MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01X Fall Term 2001

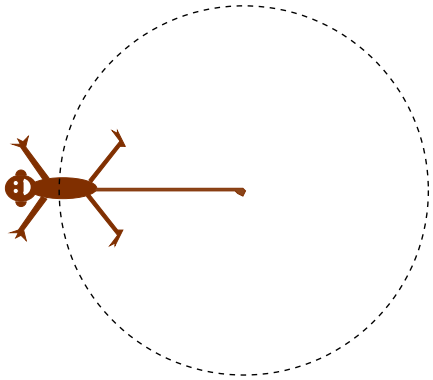
PROBLEM SET 5

Handed out: October 5
Due: October 12 at 5 pm in 4-339B.

Please write your name, subject, **recitation number**, and the name of the recitation instructor on the top right corner of the first page of your homework solutions. The solutions should be placed in the appropriate box in room 4-339B.

Problem 1:

A child swings his stuffed monkey toy by the tail in a horizontal circle of radius 0.5 m. The monkey's mass is 0.5 kg. The tail is a bit chewed-on and frayed and can only withstand a tension of about 20 N.



a. What is the maximum speed with which the child can swing the monkey so that the tail does not break?

b. What is the frequency ω corresponding to that speed?

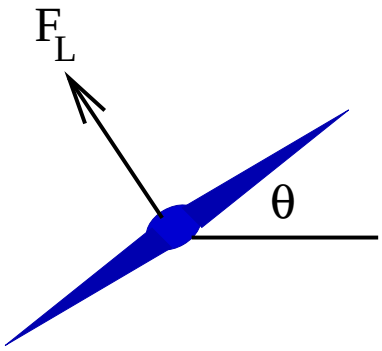
Problem 2:

Design a carnival ride on which standing passengers are pressed against the inside curved wall of a rotating vertical cylinder. The passengers stand against the inside wall; the cylinder then starts rotating, and as it speeds up the passengers are pressed outward. When the cylinder is going fast enough the floor drops away leaving the passengers "suspended".

The cylinder is to turn at most at 0.5 rev per second. The maximum μ_s between clothing and wall is 0.2. What diameter should the cylinder have to safely allow the floor to drop away?

Problem 3:

Consider an airplane flying in a circle of diameter D. The circle is horizontal, i.e. the plane of the circle is parallel to the ground. The speed of the plane, v, is constant.



The pressure of the air against the bottom of the airplane's wings exerts a "lift" force F_L. The direction of this force is always perpendicular to the wings. The airplane has mass M. The airplane's engines exert a forward "thrust" force on the plane F_t, while air resistance exerts a backward "drag" force F_d. ("Forwards" and "backwards" mean with respect to the direction of motion of the airplane.)

a. Is F_t bigger, smaller, or the same magnitude as the drag force F_d? Explain.

b. At what angle θ must the airplane be banked at in order to continue flying in its circular path? Express your answer in terms of M, v and D.