Physics 120
Term Test #1
Friday October 15, 2004

This exam sheet is double-sided. Please attempt all questions. Only a basic, non-programmable calculator is allowed. You have approximately 50 minutes to complete this test. Your work must be neat and easy to follow. If what you are doing is not clear, you will not get full marks even if you did the question correctly. Please explain all steps carefully and simplify as much as possible. When you are finished, please hand in this question sheet along with your answer sheets. Good luck.

1. Consider two space ships A and B. The ships are initially at rest at $x = 0$. At $t = 0$ s space ship A begins to move in the positive x-direction with constant acceleration and reaches its maximum speed at $t = t_A$. It then continues to move at constant velocity with this maximum speed. At $t = t_{B1}$ ($t_A > t_{B1} > 0$) space ship B begins to move in the negative x-direction, with constant acceleration, reaching its maximum speed at $t = t_{B2}$. At this time, ship B immediately reverses its acceleration (starts to accelerate in the opposite direction). Eventually, ship B will catch up to ship A.
   a) On a position-time graph *sketch* the motion of both space-ships from $t = 0$ to the time when they reach each other.
   b) *Sketch* a plot of the motion on a velocity-time graph for the same time interval as in part a.
   c) If the magnitude of ship A's acceleration is a_A and the magnitude of ship B's acceleration is a_B, calculate the separation distance between the ships at the moment that ship B reverses its acceleration.

2. Consider the apparatus below. There is friction between m_1 and the platform. The angle θ is known as are the masses. The coefficient of static friction between m_1 and the platform is μ_s and the coefficient of kinetic friction is μ_k. The pulley is negligible. Please follow the method illustrated in class in solving this problem.
   a) Calculate the tension in the rope connecting the two objects.
   b) Calculate the magnitude of the acceleration of the blocks.

3. When a jet aircraft lands on the deck of an aircraft carrier it is brought to rest with an "arresting cable". This cable is initially unstretched and hooks on to the aircraft as it comes in for a landing and pulls on it much like a spring (see diagram below). The magnitude of the force of the arresting cable is given by $F = \left[\alpha_0 x^2 + \beta_0 x\right]$ Newtons, where x is the amount (in meters) that the cable is stretched and α_0 and β_0 are constants.
   a) What should the units of α_0 and β_0 be?

   b) Consider the case when $\alpha_0 = 0.5$ and $\beta_0 = 100$. If the length of the aircraft carrier is 333 m, and the mass of the aircraft is 33700 kg (the length of the plane is negligible in this calculation), calculate the maximum speed with which the aircraft can approach the carrier to land without over-shootng the deck.