Physics 7A, Section 1 (Yildiz)

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" paper on which you may write whatever you wish. You are also allowed to use scientific calculators in general, but not ones that 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 put away. 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 and 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 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.

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

Name: _____

Signature: _____

Student ID Number: _____

Discussion Section Number: _____

Discussion Section GSI: _____

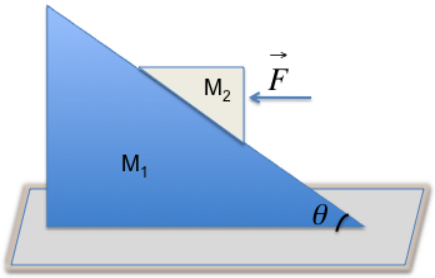
1. (20 points) Ten seconds after being fired, a cannonball strikes a point 400m horizontally and 100m vertically above the point of launch

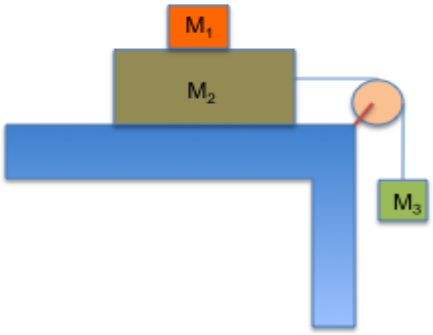
a) With what initial velocity (direction and magnitude) was the cannonball launched?

b) What maximum height was attained by the ball?

c) What is the magnitude and direction of the ball's velocity just before it strikes the given point?

2. (20 points) A wedge of mass M_2 is located on an an incline with mass M_1. The incline makes an angle θ with the horizontal and is free to move along a horizontal surface without friction. A force F is applied in the horizontal direction to the wedge, as shown in the figure. If the wedge and incline move together (e.g. they both move to the right, but do not move with respect to each other), what should be F as a function of M_1, M_2, g and θ? Ignore the friction between the wedge and the incline.



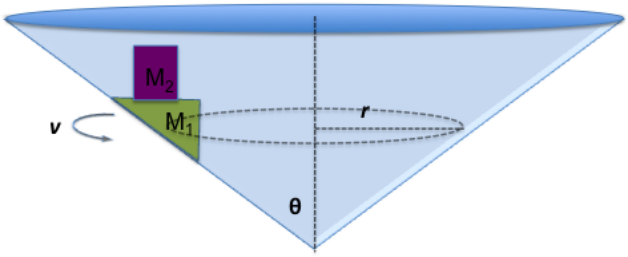


3. (20 points) As shown in the figure, a block of mass M_1 = 1kg is initially at rest on a slab of mass M_2 = 2kg on a level table. The slab is connected to a hanging mass M_3 through a massless rope and pulley. The slab has a coefficient of kinetic friction μ_k = 0.3 and a coefficient of static friction μ_s = 0.5 with both the table and the block. When released, M_3 pulls on the rope and accelerates the slab. Find the maximum mass M_3 that allows the block M_1 to move together with the slab without sliding.

4. (20 points) A wedge of mass M_1 undergoes uniform circular motion at constant speed v inside a frictionless conical surface, which makes angle θ about a vertical axis, as shown in the figure.

a) Determine the radius of rotation r at which the wedge will be in equilibrium, that is where it will have no tendency to move up or down along the conical surface. (Ignore mass M_2 in the figure for part (a). Size of M_1 is negligibly small compared to the radius of rotation.)

b) Another small box of mass M_2 is placed on top of M_1, with a coefficient of static friction of μ_s. If the velocity of M_1 remains unchanged upon the addition of M_2, and M_2 moves with M_1 without sliding, does the equilibrium radius change? Explain.



c) What is the minimum value of μ_s to allow M_2 to move with M_1 without sliding? The top surface of M_1 is horizontal.

5. (20 points) A block of mass m slides along a horizontal surface lubricated with a thick oil which provides a drag force proportional to the velocity of the block: F_d=-bv.

a) If v = v_0 at t = 0, determine v as function of time.

b) Determine x as function of time. Assume that x=0 at t=0.

c) Determine the maximum distance the block can travel.