ADVANCED PHYSICS CLUB

JANUARY 9, 2022

Useful resources

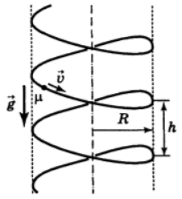
The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2020`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

We continue preparing for the F=ma exam. The new regular topic is momentum conservation law; there are also two unfinished problems on friction force.

Remaining from previous homework

1. A long wire is shaped as a coil of radius R and pitch h. The axis of the coil is vertical. There is a bead sliding down along the coil. Friction coefficient between the bead and the coil is μ. Find the steady speed of the bead.



***2.** A coin lies on a very long inclined plane with angle α. Friction coefficient is $\mu = \tan\alpha$. The coin is hit and it starts to move with horizontal velocity v along the plane. Find velocity of the coin after a very long time.

F=ma preparation

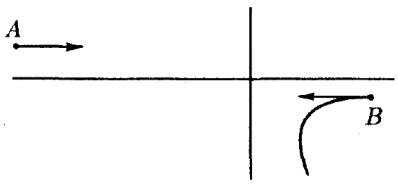
1. Solve F = ma exam 2017 and time yourself. You can download exam problems here:
`https://www.aapt.org/physicsteam/2018/upload/2017-Fma-exam.pdf`
If you don't have time for the entire exam, at least look through the problems to choose the ones most interesting/unclear to you. We will discuss the suggested problems at the beginning of the next meeting.

Homework

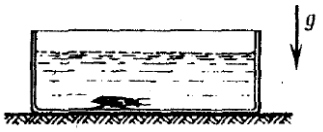
1. A proton with initial speed v flies right onto a helium nucleus which was initially at rest. What are the speeds of the particles at the moment when they are at the smallest distance from each other? Mass of helium nucleus is about four times larger than the proton's mass.

2. A missile is torn into two identical pieces at the highest point of its' trajectory which is at distance L in the horizontal direction from the launch point. On of the pieces returns exactly to the launch point. Where does the other piece land?

3. Two charged particles have masses m and $2m$ and initial speeds $2v$ and v respectively. They start moving from points A and B towards each other, as shown on the figure. The particles only interact with each other. Knowing the trajectory of particle $2m$, restore the trajectory of the particle m on the figure.



***4.** 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.



***5.** 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.

For the next meeting

IMPORTANT: The next club's meeting is at 3:00pm, via Zoom, on Sunday, **January 16**.