Physics 7A, Section 2 (Prof. Hallatschek)
Second Midterm, Fall 2014
Berkeley, CA

Rules: *This midterm is closed book and closed notes. You are allowed two sides of one-half sheet of 8.5" x 11" of paper on which you can whatever note you wish. You are also allowed to use scientific calculators in general, but not ones which can communicate with other calculators through any means.* ***Anyone who does use wireless-capable will automatically receive a zero for this midterm.*** *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 a/together 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.

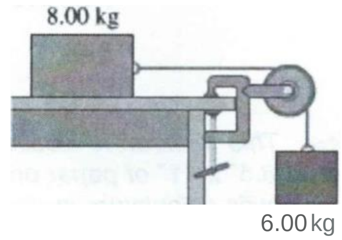
*Name:*__________________________________ *Disc* Sec *Number:* ____________________________

Signature: _____________________________ *Disc* Sec GS/: _____________________________

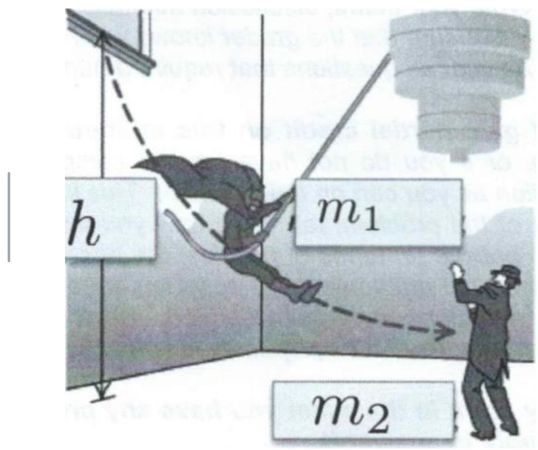
*Student ID Number:*____________________

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

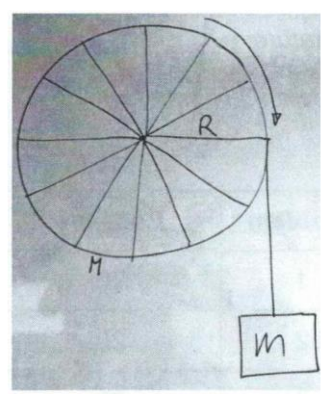
1. Consider the system shown in the figure. The rope and pulley have negligible mass, and the pulley is frictionless . The coefficient of kinetic friction between the 8.00-kg block and the tabletop is μ_k*=0.250.* The blocks are released from rest. Use energy methods to calculate the speed of the 6.00-kg block after it has descended 1.50 m.



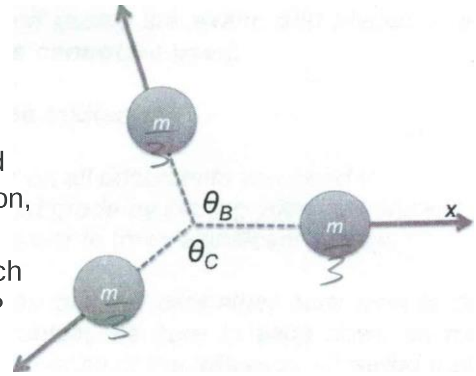
2. Superwoman (mass m_1) stands on a window ledge a height h above the floor (see figure). Grabbing a rope attached to a chandelier, she swings down to grapple with a villain of mass m_2, who is directly standing under the chandelier. (Assume that superwoman's center of mass moves downward by h. She releases the rope just as she reaches the villain .) (a) With what speed do the entwined foes start to slide across the floor? (b) If the coefficient of kinetic friction is μ_k, how far do they slide?



3. A bicycle wheel consists of a rim of unknown mass M and essentially massless spokes. Suppose we mount the bicycle wheel on a wall, so that the wheel is parallel to the wall, and so that it is free of spin around its center, but not free to move translationally. We wrap a thin, light string around the outer rim of the bicycle wheel and attach a block of mass m to the end of the string, as shown in the figure. In order to figure out the mass M of the rim, an engineering student releases the block from rest and measures the time *t* that it takes the block to fall through a distance *L.* How can the student calculate *M* from knowing *L, t, R,* m and *g?*



4. An object with mass m, initially at rest, explodes into fragments . Assume that energy Q is released in the explosion and converted into purely translational kinetic energy. (a) If the object explodes into two fragments, one with mass m_A and the other with mass m_B, where $m_A+m_B=m$, how much kinetic energy does each fragment have immediately after the explosion? (b) Now, suppose the object explodes into three fragments of identical masses $m/3$ respectively. Assume that the fragments fly off as indicated in the attached figure: *A* moves in the +x direction, and *B* and C move at angles θ_A and θ_B respectively. How much kinetic energy does each fragment have immediately after the explosion?



5. A small frictionless block, of mass *m*, slides rightward at initial speed v_0 towards a ramp of mass *M.* The ramp, initially at rest, is free to slide along the floor without friction. So, as the block slides up the ramp, the ramp starts sliding rightward. (a) What initial speed is required for the small block to just reach the top end of the ramp, which is at height *H?* (b) Assume the initial speed is smaller than this critical speed. Then the block will slide down again, leaving the ramp and sliding leftward. What will be the resulting final speed of the ramp? (c) Consider again the small block while it is sliding up the ramp. Find a general expression for the speed of the block at height *h* above the ground? (Assume *h<H).*