MA 113 Calculus I, Spring 2015
Written Assignment #4
Due Friday, February 27, 2015, at beginning of lecture

Instructions: The purpose of this assignment is to develop your ability to formulate and communicate mathematical arguments. Your complete assignment should have your name and section number on each page, be stapled, and be neat and legible. *Unreadable work will receive no credit.*

You should provide well-written, complete answers to each of the questions. We will look for correct mathematical arguments, complete explanations, and correct use of English. Your solution should be formulated in complete sentences. As appropriate, you may want to include diagrams or equations written out on a separate line. You may read your textbook to find examples of how we communicate mathematics.

Students are encouraged to use word-processing software to produce high quality solutions. However, you may find that it is simpler to add graphs and equations using pen or pencil.

The height $s(t)$ and velocity $v(t)$ at time t of an object tossed vertically in the air near the earth's surface (and ignoring all air resistance) is given by $s(t) = s_0 + v_0 t - \frac{1}{2}gt^2$ and $v(t) = s'(t) = v_0 - gt$, where $s_0 = s(0)$ is the initial position at $t = 0$, $v_0 = v(0)$ is the initial velocity at $t = 0$, and $-g$ is the acceleration due to gravity. Let M denote the maximum height of the object.

1. (5 points)
   (a) When does the object reach its maximum height M?
   (b) What is the maximum height M of the object?
   (c) After the object is tossed, when is the height of the object again equal to its initial position s_0?
   (d) When does the object hit the ground after being tossed?
   (e) What is the object's velocity when the height is s_0 the second time?

2. (5 points) This problem extends the results in (1). Let c denote any positive number satisfying $s_0 \le c \le M$. Intuitively, there are two times when the height of the object is c. Namely at some time t_1 when the object is rising and another time t_2 when the object is falling. (At the maximum height M, we should have $t_1 = t_2$.)
   (a) Given c, show how to compute t_1 and t_2. Show where you use the assumption that $s_0 \le c \le M$.
   (b) Let $v_1 = v(t_1)$, the velocity of the object when it is at height c and rising. Let $v_2 = v(t_2)$, the velocity of the object when it is at height c and falling. Find v_1 and v_2.