

PHY-421: Mechanics, UMass Amherst, Problem Set #2

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Due: Friday, Sept 11. (Late homework receives 50% credit.)

I. SLIDING OFF A DOME

A particle of mass m sits directly atop a frictionless ice dome of radius R . By very slightly displacing the particle, the particle begins to slide down the dome. At which angle will the particle fall off the slide?

II. PARTICLE IN A ROTATING TUBE

Consider a particle of mass m in a tube that is rotating with angular velocity ω around one of its ends. The axis of rotation is perpendicular to the tube. What is the trajectory of the particle? (Assume there's no friction between the particle and the tube. At $t = 0$, the particle is at rest and at distance r_0 from the axis of rotation.)

III. CAR CHASE

Consider four cars at the corners A_1, A_2, A_3, A_4 (ordered clockwise) of a square of initial diagonal $2a$. The car A_i is following the car A_{i+1} with a constant velocity v . (with the convention $A_5 \equiv A_1$ so A_4 has its velocity pointing towards A_1 .) How long does it take for the cars to meet at the same point? What is the equation of the trajectory of each car?

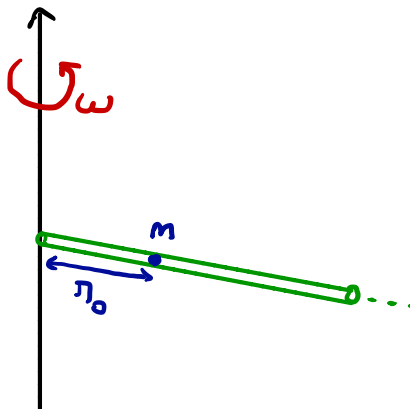


FIG. 1: Problem II: A particle of mass m is placed in tube that is rotating with angular velocity ω around one of its ends.