ADVANCED PHYSICS CLUB

FEBRUARY 12, 2023

Useful resources

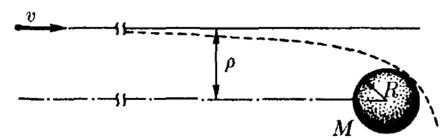
The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`http://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2022`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

Today we almost finished the assignment on the universal law of gravity and Kepler's laws. You will have more time to think about the star problems. The next topic is rotational motion.

Reassigned homework

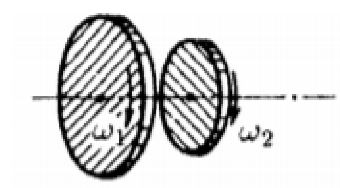
***1.** A space probe approaches a planet of mass M and radius R from far away having speed v relative to the planet. At what impact parameter ρ (which is defined on the figure - it is the distance between the planet and the line of initial motion of the probe when it is very far away from the planet) the space probe will fly as close as possible to the planet's surface without crashing?



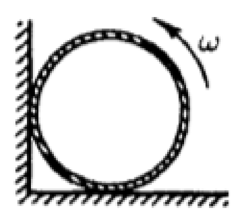
***2.** Some sci-fi book describes a cosmic ship doomed to fall on the Sun due to a small error in its' initial velocity. What is the minimal possible velocity of the spaceship at the surface of the Earth for which such scenario is possible? Assume that the engines only fire for a very short period of time at the start to provide the spaceship with that initial velocity. *Hint: we discussed in the class that if size of the Sun is negligible, then we must arrange the speed at the Earth's surface so that far away from the Earth the rocket has zero speed with respect to the Sun. Think how to improve this solution and account for the finite size of the Sun. It might be useful to look at the previous problem.*

Homework

1. Two disks with moments of inertia I_1 and I_2 are rotating around the same vertical axis without friction with angular velocities ω_1 and ω_2 respectively. Disks are suddenly brought into contact. Because of the friction between the disks after some time there is no relative slipping between the disks. What is the angular velocity of disks then? How much heat was generated during this process?



2. A thin-walled cylinder of radius R rotating with initial angular velocity ω is placed in a corner, as shown on a picture. Friction coefficient between the sides of the corner and the cylinder is μ. Find how many times will the cylinder rotate around its' axis before stopping.



3. A thin ring is rolling without slipping on a horizontal surface moving at speed v towards a smooth wall. Its collision with the wall is perfectly elastic. How much time does it take for the ring to come to a full stop after the collision with the wall? Friction coefficient between the ring and the horizontal surface is μ. Describe the motion qualitatively if instead of a thin ring we take a uniform solid disk.

4. A man of mass m stands on the edge of a disk, rotating around a frictionless vertical axis with angular velocity ω. The disk has radius R and moment of inertia I. How will angular velocity change if the man moves from the edge to the center of the disk? How will the kinetic energy of the system change? Neglect man's size compared to the disk size.

***5.** Consider two people fencing with uniform sticks. Which part of a stick should hit the other stick so that a fencer does not feel recoil? The fencer holds the stick by one of the ends with one hand.

For the next meeting

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **February 26**.