Physics 7A, Section 2 (Speliotopoulos)
Final Exam, Fall 2011
Berkeley, CA

Rules: *This final exam is closed book and closed notes. You are allowed three sides of two sheets of 8.5" x 11" of paper on which you may write whatever you wish.* **You cannot use a calculator on the exam.** *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:

- ***Show all your work in your blue book***
- *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 your solutions that you do not want the grader to grade.*

Each problem is worth 20 points. We will give partial credit on this final*, 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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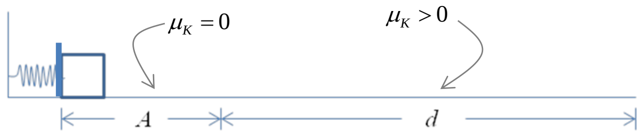
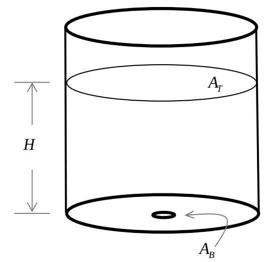
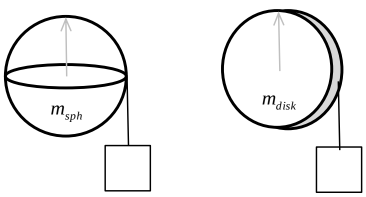
1. A block with mass, m, is placed in front of a spring, which is compressed a distance, A, from its equilibrium length, and released. (The block is not attached to the spring.) While the surface underneath the spring is frictionless, the surface beyond the springs equilibrium length has a coefficient of kinetic friction, μ_k. If the block stops after traveling a distance, d, what is the spring constant, k, of the spring in terms of m, A, and d?



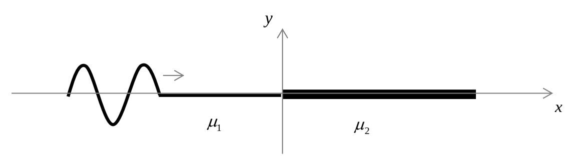
2. The top of a cylindrical container of water has a cross-sectional area, A_T. It has a small hole at the bottom of it that has cross-section area, A_B. (See figure to the right.) If initially the container was filled to a height, H, find the time, T, it would take to empty the container in terms of H, A_T, A_B, and the acceleration due to gravity, g.

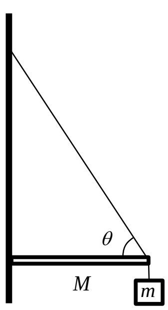




3. A solid sphere and a solid disk have the same radius. They both have strings wound around their circumference, and identical blocks are attached to the end of the strings (see figure on left). The blocks are then dropped. If the sphere has mass, m_{sph}, and the disk has mass, m_{disk}, what must the ratio m_{sph} / m_{disk} be so that the velocity of the blocks are the same after traveling the same vertical distance?

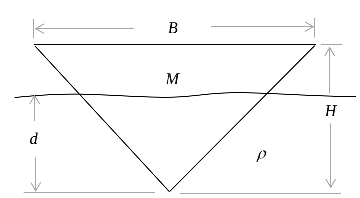
4. Two cords, one with linear mass density, μ_1, and the other with linear mass density, μ_2, are attached together at one end; the cords are under tension. A traveling sinusoidal wave with amplitude, A, is incident on the junction from the left, and after it reaches the junction, there is a transmitted wave with amplitude, A_T, moving to the right, and a reflected wave with amplitude, A_R, moving to the left. Consequently, after the incident wave reaches the junction, in the left cord there is the combined wave, $D_1(x,t) = A\sin(k_1x - \omega t) + A_R\sin(k_1x + \omega t)$, while in the right cord there is just the one wave $D_2(x,t) = A_T\sin(k_2x - \omega t)$. The waves, $D_1(x,t)$ and $D_2(x,t)$, have to satisfy two boundary conditions at the junction of the two cords. State these boundary conditions, and use them to find the transmission coefficient, $T = A_T/A$, of the wave in terms of μ_1 and μ_2.

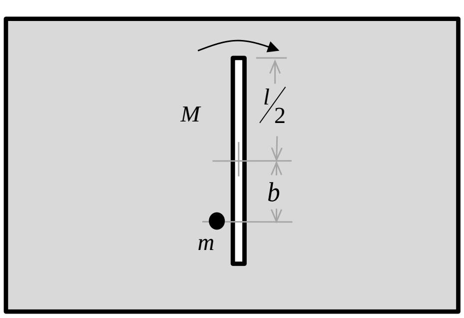




5. One side of a rod with mass, M, is placed perpendicular to a wall while the other side is attached to a cable at an angle, θ, from the horizontal (see figure on left). A mass, m, is hung from the end of the rod. Find the minimum coefficient of static friction, μ_S, between the rod and the wall in terms of m, M, and θ for the rod not to move.

6. A wedge has mass, M, a length, L, and a triangular cross-section with base, B, and height, H. When the wedge is placed in the liquid with density, ρ, it sinks to an equilibrium depth, d, within the liquid (see figure on right). When it is push a small distance, $|y| \ll d$, further into the liquid, it oscillates with frequency, ω. Find d and ω in terms of M, L, B, H, ρ, and acceleration due to gravity, g.





7. A rod with mass, M, and length, l, is rotating in place on a frictionless table (see figure on left). A small mass, m, (with $2m > M > m$) is placed at a distance, b, below the rotational axis of the rod, and the rod collides elastically with the mass. If the rod stops rotating after the collision, find b in terms of M, l, and m.