ADVANCED PHYSICS CLUB

NOVEMBER 18, 2018

Today's meeting

The topic of today's meeting were conservation laws in mechanics. We talked about the conservation of momentum and energy for a system of particles and mentioned their relationship to symmetries.

Discussed problem (from previous homework)

1. Two children stand on a large, sloping hillside that can be considered as a plane. The ground is just sufficiently icy that a child would fall and slide downhill with a uniform speed as the result of receiving even the slightest impulse. For fun, one of the children (leaning against a tree) pushes the other with initial speed v_0 at an angle β with respect to the downhill direction. The other child slides down the slope with a velocity that changes in both magnitude and direction. What will be the child's final speed if air resistance is negligible and the frictional force is independent of the speed?

Hint: Calculate by how much the speed of the pushed child and its velocity component down the slope change in unit time. Find a relationship between the rates of change of these two quantities.

Homework

1. Two bouncy balls of masses m_1 and m_2 are stacked freely on top of each other as shown in the Figure below and dropped towards the floor with zero initial velocity. Just before they touch the ground, they are falling at a speed v. Find the upwards speed of the top ball just after the bounce, assuming it is much lighter than the bottom ball. Suppose the collision is perfectly ellastic.

2. Similarly to Problem 1, we drop N balls stacked on top of each other, such that the top one is much lighter than the second from the top, which itself is much lighter than the third, etc. What will be the speed of the top ball after the bounce?

3. Now, let us again drop N balls as above but this time let the bottom one have mass M and the jth ball from the bottom have mass $m_j = \frac{2M}{j(j+1)}$. What will be the speed of the top ball after the bounce?

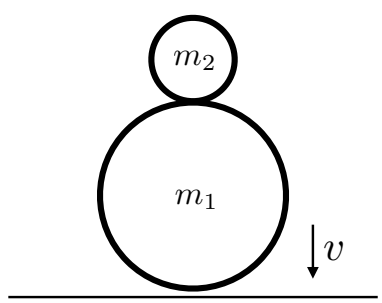

Figure 1. Bouncy balls just before they collide with the ground.

For the next meeting

Next time we will talk about conservation of angular momentum and the motion of a rigid body.

IMPORTANT: There is no club on November 25. The next club's meeting is at 2:40pm, room P-131, on Sunday, **December 2**.