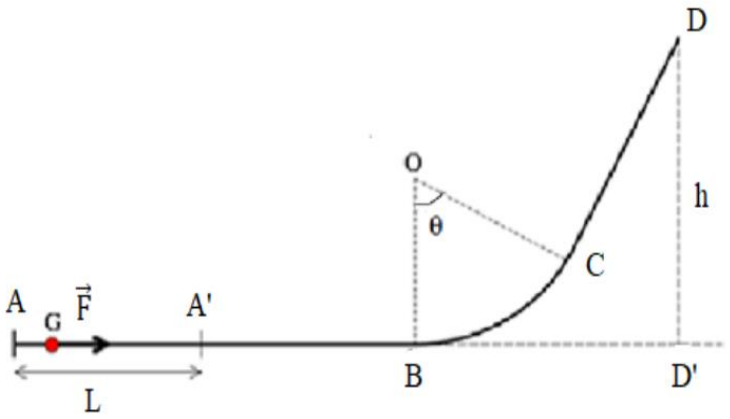
Exercise Set 5 (TD5): Mechanics

Work and Energy (part 2)

Exercise 1: Puck game (jeu de palet)

This game consists of a track on which a small, hard disk, similar to a hockey puck, with mass m is propelled and then released. The track lies in a vertical plane and consists of three sections connected to each other: a horizontal rectilinear section AB, a circular arc BC of radius R and angle ϑ, and lastly an inclined rectilinear section CD. The diagram below shows the trajectory followed by the puck's center of mass G.



The shot is successful if the puck G reaches point D, which is at a height h above the horizontal plane that contains AB. For the segment of length L between points A and A', we will assume that a constant force of propulsion $\vec{F}$ is applied on the puck. All sources of friction will be ignored throughout the exercise.

Data given:
$L = 0.5$ m ; $h = 1.5$ m ; $g = 10$ m.s^{-2} ; $m = 5$ kg. We also assume that OC = OB = R, and that the puck has zero initial velocity ($v_A = 0$).

1. Along the AA' section
   - **a.** Draw all external forces that act on the puck between points A and A'.
   - **b.** Using the work-kinetic energy theorem between points A and A', find the expression for the magnitude of the force $\vec{F}$ in terms of L, m and the velocity of the puck at A'.

2. Along the A'B section, what is the connection between the velocity at point B and the velocity at point A'? Justify your answer.

3. Along the BD section
   a. Using the theorem of mechanical energy conservation, determine the expression for the velocity at point B, in terms of g and h, given that **the puck reaches point D with zero velocity.**
   b. Deduce the expression for the magnitude of the force $\vec{F}$, which is exerted on the puck between points A et A', in terms of g, h, m and L. Calculate its numerical value.

4. Along the BC section, use the theorem of mechanical energy conservation to express the velocity at point C in terms of g, h, R and ϑ.