Physics 7A, Instructor: Yildiz
Second Midterm, Spring 2011, Berkeley, CA

Rules: This midterm is closed book and closed notes. You are allowed two sides of one formula sheet of 8.5" x 11" of paper. You are allowed to use scientific calculators in general, but not ones which can communicate with other calculators through any means, nor ones that can do symbolic integration. Anyone who does use a wireless device will automatically receive a zero for this midterm. Cell phones must be turned off during the exam, and placed in your backpacks.

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 the 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 be sure to write down a clear diagram of the problem with a coordinate axis, show forces acting on each object, and equations required to solve the problem. Correct answer without any work leading to it will not receive any credit.

Copy and fill in the following information on the front of your bluebook:

Name: _____

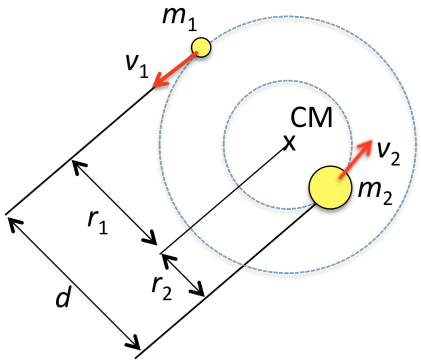
Signature: _____

Student ID Number: _____

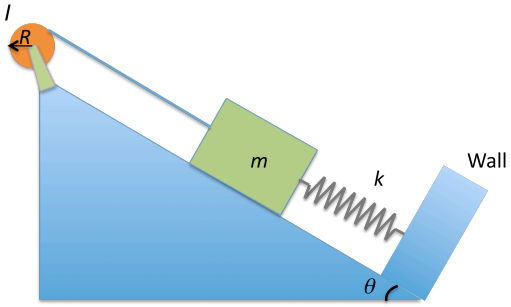
Disc Sec Number: _____

Disc Sec GSI: _____

1. (15 points) Two stars of masses m_1 and m_2. Separated by a distance d, revolve in circular orbits about their center of mass CM (see Figure). Find the period of rotation of each mass in terms of d, m_1, m_2, and G (universal gravitation constant).



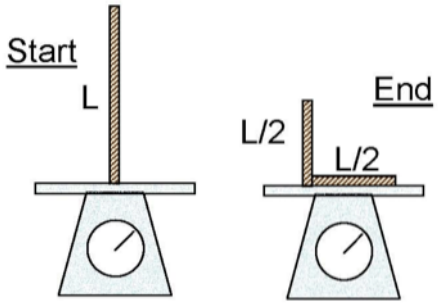
2. (20 points) A block of mass m is at rest on an incline, which makes angle θ to the horizontal. Coefficient of kinetic friction between the block and the incline is μ_k. One end of the block is connected to a massless spring of force constant k, and the other end is fastened to a massless cord wrapped around the reel. The reel shown in figure has radius R and moment of inertia I. The reel is wound counterclockwise so that



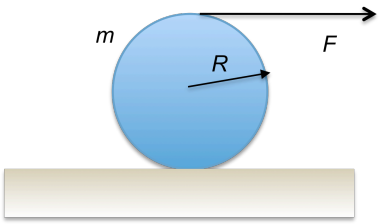
the spring stretches a distance d from its equilibrium length and the reel is then released from rest. Find the angular speed of the reel after the block has traveled a distance d back to the equilibrium position of the spring.

3. (20 points) Two gliders are set in motion on a horizontal air track. A spring of force constant k is attached to the front of a first glider of mass m_1, which moves to right with a velocity v_1. The second glider with a mass m_2 moves at a slower velocity v_2 to the right, as shown in the figure. When the spring collides with m_2, a) Find the maximum compression x_{max} of the spring, b) Find the speed of each mass at maximum compression, c) Explain whether the collision is elastic or not.

4. (20 points) A uniform rope of length L and mass M is released from rest with its lower end just touching the top of a scale. The rope is released and falls to the scale under gravity. Find the normal force exerted by the scale on the rope after the chain has fallen through a distance $L/2$. (Assume the part of the rope that reaches to the scale instantly comes to rest).



5. a) (10 points) A spool of wire of mass m, and radius of R is unwound under a constant force of F. Assuming the spool is a uniform solid cylinder that rolls without slipping. a) Find the acceleration of the spool's center of mass, and the magnitude and direction of frictional force F_f between the spool and the surface, in terms of F.



b) (15 points) A plank with mass m_1 rests on top of two identical cylinders that have mass m_2 and radius R. The plank is pulled by a constant horizontal force F at one end. The cylinders roll without slipping on a flat surface. There is also no slipping between the cylinders and the plank. Find the initial acceleration of the plank at the moment the rollers are equidistant from the ends of the plank, and the directions and magnitudes of friction forces acting on each object (two cylinders and the plank).