Physics 7A, Section 1 (Prof. Hallatschek)
Second Midterm, Spring 2015
Berkeley, CA

Rules: *This midterm is closed book and closed notes. You are allowed two sides of a sheet of 8.5" x 11" of paper on which you can note whatever you wish.* ***You are not allowed to use scientific calculators.*** *Cell phones must be turned off during the exam, and placed in your backpacks.* ***In particular, cell-phone-based calculators cannot be used.***

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.*
- *Answer all questions that require a numerical answer to three significant figures.*

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 problems, just raise your hand, and we will see if we are able to answer it.

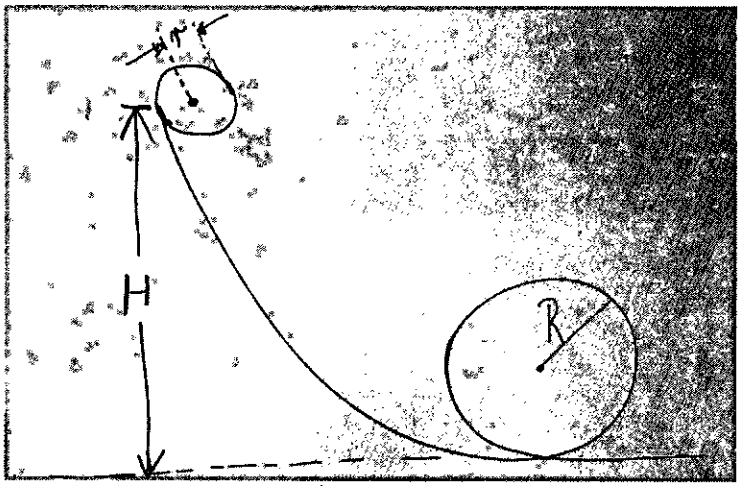
Name: ______________________ *Disc Sec Number:* ______________________

Signature: ______________________ *Disc Sec GSI:* ______________________

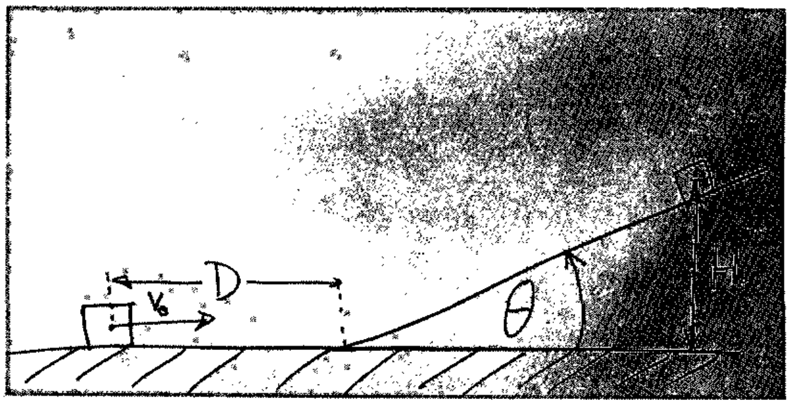
Student ID Number: ______________________

Problem	***Possible***	***Score***
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

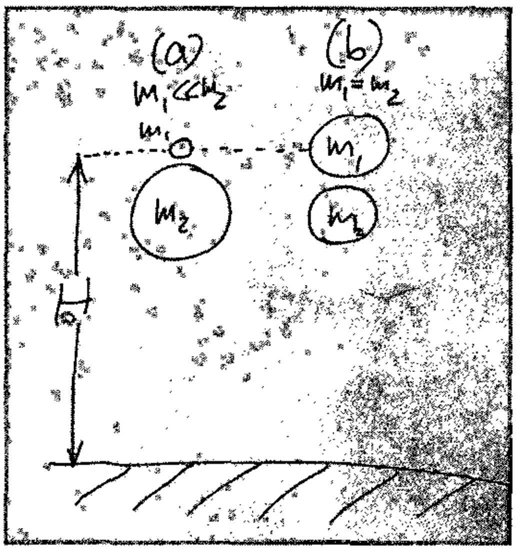
1. **Hoop rolling down a loop.** A hoop (mass m, radius r) rolls, without slipping, down a ramp (initial height=H) and enters a circular loop (radius R), as shown in the figure. How large must H be at least for the hoop to complete the loop without detaching from the track.



2. **Box sliding up a ramp**: Somebody kicks a box (mass m) so that it slides up a ramp (inclination angle θ), as indicated in the figure. What height H will the box reach if it has velocity v_0, just after the kick, (a) if you ignore friction and (b) if you take into account friction (suppose the kinetic friction coefficient is μ_K everywhere on the track). Assume that box slides smoothly from the floor onto the ramp (i.e., no sudden change in velocity at the kink).

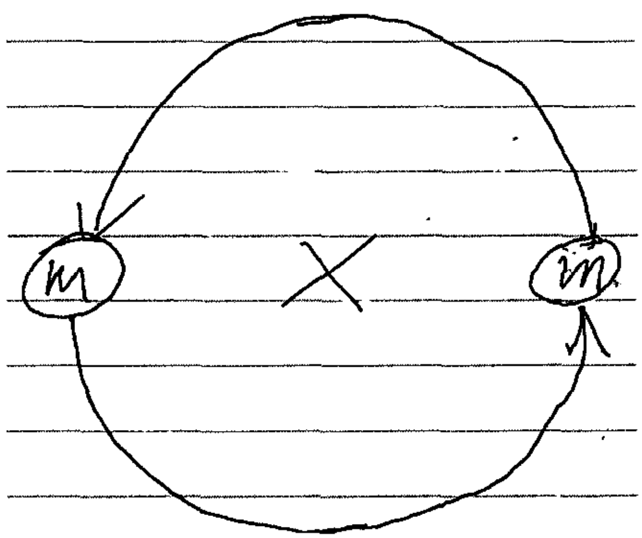


3. **Falling balls:** (a) A Ping-Pong ball (mass m_1) is positioned just on top of a basketball (mass m_2), with a little gap in-between (see Fig. a). Then, both balls are dropped at the exact same time. Assume that all collisions are purely elastic. How high does the Ping-Pong ball come back up if it is released from height H? (b) What height does the top ball reach if both balls have the exact same mass?



$H >> r_1, r_2$

4. **Binary star system:** Two identical stars (each of mass *m*) are separated by a distance *D*. They revolve around their common center (shown by *X*), each star executing a circular orbit about this point. (a) what is the common period of revolution of the stars? (b) Suppose a meteoroid (approximated by small point mass) passes through point *X*, moving perpendicular to the orbital plane of the stars (i.e., out of the page). At this time, the meteoroid is traveling at speed v_0. How large does v_0 need to be for the meteoroid to escape from the star system (i.e. to never return)?



5. **Rolling Yo-Yo:** A Yo-Yo, seen here in cross-section, rests on a horizontal table and is free to roll without slipping. If the string is pulled at an angle $\theta<\theta_c$, the Yo-Yo rolls to the right. If the string is pulled at an angle $\theta>\theta_c$, the Yo-Yo rolls to the left. Find the angle θ_c at which the behavior changes.