ADVANCED PHYSICS CLUB

NOVEMBER 6, 2022

Useful resources

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`http://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2022`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

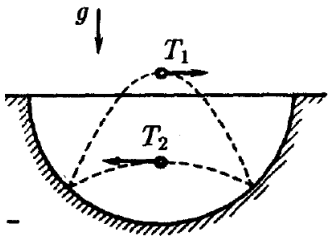
Today we continued solving problems on projectile motion. The few remaining problems are reassigned. Our new assignment is on circular motion.

Reassigned Homework

1. A ball is released from rest and hits an inclined plane after falling a distance H. Find the distances between points at which the ball hits the inclined plane after the initial collision. Assume that all collisions are perfectly elastic. The plane is inclined at an angle α.

2. A hose is lying on the ground. Water flies our of this hose at an angle 45° to the horizon with speed 10 m/s. Cross section area of the hose is 5 cm^2. Find the total mass of water which is in the air at any given moment of time.

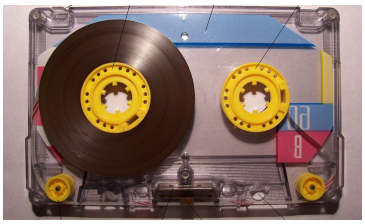
***3.** A ball periodically goes back and forth between two points in a spherical hole. These points are at the same height, collisions of the ball with walls of the hole are elastic. Time interval between collisions when the ball moves right is T_1 and when it moves left time interval is $T_2 \neq T_1$. Find the radius of the hole.



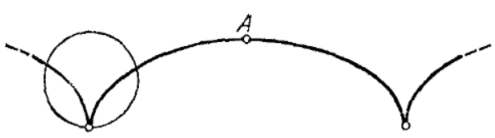
New Homework

1. A small object moves on a circle of radius r with speed linearly growing in time: $v = kt$. Find how full acceleration of the object depends on time.

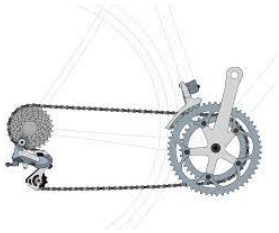
2. While listening to music on a tape a young physicist has noticed that the outer radius of the cassette tape decreased by half in 20 minutes. How long would it take after that for the outer radius to decrease by half again?



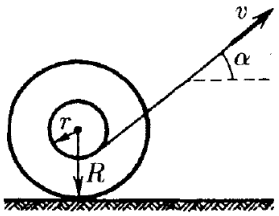
3. Consider a wheel rolling without slipping on a flat horizontal surface. A given point on the rim of the wheel will follow an interesting curve, known as a cycloid (shown on the figure). Find the radius of curvature of a cycloid at the highest point of its arc (this might seem more like a geometry problem, but it has a kinematic solution). Radius of the wheel R is given.



4. a) Explain why bicycles need gears.
b) If we increase the radius on the front gear, will it be easier or harder to pedal? How about the rear gear?



***5.** A thread coiled around a bobbin is pulled with velocity v at an angle α (see picture). The bobbin rolls without slipping on a horizontal surface. Find velocity of the axis of the bobbin and its angular velocity. For which α does the bobbin move right? Left? The thread is very long, so α does not change during the motion.



***6.** Because of the finite exposure needed, in a side-on photograph of the front wheel of a moving bicycle, the spokes seem blurred. However, there will be some apparently sharp points in the picture. Where are these sharp points? For the sake of simplicity, suppose that the bicycle spokes are radial.

For the next meeting

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **November 13**.