Physics 7A, Section 1 (Speliotopoulos)
First Midterm, Fall 2010
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 out formulas and basic facts on both sides. You may not write out solutions to homework problems or specific examples on your sheet. 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.*

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: ____________________

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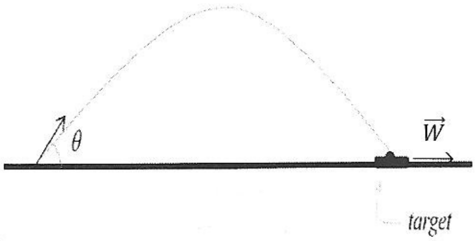
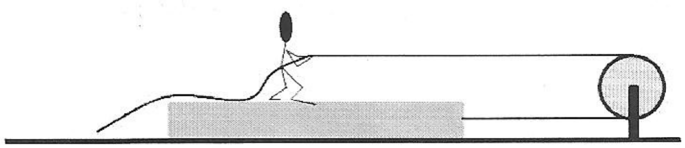
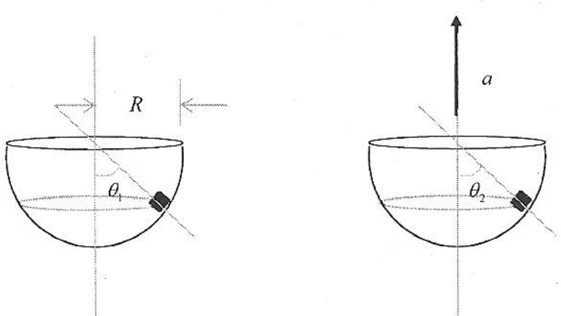
1. Two cars are driving side-by-side down a straight road, and they are traveling at the same speed, v_0. Suddenly, the first car slams on its brakes, and slows down at a constant de-acceleration until it is stopped for an instant. The car then slams on the gas and accelerates with a constant acceleration until it is traveling once again at v_0. Show that if the first car travels a distance, d, during this whole process of slowing down and speeding up, and the second car travels a distance, D, then $D = 2d$ irrespective of the rate at which the first car accelerates and de-accelerates.



2. A tennis ball launcher is placed on a grass lawn, and a target is placed flat on the ground beside it. This target is attached to a car by a rope (see figure), and at the instant the launcher fires a ball at an angle, θ, and a speed, v_0, the target travels to the right at a constant speed, W. When the tennis ball lands, it hits the center of the target. At the instant this ball lands, a second ball is launched at the same angle, but at a speed, v. What must v/v_0 be so that the second tennis ball also hits the center of the target? (You should get a pure number.)



3. The figure to the left shows a man with mass, $m = 80$ kg, standing on a plank with mass, $M = 200$ kg. The man is pulling with force, F, on a rope that is connected by a pulley to the plank below him. If $F = 200$ N is the maximum force he can pull on the rope before his feet start slipping, find the difference, $\mu_s - \mu_k$, where μ_s is the coefficient of static friction between his feet and the plank, and μ_k is the coefficient of kinetic friction between the plank and the ground. As usual, the rope and the pulley have negligible mass, and you can assume that the plank is sliding with this F.



4. Figure A to the left shows a toy car with constant speed, v, racing around a bowl with radius, R, and at an angle, $\theta_1 = 30^o$, from the vertical. Figure B shows the same car moving at the same speed and in the same bowl, but now the bowl and its contents are being accelerated upward with acceleration, a; the car is now at an angle, $\theta_2 = 28^o$, from the vertical. If the car has the same speed in the two cases, what is a/g? All surfaces are frictionless.

Fig. A *Fig. B*

5. The figure below shows two masses resting on a larger block in the shape of an equilateral triangle. The two blocks have mass m_1 and m_2, with $m_2 > m_1$. They are connected to one another through a string running over a pulley. The whole system is being accelerated to the right at an acceleration, a, chosen such that the two small blocks do not move relative to the triangle. If at this acceleration mass m_1 is just starting to lose contact with the triangle, what is m_2/m_1? Your final answer should depend only on θ. All surfaces are frictionless.