ADVANCED PHYSICS CLUB

JANUARY 19, 2025

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=ay2024`
The practical information about the club and contacts can be found on the same web page.

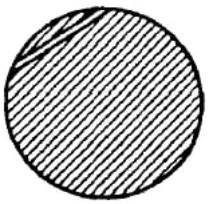
Today's meeting

We solved some of the assigned problems on harmonic motion, two remaining problems are reassigned. The next topic is rotational dynamics.

Reassigned homework

1. A block hanging still on a vertical spring extends it by length l. Find the period of small vertical oscillations of the suspended block.

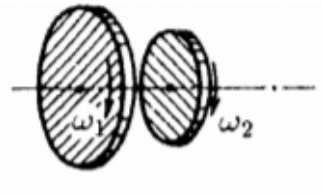
***2.** A straight tunnel is dug through the Earth, not passing through its center. How long would it take a train with engine off to travel from one end to the other end in such a tunnel? Neglect friction and air resistance.



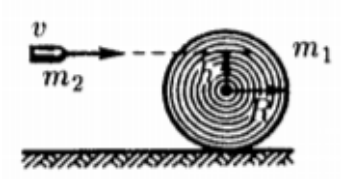
Homework

1. Solve the following problems from the previous F = ma exams:
(a) 25 (2009: `https://www.aapt.org/physicsteam/2010/upload/2009_F-ma.pdf`)
(b) 24 (2010: `https://www.aapt.org/physicsteam/2010/upload/2010_Fma.pdf`)
(c) 24, 25 (2011: `https://www.aapt.org/physicsteam/2012/upload/WebAssign-exam1-2011-1-4.pdf`)
(d) 10 (2012: `https://www.aapt.org/physicsteam/2013/upload/exam1-2012-unlocked.pdf`)

2. Two disks with moments of inertia I_1 and I_2 are rotating around the same 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?



3. A cylinder of mass m_1 and radius R is at rest on a horizontal plane. A bullet of mass m_2 flying horizontally with velocity v at the height $h < R$ above the cylinder axis hits the cylinder. Assuming the collision is absolutely inelastic and $m_2 \ll m_1$, calculate the axis velocity and angular velocity of the cylinder after the collision.



4. A man of mass m stands on the edge of a rotating horizontal disk. The disk has radius R and moment of inertia I, it rotates without friction around vertical axis with angular velocity ω. How will the 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.

For the next meeting

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