MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Physics

Physics 8.01 Spring 2005

PROBLEM SET 4

Saturday, February 19, 2005

Due Date: Thursday, February 24, 2005, 3:00 p.m.

Corrected Version, 2/19/05, 5:00 pm: Y&F:115 ⇒ Y&F:5.115

Reading Assignment: Young and Freedman, Sections 5.3 – 5.5; Busza, Cartwright, and Guth: pp. 204-206 of Chapter 6, through the paragraph that begins on p. 205. BCG discuss circular motion in one paragraph in the middle of p. 15.

Topics for the week: Frictional forces, circular motion and the banking of tracks, and the conical pendulum. (The number of new principles is very small, but the scope of problems to which these principles can be applied is very large.)

Instructions:

If a problem is marked ***DO***, you should write a solution to hand in to be graded. The graders will read your answers to one or two questions on each problem set, and they will check whether the other problems have at least been handed in.

The quiz on this material, to be given at 10:05 am on Friday, February 25, will include at least one problem that is at most a slight modification of one of the problems (***DO*** or ***STUDY***) on this problem set.

Your written solutions are due by 3:00 pm in room 4-339B on Thursday, February 24. Please indicate the number, instructor, and time of your recitation section, and be sure to submit your paper to the correct bin. Solutions will be made available on the 8.01 website shortly afterward, so that you will be able to use them in studying for the quiz.

Frictional Basics:

1)	***DO:***	SG:6A.1	Dragging crates in a warehouse

Circular Motion Basics:

2)	***DO:***	Y&F:5.114	What to do when your frictionless table has a hole in it

More Difficult Friction Problems:

3)	***STUDY:***	SG:6B.2	(S) Lugging a desk across a level floor
4)	***DO:***	Y&F:5.62	A block on top of a block
5)	***DO:***	SG:7.8	A suitcase placed on a conveyor belt. Omit the part of the problem about work, which we have not yet studied. A revised statement of the problem appears at the end of this problem set.
6)	***DO:***	SG:7.15	(H) One or two blocks pulled by a rope

More Difficult Circular Motion Problems:

7) ***DO:*** Y&F:5.95 Maximum and minimum speeds on a banked road. For help, see the worked problem 6E.6 in the *Study Guide*, or Example 5.24 in Young & Freedman.

8) ***DO:*** Y&F:5.115 A bead on a rotating circular hoop. *Hint: Note that this situation is almost the same as the conical pendulum.*

Problems with Air Drag:

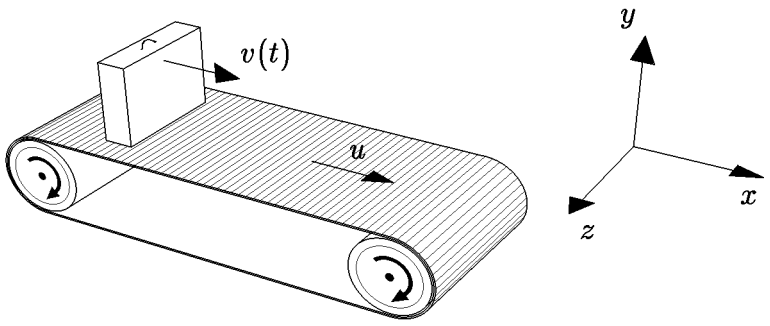
9) ***DO:*** Y&F:5.14 An airplane moving in a straight line

10) ***DO:*** Y&F:5.105 Fluid resistance and terminal speed. *Note that Eq. (5.10) of Young & Freedman can be found on p. 180.*

REVISED VERSION OF PROBLEM 7.8

7.8 A suitcase placed on a conveyor belt

A suitcase of mass M is placed on a level conveyor belt at an airport. The coefficient of static friction between the suitcase and the conveyor belt is μ_s, and the coefficient of kinetic friction is μ_k, with $\mu_k < \mu_s$.



The conveyor belt moves with constant speed u, and at time $t = 0$ the suitcase is placed on the conveyor with speed $v = 0$. At $t = 0$, what is the total force $\vec{\mathbf{F}}$ acting on the suitcase? How long does the suitcase take to reach the speed of the conveyor belt (i.e. at what time t does $v(t) = u$)? Is the frictional force on the suitcase in the same direction or in the opposite direction of its motion? After the suitcase reaches the speed of the conveyor belt, what is the force of friction that acts on it?