ADVANCED PHYSICS CLUB
JANUARY 26, 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 rotational dynamics, two remaining problems are reassigned. The next topic is gravity and orbital motion.

REASSIGNED HOMEWORK

1. 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?
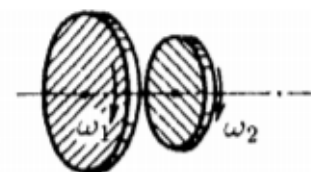
2. A cylinder of mass m_1 and radius R is at rest on a horizontal plane. A bullet of mass m_2 flying horizontally with velocity v at the height $h < R$ above the cylinder axis hits the cylinder. Assuming the collision is absolutely inelastic and $m_2 \ll m_1$, calculate the axis velocity and angular velocity of the cylinder after the collision.
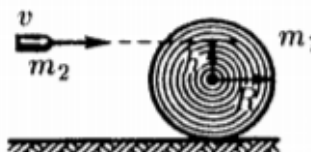
3. A man of mass m stands on the edge of a rotating horizontal disk. The disk has radius R and moment of inertia I, it rotates without friction around vertical axis with angular velocity ω. How will the angular velocity change if the man moves from the edge to the center of the disk? How will the kinetic energy of the system change? Neglect man's size compared to the disk size.

HOMEWORK

1. Solve the following problems from the previous F = ma exams:
   (a) 5, 21,22 (2009: `https://www.aapt.org/physicsteam/2010/upload/2009_F-ma.pdf`)
   (b) 17,21,25 (2010: `https://www.aapt.org/physicsteam/2010/upload/2010_Fma.pdf`)
   (c) 5, 23 (2011: `https://www.aapt.org/physicsteam/2012/upload/WebAssign-exam1-2011-1-4.pdf`)
   (d) 9, 25 (2012: `https://www.aapt.org/physicsteam/2013/upload/exam1-2012-unlocked.pdf`)

2. a) Find the mass of the Earth knowing the free fall acceleration on its' surface $g = 9.8$ m/s^2 and its' radius $R = 6370$ km . b) Find the escape velocity for the Earth.

3. A satellite is orbiting the Earth with velocity v. What additional velocity should it be supplied with so that it can escape the Earth gravity completely?

4. How long would an Earth's year be if mass of the Earth was equal to mass of the Sun and the distance between them stayed the same?

FOR THE NEXT MEETING

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **February 2**.