MIDTERM

July 18^{th}, 2013
80minutes ◇ 100points

Physics 7A Summer 2013
University of California at Berkeley

This midterm is closed book and closed notes. You are allowed one side of a sheet of paper on which you may write whatever you wish. You are not allowed to use calculators. Anyone who does use a wireless capable device will automatically receive a zero for this midterm. Cell phones must be turned off.

Please make sure that you do the following during the midterm:

- ◇ Write your name, discussion number, ID number on all documents you hand in.
- ◇ Make sure that the grader knows what s/he should grade by circling your final answer.
- ◇ Cross out any parts of your solutions that you do not want the grader to grade.

We will give partial credit on this midterm, so if you are not altogether sure how to do a problem, or if you do not have time to complete a problem, be sure to write down as much information as you can on the problem. This includes any or all of the following: drawing a clear diagram of the problem, telling us how you would do the problem if you had the time, telling us why you believe (in terms of physics) the answer you got to a problem is incorrect, and telling us how you would mathematically solve an equation or set of equations once the physics is given and the equations have been derived. Don't get too bogged down in the mathematics; we are looking to see how much physics you know, not how well you can solve math problems. If at any point in the exam you have any questions, just raise your hand, and we will see if we are able to answer them.

PROBLEM 1 ◇ BALLOON DELIVERY SERVICE ◇ *30points*

Entrepreneurial monkeys are starting a hot air balloon delivery service. They have balloons at height H above ground from which they horizontally throw packages and they claim they can precisely deliver to any destination.

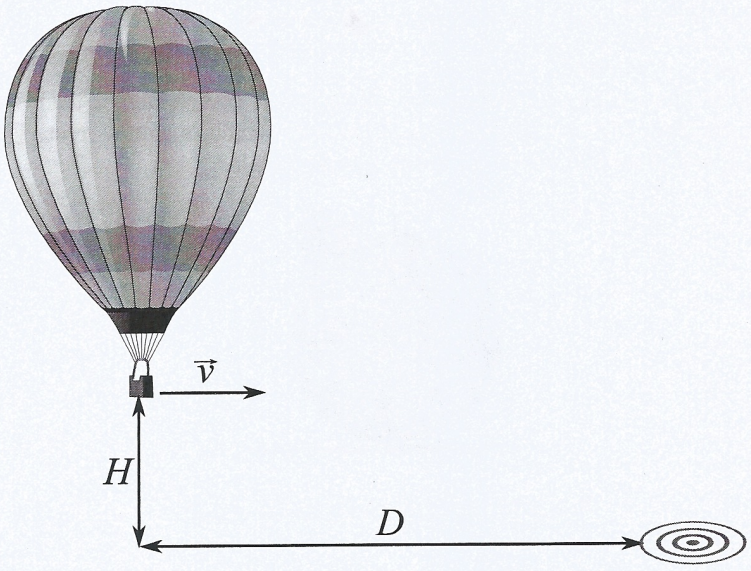

Figure 1: Packages are thrown from the balloon horizontally.

- ◇ **A** The destination for the first package is a horizontal distance D away from the balloon which is at rest. What should be the speed v_1 of the first throw?
- ◇ **B** For the second throw the destination is a target moving on the ground while the delivery balloon is still at rest. The target is again horizontal distance D away in the moment of the throw but it is moving with horizontal speed v_t away from the balloon. What should the speed v_2 of the second throw be?
- ◇ **C** If at the moment package is thrown the balloon is moving with upward speed v_b and upward acceleration a_b what is the speed v_3 of the throw that hits a target moving like in part **B**?

You can ignore wind and air resistance in this problem.

PROBLEM 2 ◇ MONKEY WEDGE ◇ *40points*

A monkey of mass m slides down a wedge of mass M and height H making an angle θ with the horizontal. The monkey starts from rest at the very top of the wedge which is also initially at rest.

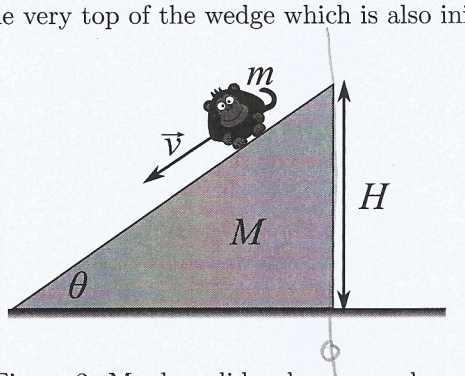

Figure 2: Monkey slides down a wedge.

- ◇ **A** If the wedge is very smooth so there is no friction what is the speed of the wedge when the monkey reaches its bottom?
- ◇ **B** How much work did monkey do on the wedge?
- ◇ **C** Now assume that there is friction between the monkey and the wedge and still no friction between the wedge and the floor. What is the condition that the coefficient of static friction μ_s must satisfy so that the monkey starts slides down?
- ◇ **D** Given that friction satisfies this condition and the coefficient of kinetic friction $\mu_k < \mu_s$ what is the speed of the wedge when the monkey reaches its bottom?

PROBLEM 3 ◇ MONKEY BALL ◇ *30points*

The monkey gets bored of the wedge and finds a ball of radius R (much bigger than the monkey) to slide down. The monkey starts from rest at the very top of the ball which is also at rest. Unlike the wedge this ball is fixed to the table and does not move while the monkey slides.

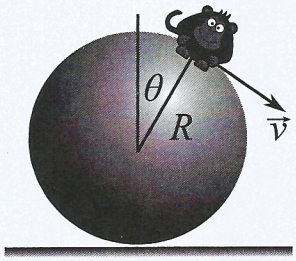

Figure 3: Monkey slides down a ball.

- ◇ **A** If the ball is very smooth so there is no friction at what angle θ will the monkey loose contact with the ball?
- ◇ **B** If the friction were present would the monkey fly off the ball at a greater or lesser angle?
