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 vertical 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 $a(t) = 100 \times \exp(-\tanh(b \times t) \times b \times t/10)^2$ (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 $g = 9.8 \text{ m/s}^2$ (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 $T_t$?