ADVANCED PHYSICS CLUB

JANUARY 30, 2022

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=ay2020`
The practical information about the club and contacts can be found on the same web page.

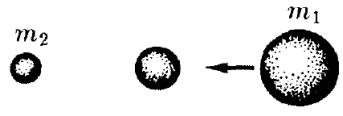
Today's meeting

We continue solving problems on energy conservation law and collisions; most of this assignment will be to finish the problems from previous assignments which we haven't discussed yet. There will be one additional hard problem.

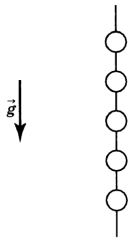
Remaining from previous homeworks

***1.** In a very dense fog lots of tiny water droplets "float" with negligible speed. If one of the droplets for some reasons gets a bit larger, it starts falling and absorbs the other droplets it meets on the way. Assuming this droplet stays spherical during the fall, it turns out that it falls with constant acceleration despite air resistance, which is proportional to the speed of the droplet squared and its' cross section area. Find the maximal possible acceleration of such a droplet.

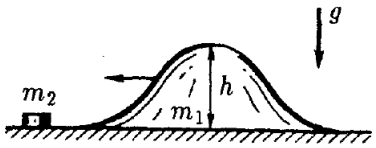
2. In a system of three balls two of them are initially at rest. The moving ball has mass m_1 and collides with the intermediate ball which then collides with the last ball of mass m_2. For which mass of the intermediate ball will the speed of m_2 after the collision be maximal for a given initial speed of m_1? All collisions are perfectly elastic and central.



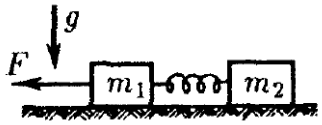
3. Five identical beads are initially held at rest on a vertical wire. They could slide along the wire without friction, collisions between the beads are perfectly elastic. The beads are simultaneously released with random (in value and direction) initial velocities. What is the maximal possible number of collisions between the beads during their subsequent motion?



4. A smooth "hill" of mass m_1 and height h could slide without friction along a horizontal plane. For what minimal initial speed of the "hill" a small body of mass m_2 (initially at rest on the plane) will go over the "hill"? The transition between the "hill" and the plane is smooth.

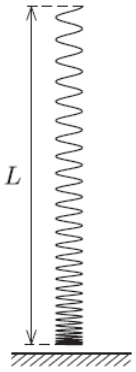


***5.** Two bodies of masses m_1 and m_2 are connected with an undeformed spring and lie on a horizontal plane. Find what minimal constant force should be applied to the left body so that the other body eventually starts moving. Friction coefficient is μ.



New Homework

***1.** A Slinky is a spring with very small spring constant and non-negligible mass. Consider a Slinky of mass m which initially was fully contracted and lying on a desk. Then we extend it by pulling one end up, until all Slinky is in the air with its lower end almost touching the desk. At this state the total length of the Slinky is L and it is much larger than its' length in the contracted state. Find



(a) What work had to be done to raise the Slinky above the desk as described?

(b) If the Slinky is released, how will it move? What will be the speed of its' lower end right before it hits the desk?

(c) How long does it take for Slinky to fall on the desk?

For the next meeting

IMPORTANT: The next club's meeting is at 3:00pm, via Zoom, on Sunday, **February 6**.