ADVANCED PHYSICS CLUB
OCTOBER 23, 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 solved some problems on linear motion with acceleration. We continue with more problems on kinematics - from simple to more complicated, now on projectile motion.
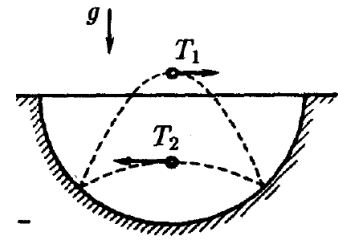
REASSIGNED HOMEWORK

*1. You are standing on a platform next to a train which is scheduled to depart at 12:00:00. It's exactly 12:00:00 by your watch, but the second to last carriage already starts moving past you, and it goes past you completely in 10 s. Then the last carriage goes past you in 8 s. The train has in fact departed on time and it is moving with a constant acceleration. How much does your watch fall behind?

*2. An ant is running away from an anthill with speed inversely proportional to the distance from the center of the anthill. At the moment when the ant is at point A which is 1 m away from the center of the anthill, its speed is 2 cm/s. In what time will the ant reach point B which is located 2 m away from the center of the anthill?

NEW HOMEWORK

1. In order to model how objects move on the moon, where the free fall acceleration is only 1.5m/s^2, a student prepares an inclined plane and studies how particles move on the inclined plane. At what angle would the inclined plane precisely model motion of particles on the moon?

2. A ball is thrown from the ground with a given velocity v at an angle α to the horizon. For what α the distance traveled by the ball in the horizontal direction before hitting the ground is maximal? What is this distance?

3. What should be the initial velocity of a cannon missile in order to hit a rocket, moving with vertical acceleration a? The rocket starts accelerating at the same moment as the cannon fires. The cannon and the rocket launching point are both on the ground level, the distance between them is L. The cannon fires at the angle $45°$ to the horizon.

4. 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.

5. 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.

*6. What minimal velocity should a ball have in order to go over a rectangular house of height H and length L, if it's thrown by a teenager of height h who can choose an arbitrary position on the ground to make the throw?

*7. 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.