Midterm 01

Due date Friday October 7th of 2011 at 1pm.

Discuss the relevant physics equation, describe you solution, show results. Matlab code might be shown only in the email submission.

Problem (100 points total)
You are working for NASA. Your team is responsible to design a rocket which should lift off and after travel time $T_t = 50$ seconds in the gravity field of the Earth must reach a certain orbit with the final verical velocity $v_f = 0$. Do not worry about horizontal velocity, it is another team responsibility.
Engineers provided you with an engine capable to provide to the rocket a time dependent lift acceleration in the form of $a(t) = 100 * \exp(-(\tanh(b * t) * b * t/10)^2)$ (when other forces are disregarded) during time till a fuel line is cut off $T_c = 10$ seconds. The acceleration changes with time since due to a temperature stress of the rocket. However at time T_c no fuel is left and thus no lift force provided.
Assume that rocket starts from the planet Earth, treat the acceleration due to gravity as a constant $g = 9.8$ m/s^2 (i.e. neglect gravitational force change). Disregard the air drag.
Task 1 (60 points): Your job is to **find the proper value of coefficient** b. Do not forget the units.
Task 2 (40 points): Plot velocity of the rocket as a function of time once the proper value of b is found.

Bonus is harder but it is within a reach!
Bonus (10 points): Plot the altitude of the rocket as a function of time. What is the altitude of the rocket at time T_t?