



# LPR Cup

11.s01.e03



*FC Lokomotiv is the fifth wheel  
in the Moscow football cart  
Folklore*

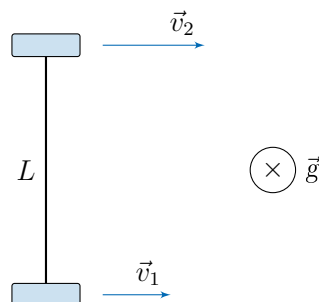
## Rod

At the ends of a uniform rod of length  $L = 0,8$  m, two similar small light rollers are fixed, which can only rotate freely around the axis directed along the rod (see Fig.). The system is located on a horizontal surface, and the coefficient of sliding friction between the rollers and the surface is equal to  $\mu$ .

At the initial moment of time, the ends of the rod are given the speeds  $v_1 = 1$  m/s and  $v_2 = 2,5$  m/s, directed perpendicular to the rod in one direction (see the figure).

1. At which values of the friction coefficient  $\mu$  between the rollers and the surface, the rollers will move without slipping? (1 point)
2. Here and further, consider that  $\mu = 0,1$ . Get the dependence of the angular speed of rotation of the rod on the time  $\omega(t)$ . (3 points)
3. Find the minimum speed of the center of the rod  $v_{min}$  during movement. (3 points)
4. Find the angle between the vectors of initial speed and minimum speed at the moment when it is reached. (2 points)
5. Find the time after which  $v_{min}$  is reached. (1 point)

$g$  can be considered as  $10$  m/s<sup>2</sup>



First hint — 11.05.2020 14:00 (Moscow time)

Second hint — 13.05.2020 14:00 (Moscow time)

Final of the second round — 15.05.2020 22:00 (Moscow time)