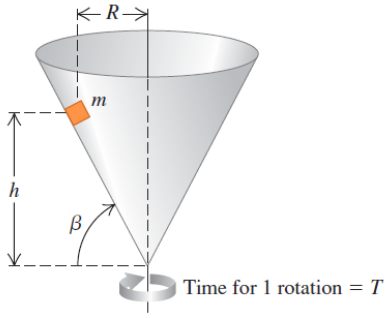
Fall 2019 Physics 7A Lec 002 (Yildiz) Midterm I

1. A student sits atop a platform a distance h above the ground. He throws a large firecracker horizontally with a speed v. However, a wind blowing parallel to the ground gives the firecracker a constant horizontal acceleration with magnitude a. This results in the firecracker reaching the ground directly under the student. Determine the height h in terms of a, v and g. Ignore the effect of air resistance.

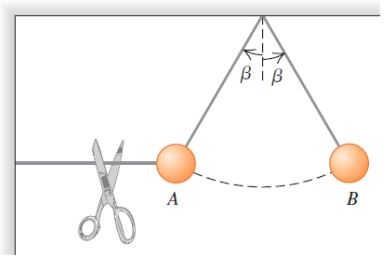
2. Two students are canoeing on a river. While heading upstream, they accidentally drop an empty bottle overboard. They then continue paddling for 60 minutes, reaching a point 2.0 km farther upstream. At this point they realize that the bottle is missing and, driven by ecological awareness, they turn around and head downstream. They catch up with and retrieve the bottle (which has been moving along with the current) 5.0 km downstream from the turn-around point. (a) Assuming a constant paddling effort throughout, how fast is the river flowing? (b) What would the canoe speed in a still lake be for the same paddling effort?

3. A small block with mass m is placed inside an inverted cone that is rotating about a vertical axis such that the time for one revolution of the cone is T. The walls of the cone make an angle β with the horizontal. The coefficient of static friction between the block and the cone is μ_s. If the block is to remain at a constant height h above the apex of the cone, what are (a) the maximum value of T_{max} and (b) the minimum value of T_{min}? Find expressions for T_{max} and T_{min} in terms of β and h.

A block inside a spinning cone.



4. A ball is held at rest at position A by two light strings. The horizontal string is cut and the ball starts swinging as a pendulum. Point B is the farthest to the right the ball goes as it swings back and forth. What is the ratio of the tension in the supporting string at position B to its value at A before the horizontal string was cut?
Hint: The velocity of the ball is zero at point B.



5. A popular carnival ride consists of seats attached to a central disk through cables. The passengers travel in uniform circular motion. The radius of the central disk is R_0, and the length of the cable is L. The mas of one of the passengers including the chair is m.
a) If the cable makes angle θ with respect to the vertical, what is the speed v of this passenger?
b) What is the magnitude of the force F_T exerted by the cable on the chair?
c) How much time it takes for the passenger to make a complete turn (i.e. the period T of circular motion)?