ADVANCED PHYSICS CLUB

OCTOBER 20, 2019

Homework problems

1. A ball is thrown from the ground with a given velocity v at an angle α to the horizon. At which angle is the distance traveled by the ball in the horizontal direction before hitting the ground is maximal? What is this distance? (Hint: this problem is related to the warm-up exercise from the last class).

2. In order to model how objects move on the moon, where the 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?

3. What should be the initial velocity of a cannon missile in order to hit a rocket, starting to move with a vertical acceleration a at the same time as the cannon fires? Cannon and rocket are located on the same horizontal plane, the distance between them is L. The cannon fires at the angle 45° to the horizon.

Additional problems

4. A ball is thrown upwards vertically with velocity v and reaches maximal height H after time T. A ball is released at rest from height H at the same time as the previous ball is thrown. They meet at some point x (measured from the ground) after flight time t. Specify whether $x > H/2$ or $x = H/2$ or $x < H/2$ and also whether $t > T/2$, $t = T/2$, or $t < T/2$.

5. A ball is released with no initial velocity from a height h above a very long inclined plane. The angle between the plane and the horizon is α. a) Find the velocity of the ball immediately after it hits the plane for the second time. b) The same question after the 10th collision. All collisions are elastic.

6. A rock thrown from a point $(0, 0)$ with initial velocity v has reached point (x, y). Find: a) tangent of the angle between the initial velocity of the rock and the horizon; b) the region where the rock could get with this initial velocity (but the angle at which it is thrown could be varied. A convenient way to specify the region is to find its' boundary); c) the smallest initial velocity of the rock such that it still could reach the point (x, y).

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

For the next meeting

The next club's meeting is at 2:40pm, room P-122, on Sunday, **October 27**.