ADVANCED PHYSICS CLUB

NOVEMBER 13, 2022

Useful resources

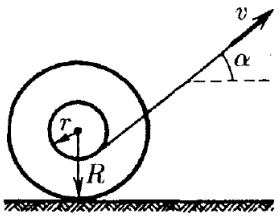
The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`http://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2022`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

Today we solved problems on circular motion. The few remaining problems are reassigned. Our new assignment is on Newton's laws.

Reassigned Homework

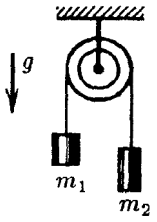
***1.** A thread coiled around a bobbin is pulled with velocity v at an angle α (see picture). The bobbin rolls without slipping on a horizontal surface. Find velocity of the axis of the bobbin and its angular velocity. For which α does the bobbin move right? Left? The thread is very long, so α does not change during the motion.



***2.** Because of the finite exposure needed, in a side-on photograph of the front wheel of a moving bicycle, the spokes seem blurred. However, there will be some apparently sharp points in the picture. Where are these sharp points? For the sake of simplicity, suppose that the bicycle spokes are radial.

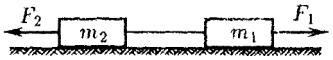
New Homework

1. Find acceleration of the blocks and tension forces in the system shown on the figure. Neglect masses of the pulley and ropes, also neglect friction.

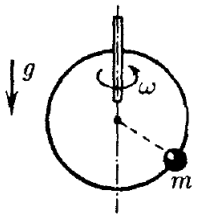


2. A train is moving with speed v_0 on a straight horizontal rail track. Suddenly 1/3 of the train cars are detached and after some time the speed of detached cars has decreased by half. Find the speed of the rest of the train at this moment assuming that the traction force didn't change. Assume that friction force is proportional to weight and does not depend on speed.

3. Two bodies of masses m_1 and m_2 are connected by a thread which withstands tension up to T. Bodies are acted upon by forces $F_1 = \alpha t$ and $F_2 = 2\alpha t$, where α is a constant coefficient and t is time. Find the time when the thread will be torn.



4. A small bead can move freely along a vertical smooth circle of radius R. The circle is rotating with angular speed ω around a vertical axis going through the center of the circle. Where is the equilibrium point of the bead? Is this equilibrium stable?



***5.** A square curtain is hanging down vertically, attached by its top side to a horizontal rod. Then the bottom side of the curtain is elevated to the same level as the top side, so that the curtain is folded in two. Find how the force acting on the rod depends on time after the elevated end of the curtain is let go. Assume that the curtain is thin and soft. The size of the curtain is 1.5 m $\times$ 1.5 m, its mass is 3 kg.

***6.** A constant force starts acting on a body which initially was moving with speed v_0. After time Δt speed of the body is decreased by half. After one more time interval Δt speed of the body is a quarter of initial speed. Find speed of the body after time $3\Delta t$ since the moment when the force was first applied.

For the next meeting

IMPORTANT: The next club's meeting is at 3:30pm, via Zoom, on Sunday, **November 20**.