Physics 7A- Fall 2008 (Lanzara)

2nd MIDTERM

This exam is closed book, but you are allowed half page (double-sided) of handwritten notes of a one 8.5" x 11" page. You may use a calculator, however NO wireless calculators or any calculator functions on your cell phone are allowed. **Anyone using a wireless calculator will forfeit their exam and automatically receive the score of zero.**

Don't forget: a) Write your name, Discussion Section #, GSI name and SID# on the top of all materials you intend to hand in and want to be graded.
b) Remember to circle all of your final answers.
c) Cross out any work you decide is incorrect, with an explanation in the margin.

Suggestions:
Read through the entire exam. Start with the problems you are most familiar with. In this way you will secure some credits.
In general: Work to maximize your credit -- try to obtain at least partial credit on every part of every problem.
- For partial credits show all relevant drawings and explain clearly your reasoning.
- If you recognize that an answer does not make physical sense and you do not have time to find your error, write that you know that the answer cannot be correct and explain how you know this to be true. (We will award some credit for recognizing there is an error.).
- Do not get bogged down in algebra - if you have enough equations to solve for your unknowns, box the equations, state how you would finish, and move on (you can go back and complete the algebra later if you have time).

And if you have questions about the interpretation of a problem, *please ask!*

GOOD LUCK!

Print Name____________________________ Discussion Section# or Time _____________

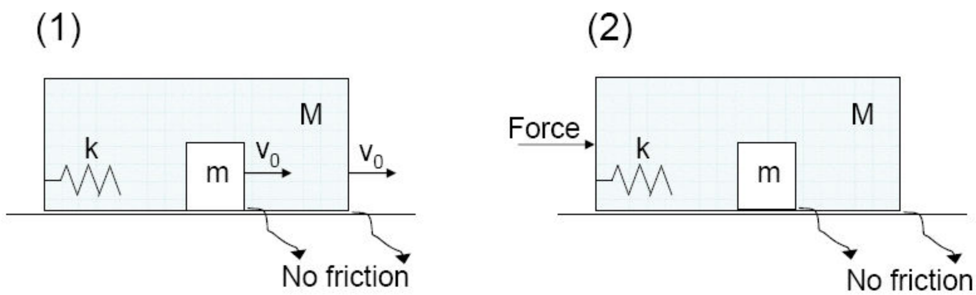
Signature _____________________________ Discussion Section GSI _________________

Student ID# ___________________________

Problem	Points	Score
1	25	
2	25	
3	20	
4	20	
TOTAL	**90**	

Problem 1 (25pts):

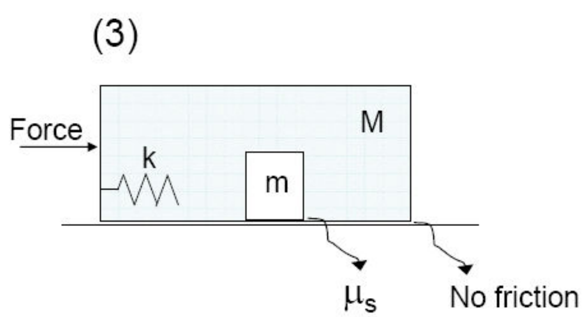
Consider the system shown in the figure below, made of a box of mass M, a massless spring attached to the left wall of the box and a cube of mass m inside the box.
The box can slide freely on a horizontal plane.
The mass of the cube is m=200grams and the spring constant is k=0.2N/m. The spring is initially uncompressed.
The box and the cube initially move together with a constant velocity v_0 (Figure 1), as measured by an outside observer. No friction force is present between the box and the cube and between the box and the horizontal plane.



After we apply a force to the box (Figure 2), the box accelerates with constant acceleration $a=5.0m/s^2$.

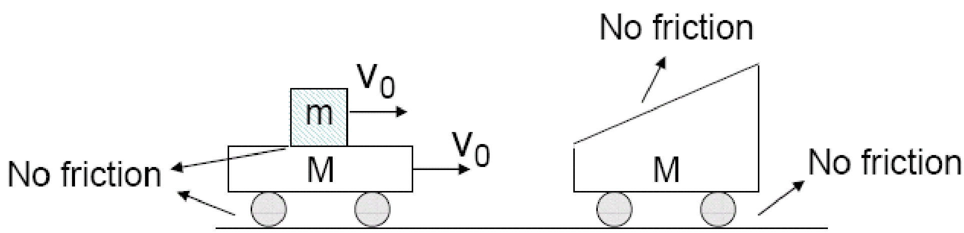
a) (5 pts) Briefly describe what happens to the motion of the cube immediately after we apply the force to the box, as seen from an outside observer.
b) (10 pts) Calculate the maximum compression of the spring.

Consider now the situation in which the friction between the cube and the box is non zero (see Figures 3), with coefficient of static friction μ_s=0.50, while the friction between the box and the horizontal plane is still zero.
If we apply a force to the box like before, resulting in a constant acceleration of the box of a= $5.0m/s^2$:

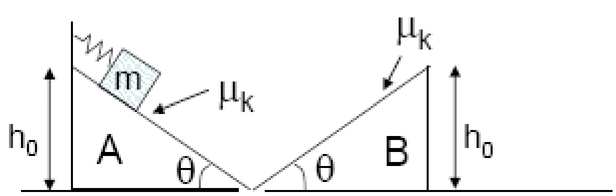


c) (10pts) Find the maximum compression of the spring. Explain your answer.
For ease of calculations use $g=10m/s^2$ for the acceleration of gravity.

Problem 2 (25pts):
A block of mass m is placed on top of a cart of mass M. The two move initially together with velocity v_0 on a frictionless horizontal plane. The cart collides with another cart of equal mass M, of triangular shape, initially at rest (see figure). The collision is completely inelastic. As a result of the collision the two carts will move together and the block of mass m will start sliding to the right. Neglect friction between the block and the carts.
a) (10pts) What are the velocities of the block and the two carts right after the collision?
b) (15pts) Find the maximum height that the block m will reach on the second cart.



Problem 3 (20 points)
Consider the system shown in the figure below formed by two wedges of angle θ , height h_0 and mass M. The two wedges are attached to the horizontal plane and cannot slide. A massless spring of elastic constant k is on top of wedge A. A block of mass m is attached to the spring at height h_0 and the spring is initially compressed by x_0. When the spring is released the block will slide down wedge A and then up wedge B. Assume that the transition from one wedge to the other occurs smoothly (i.e. the bottom surface of the box remains in contact with the wedges at all times). The coefficient of dynamic friction between the wedges and the block is μ_k.
Determine to what height the block will rise on wedge B.



Problem 4 (20pts):

Consider the system shown in the figure below, composed of a massless rod of length 2L which pivots at the center, a block of mass M attached to one end of the rod, a frictionless spool of rope with radius R and moment of inertia I, attached to the other end of the rod, and another block of mass M attached to the spool by its rope. Consider R much smaller than L and neglect the weight of the spool.

The system is held initially at rest.

a) (10pts) Will the system remain in equilibrium once released? Explain your answer using forces and a force diagram.

b) (5pts) Find the tension of the rope right after the system is released.

c) (5pts) Find the acceleration at which the mass attached to the spool will initially descend.