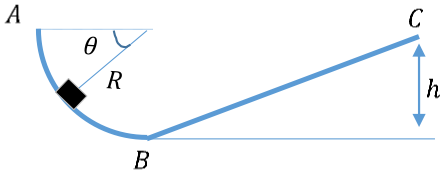
Find the differential equation that represent the motion of m (consider θ is small) by using: 1) the second law of Newton, 2) the angular momentum theorem.

- Give the solution of the differential equation (Find $\theta(t)$).
- Deduce the tension force in the wire.

Exercise 6

A mass M moves along the path ABC (figure).

AB is a quarter of the circle, and AC is a straight line inclined at an angle θ and of height 2h=BC. M moves without friction on part AB but with kinetic friction on part BC. The mass starts moving from the point A. By applying Newton's laws, find:



- The velocity (in function of $\theta, R\ and\ g$) at a point m_1 on the path AB.
- The reaction in function of $\theta, M, R\ and\ g$.
- Deduce the velocity at the point B.
- The velocity (in function of $\theta, x, g\ and\ \mu_k$) at a point m_2 on the path BC.