Physics 7A, Section 2 and 3 (Speliotopoulos)
First Midterm, Spring 2011
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 may write whatever you wish. You are also 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-capable device 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 two significant figures.*
- *Cross out any parts of the your solutions that you do not want the grader to grade.*

Each problem is worth 20 points. 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.*

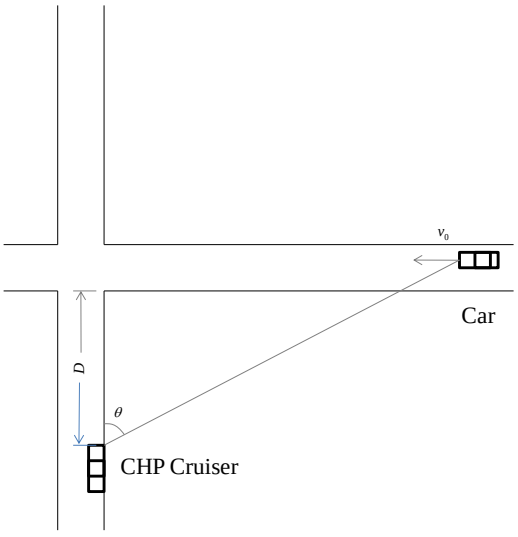
If at any point in the exam you have any questions, just raise your hand, and we will see if we are able to answer them.

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

Name: _____ *Disc Sec Number:* _____

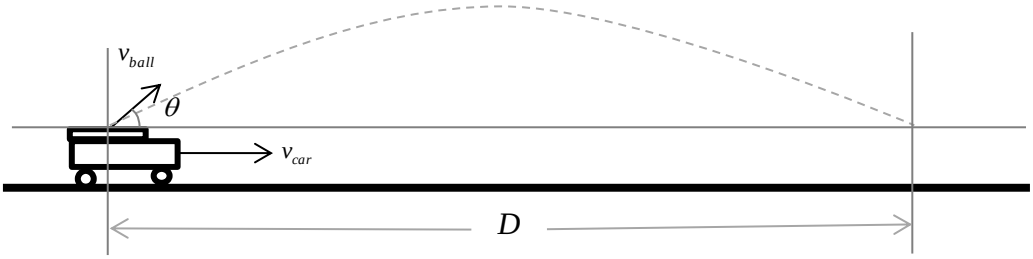
Signature: _____ *Disc Sec GSI:* _____

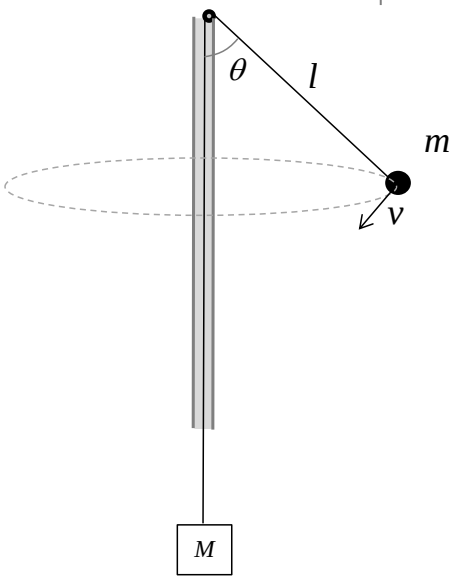
Student ID Number: _____



1. In the rural roads of California, a CHP cruiser is parked a distance D = 1000 m from an intersection. The CHP officer in the cruiser sees a car speeding down the cross street at a constant speed of v_0 =150 *kph* (see figure). To intersect the car right when it reaches the intersection, the office steps on the gas and starts accelerating his cruiser when the speeding car reaches the angle, θ, shown in the figure. What is this θ? Assume that his cruiser accelerates at a constant acceleration of $4\ m/s^2$.

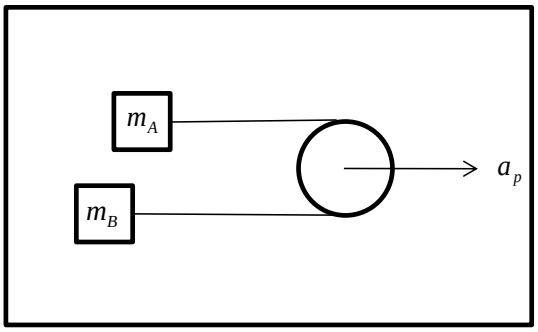
2. A tennis ball launcher is mounted to the roof of a car that is driving down the street with a speed of $v_{car} = 20\ m/s$. The launcher launches a tennis ball with a speed $v_{ball} = 10\ m/s$, and an angle θ from the horizon; both v_{ball} and θ are measured relative to the car. Calculate the distance, *D*, the ball travels relative to the ground in term of θ, and using calculus, find the angle at which *D* is maximum (see figure below). This distance is measured along the road from the point at which the ball is launched to the point at which the ball reaches the same height of the car. Neglect air resistance.





3. The demo of the conical pendulum seen in class involves a ball with mass, *m*, connected to a hanging weight of mass, $M > m$, through a pulley that can rotate without friction in the horizontal plane (see figure to the left). The ball is given a speed, *v*, and rotates about the vertical rod at an angle, θ, from the vertical; the mass *M* does not move up or down. Find θ and *v*, in terms of *g*, *m*, *M*, and the length of the string, *l*, between the pulley and the ball.

4. The figure to the right shows two blocks on top of a frictionless table. The blocks are attached to one another by a string that runs through a pulley with negligible mass. If the pulley is accelerated to the right with acceleration, a_p, what is the acceleration a_A and a_B of each mass, and the tension, *T*. of the string? Express these quantities in terms of m_A, m_B, and a_p.



5. The figure below shows three blocks stacked on top of a *frictionless* table. The top block and the bottom block are connected to each other by a string through a pulley with negligible mass. The coefficient of kinetic friction between the three blocks is the same $\mu_k = 0.30$. When a force, *F=40 N*, is applied to the middle block, all three blocks accelerates, and thus slide with respect to one another. What is the acceleration of each of each block?