Hint 2

IMPORTANT! The next task is both a hint and an alternative to the main task. Three important points:

1. You can continue to send the solution to the main problem.
2. At any moment before the final deadline you can start to solve the Alternative problem. If you do so, at the beginning of the solution write: *I am doing the Alternative problem!* In this case a penalty coefficient for the Alternative problem is

$$0{,}7 \cdot \sum_i \frac{k_i \cdot p_i}{10},$$

   where p_i is a point for the problem item, and k_i is a penalty coefficient for the corresponding problem's item at the moment of moving to the Alternative problem. In other words, maximal points for the alternative problem equals to the maximal points you can gain at the moment of moving to the alternative one multiplied by 0,7. Also, we remind you that a penalty coefficient can't be less than 0,1. Solutions of the main problems from that moment will not be checked. Be careful!
3. The task consists of several items. The penalty multiplier earned by **before** is applied to all points. In the future, each item is evaluated as a separate task. If you send a solution without any item, this item's solution is considered as Incorrect. For more information about scoring points for composite tasks, see the rules of the Cup.

Alternative problem

Let's consider two points A and B placed on the same horizontal plane at the distance L from each other. The gravitational field is constant and equal to $\vec{g}$.

A point particle can move without any friction in a smooth channel connecting A and B points having a zero speed at point A. Let φ be an angle between the particle velocity $\vec{v}$ and the vector of acceleration of gravity $\vec{g}$. The channel is provided to connect points A and B with the minimum travel time. Direct the y-axis in the direction of the gravitational acceleration, and the x-axis from point A to the B. The origin should be in point A.

1. *(2 points)* Find the connection between the v and φ that guarantee the minimum travel time.

Let C be some point of the trajectory of the point particle. We can draw a line segment perpendicular to the velocity from the point C to the x-axis. Let denote the intersection point with the x-axis by D.

2. *(0,5 points)* Find CD in terms of y and φ.
3. *(3,5 points)* Find the maximum value of the CD during the movement.
4. *(4points)* Find the smallest possible time of movement tmin between points A and B.