ADVANCED PHYSICS CLUB

MARCH 5, 2023

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`http://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2022`
The practical information about the club and contacts can be found on the same web page.

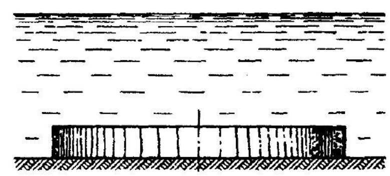
Today's meeting

Today we discussed some problems from F=ma of this year. We then solved three problems from the assignment on hydrostatics. The rest of the homework is reassigned with some new problems added. The new topic is hydrodynamics: motion of fluids. In case you have not encountered it before, I will give a short introduction on Bernoulli law and Torricelli's equation before we start discussing the new problems.

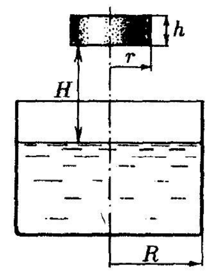
Reassigned homework

1. Communicating vessels of diameters d_1 and d_2 share some amount of liquid of density ρ in them. Find the change in the liquid level if one puts a body of mass m with density less than ρ in one of the vessels.

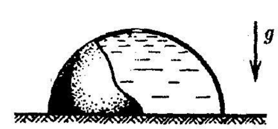
2. A wooden cylinder of radius 1 m and height 0.2 m is attached to the bottom of a tank of depth 1 m. After being released it goes up. What quantity of heat is released after the cylinder and the water stop moving? Wood density is $0.8 \cdot 10^3$ kg/m^3



3. Cylindrical cork of radius r and height h falls into a cylindrical tank of radius R filled with water. Initial elevation of the cork above the surface of the water is H and its' initial speed is zero. What quantity of heat is released by the time cork and water stop moving? Density of cork is ρ, density of water is $\rho_0 > \rho$.

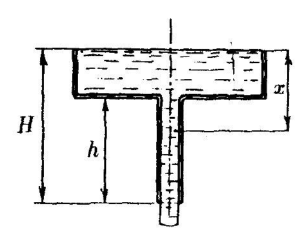


***4.** A thin-walled metal hemisphere with a little hole at the top rests on a table. Hemisphere's edges fit snugly against the table. Water is being poured inside through the hole and when it rises all the way to the hole, it lifts the hemisphere and starts flowing underneath it. Find the mass of the hemisphere if its' internal radius is R and density of water is ρ.



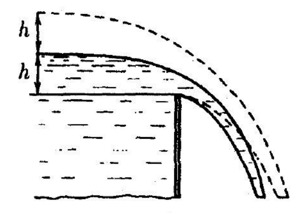
New homework

1. Liquid of density ρ flows out of a wide tank through a narrow tube at the bottom. How do pressure and speed of the fluid depend on the vertical coordinate x? Atmospheric pressure is P_0, dimensions of the tank and the tube are shown on the picture.



2. A wide stream of water flows down a long inclined plane. A group of students measures depth of the stream at some point. Then they measure depth at another point, distance l down along the plane from the first one, and it turns out to be a half of the depth at the initial point. What distance down the flow does depth become four times smaller?

***3.** Imagine a wide dam with water level being d above the edge. How many times would the water discharge (the volume of water flowing through the dam in the unit of time) grow if the water level was $2d$ above the edge?



For the next meeting

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **March 12**.