Midterm 01

Due date Monday October 4th of 2010 at 1pm.

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

Problem (100 points total)

You are working for NASA. Your team is responsible to design a rocket which will lift off and after travel time $T_t = 50$ second in the gravity field of the Earth will reach certain orbit with final verical velocity $v_f = 0$. Do not worry about horizontal velocity. It is other team responsibility.

Engineers provided you with an engine capable to provide to the rocket a time dependent lift acceleration in the form of $a(t) = b * (1 - \exp(-t^2))$ (when other forces are disregarded) during time till fuel is cut off $T_c = 10$ second. The acceleration grows with time since rocket burns fuel and becomes lighter. 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 drug.

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.

Bonuses are hard but within a reach!

Bonus 1 (10 points): Plot the altitude of the rocket as a function of time.

Bonus 2 (10 points): What is the altitude of the rocket at time T_t?