ADVANCED PHYSICS CLUB

OCTOBER 15, 2023

USEFUL RESOURCES

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2023
The practical information about the club and contacts can be found on the same web page.

TODAY'S MEETING

Today we solved most of the assigned problems on motion with acceleration. We collected ideas regarding problem 6, please finish solving it. Problem 7 is reassigned.

REASSIGNED PROBLEMS

6. Two runners stand still at points A and B each holding one end of a long rubber cord. After a signal they start running: runner A runs with constant velocity 1 m/s to the east and runner B runs with constant acceleration to the south. An observer noticed that point C on the cord has passed through a particular point D shown on the figure. Measurements on the figure are as follows: AC = 2m, AB = 10m, D_x = 4m, D_y = -4m (coordinates of point D are given with respect to point A). Find the acceleration of runner B.
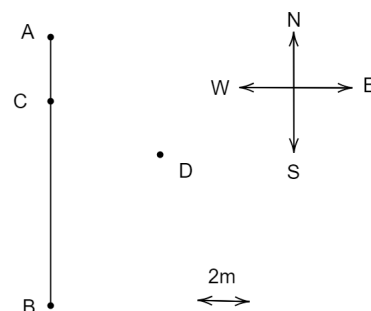

7. If acceleration changes, the rate of this change is called jerk: $j = \dfrac{\Delta a}{\Delta t}$ (acceleration changes by Δa in time Δt). For jerk 1 m/s^3 what will speed be in 5 s if the initial speed was zero? What will be the distance traveled in the same amount of time? Could you think of practical situations in which it is important to consider jerk?

NEW HOMEWORK

Our next topic is projectile motion.

1. A ball is launched on a smooth plane inclined at 45° to the ground. Initial velocity of the ball is equal to v and makes 45° with the horizontal edge of the plane. What horizontal distance the ball will travel during its' motion?

2. A rock it thrown with initial speed v in some direction. What will be its speed at a point with elevation h with respect to the initial point?

3. A smooth hollow cylinder of radius R stands vertically. A ball is launched along its' internal surface at an angle α to the ground. Find the initial speed of the ball for it to return to the same point.

4. Water is coming from a hose of the cross-section A at velocity v. The velocity makes angle θ to the ground. The hose is at the ground level. Find the mass of the water which is in the air at any given moment.

5. A ball is bouncing back and forth between two walls of a rectangular box along the same trajectory. One of the walls makes angle α to the ground. The time interval between two consecutive bounces is Δt. Find speed of the ball right after the collision for both of the collision points.
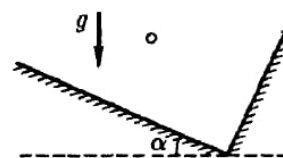
*6. Find the minimum velocity required to launch a stone from ground level in such a way that it reaches a point at a horizontal distance l and a height h.

Hint: It may help to think about the inverse problem: maximize h for given v and l.

*7. A fireman with a hose is standing at distance l away from an infinite vertical wall. Find the shape of the 2-dimensional region on the wall that he can reach with water from the hose. Water is coming out of the hose with speed v at height h above the ground.

For the next meeting

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **October 22**.