ADVANCED PHYSICS CLUB

MARCH 10, 2024

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=ay2023`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

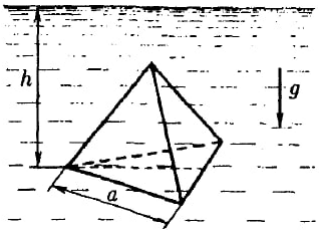
Today we solved some of the assigned problems on Paskal's and Archimedes laws. The remaining problems are reassigned. Next, we will start electricity and magnetism. Our first assignment is on Coulomb law.

Reassigned Homework

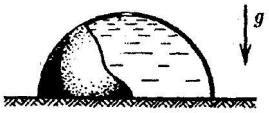
4 A vessel with water slides down an inclined plane. The plane makes angle α with the horizon, friction coefficient between the vessel and the plane is μ. What angle does the surface of the water in the vessel make with the horizon?

5 An entire planet is made out of incompressible liquid of density ρ. Find the pressure at distance r from the center if the whole planet has radius R. What is the pressure at the center of the planet? The gravitational constant G is given.

***6** A regular tetrahedron floats under the surface of water in such a way that its bottom face is horizontal and at depth h. The tetrahedron side has length a, water density is ρ. Find the force exerted by the water on any other face (non-horizontal) of the tetrahedron.



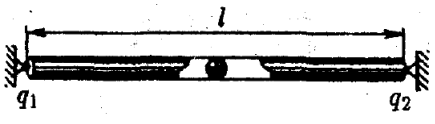
***7** A thin-walled metal hemisphere with a little hole at the top rests on a table. Hemisphere's edges fit snugly against the table. Water is being poured inside through the hole and when it rises all the way to the hole, it lifts the hemisphere and starts flowing underneath it. Find the mass of the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



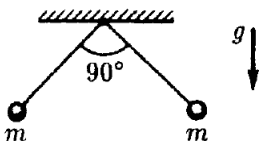
Reassigned Homework

1. Assume that somebody managed to completely separate positive and negative charges in 1 cm^3 of water and these charges were put 100 km apart. What would be the force of attraction between these charges?

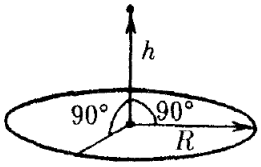
2. Two positive charges q_1 and q_2 are located at the ends of a horizontal tube of length l. Find the equilibrium position of a bead with positive charge q inside the tube. Is this equilibrium stable? Would the equilibrium be stable for a negatively charged bead?



3. Two beads have the same mass m and the same charge. The beads are hung on two threads of length l which are attached to the same point. Find the charge of the beads, if the threads make 90° at equilibrium.



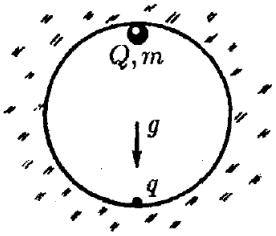
4. What is the electric field at the center of a uniformly charged thin ring of radius R? What is the electric field on the axis of the ring at distance h from its center? The charge of the ring is Q.



5. a) A metal ring with more and more electric charge steadily put onto it was torn by the Coulomb force when its charge reached Q. Another ring with exactly the same dimensions was made out of a material 10 times more durable than the first one. What charge would tear the new ring?

b) If the first material is used to make a ring with all dimensions three times larger than the first one, what charge would tear such a ring?

***6.** A charge q is attached to the bottom point of a spherical cavity of radius R. A small bead of mass M is placed at the top point of the cavity. What charge should the bead have in order to be in stable equilibrium at the top of the cavity? Free fall acceleration is g.



For the next meeting

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **March 17**.