ADVANCED PHYSICS CLUB

JANUARY 28, 2024

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.

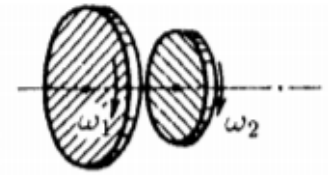
Today's meeting

Today we solved all the assigned problems on simple harmonic motion. The new topic is rotational dynamics.

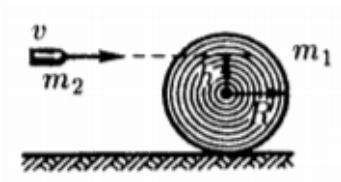
Homework

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, 25 (2011: `https://www.aapt.org/physicsteam/2012/upload/WebAssign-exam1-2011-1-4.pdf`)
   (c) 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?

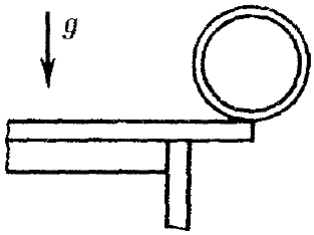


3. A cylinder of mass m_1 and radius R is at rest on a horizontal plane. A bullet of mass m_2 flying horizontally with velocity v at the height $h < R$ above the cylinder axis hits the cylinder. Assuming the collision is absolutely inelastic and $m_2 \ll m_1$, calculate the axis velocity and angular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

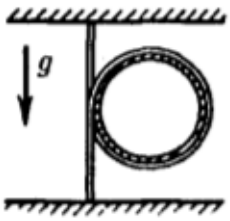


4. A man of mass m stands on the edge of a rotating horizontal disk. The disk has radius R and moment of inertia I, it rotates without friction around vertical axis with angular velocity ω. How will the angular velocity change if the man moves from the edge to the center of the disk? How will the kinetic energy of the system change? Neglect man's size compared to the disk size.

5. A thin ring stands on the edge of a desk so that its' center is right above the edge. The ring starts rolling without slipping off the desk. By what angle will it turn by the time it loses contact with the desk? Would this angle be larger or smaller if instead of a ring it was a solid ball?



***6.** A uniform heavy rope with ends fixed along the same vertical line is grasped around a massless ring that is initially held still. What is the acceleration of the ring if it's suddenly let go from rest?



***7.** 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 4**.