ADVANCED PHYSICS CLUB

JANUARY 23, 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

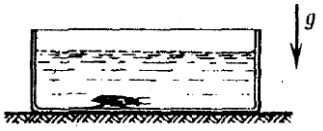
We continue preparing for the F=ma exam. We also continue solving problems about energy conservation law and collisions; there are also some unfinished problems on momentum conservation.

F=ma preparation

1. Solve F = ma exam 2019 and time yourself. You can download exam problems here:
`https://www.aapt.org/physicsteam/2020/upload/2019_Fma_A.pdf`
If you don't have time for the entire exam, at least look through the problems to choose the ones most interesting/unclear to you. We will discuss the suggested problems at the beginning of the next meeting.

Remaining from previous homeworks

***1.** A tank with water with density ρ_0 rests on a frictionless table. Volume of water is V_0. There is a bug with volume V and density ρ at the bottom of the tank. The bug starts to move with horizontal velocity v with respect to the tank. With what velocity will the tank move on the table? Neglect mass of the tank. Water level stays horizontal at all times.

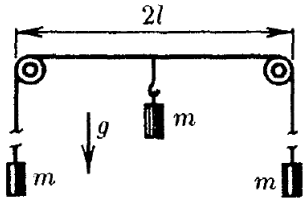


***2.** In a very dense fog lots of tiny water droplets "float" with negligible speed. If one of the droplets for some reasons gets a bit larger, it starts falling and absorbs the other droplets it meets on the way. Assuming this droplet stays spherical during the fall, it turns out that it falls with 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.

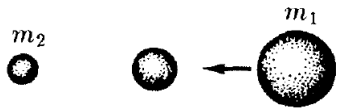
New Homework

1. A contracted spring with spring constant k is sandwiched between two bodies on a horizontal frictionless plane. After the bodies were released, they passed distances x_1 and x_2 respectively by the time the spring came back to its equilibrium length. Find kinetic energies obtained by each of the bodies.

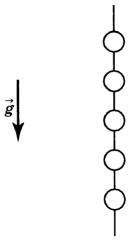
2. In a system shown on the figure the central block is attached to the center of the rope connecting the other two blocks and initially is held at rest. Find the maximal deviation of the central block from its' initial position during subsequent motion after it is released.



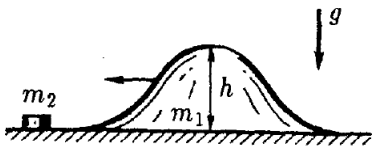
3. In a system of three balls two of them are initially at rest. The moving ball has mass m_1 and collides with the intermediate ball which then collides with the last ball of mass m_2. For which mass of the intermediate ball will the speed of m_2 after the collision be maximal for a given initial speed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



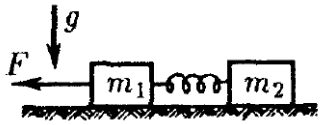
4. Five identical beads are initially held at rest on a vertical wire. They could slide along the wire without friction, collisions between the beads are perfectly elastic. The beads are simultaneously released with random (in value and direction) initial velocities. What is the maximal possible number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



5. 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.



***6.** 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.



FOR THE NEXT MEETING

IMPORTANT: The next club's meeting is at 3:00pm, via Zoom, on Sunday, **January 30**.