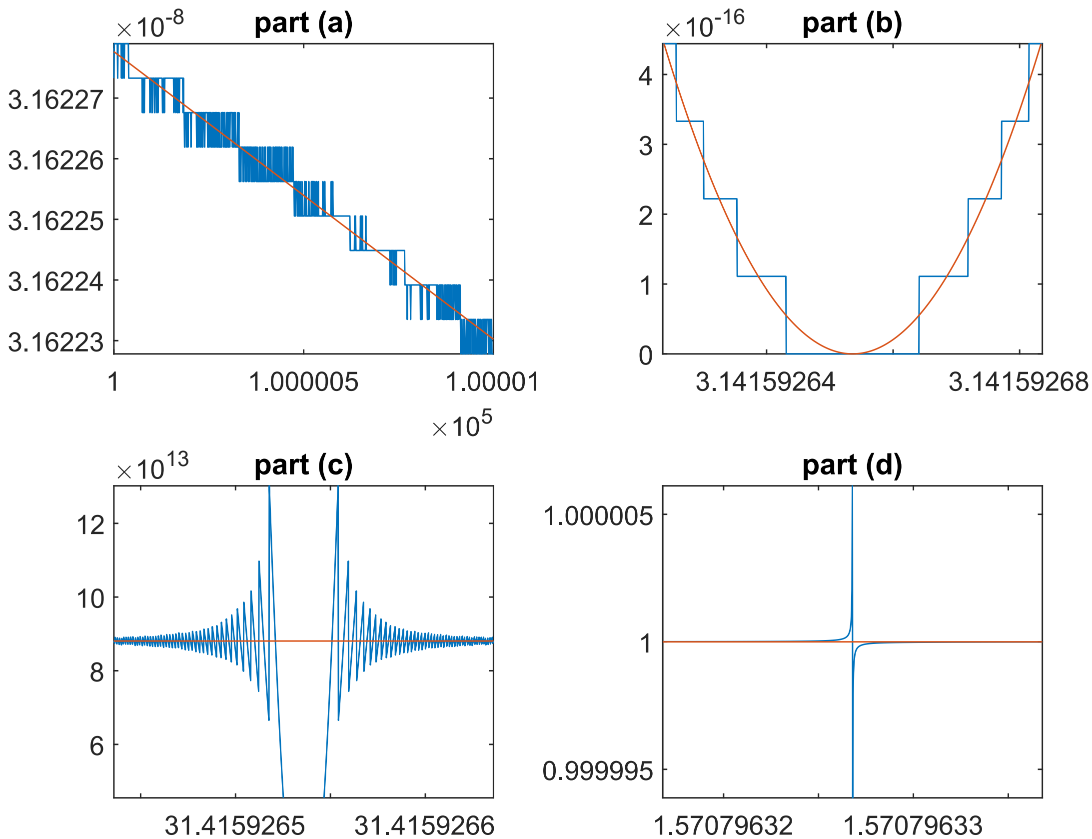
458 Final Part 2 Solutions[1]

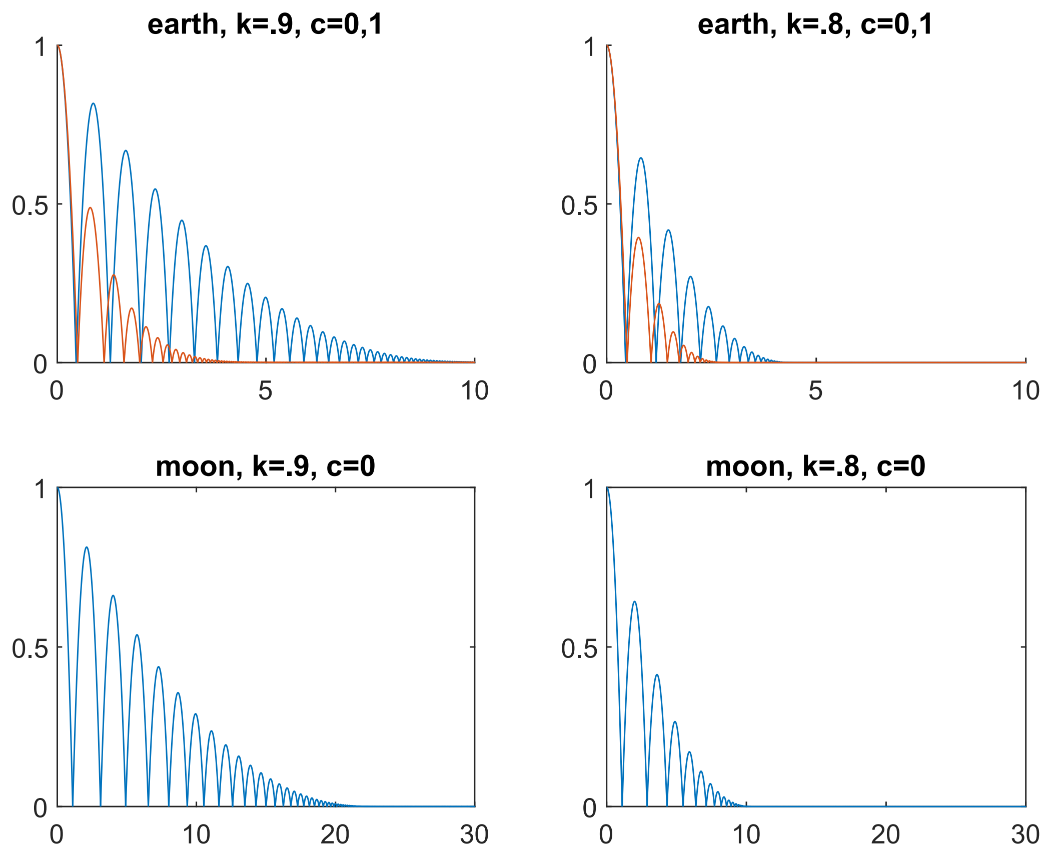
1. Problem 1



[1]December 13, 2022,

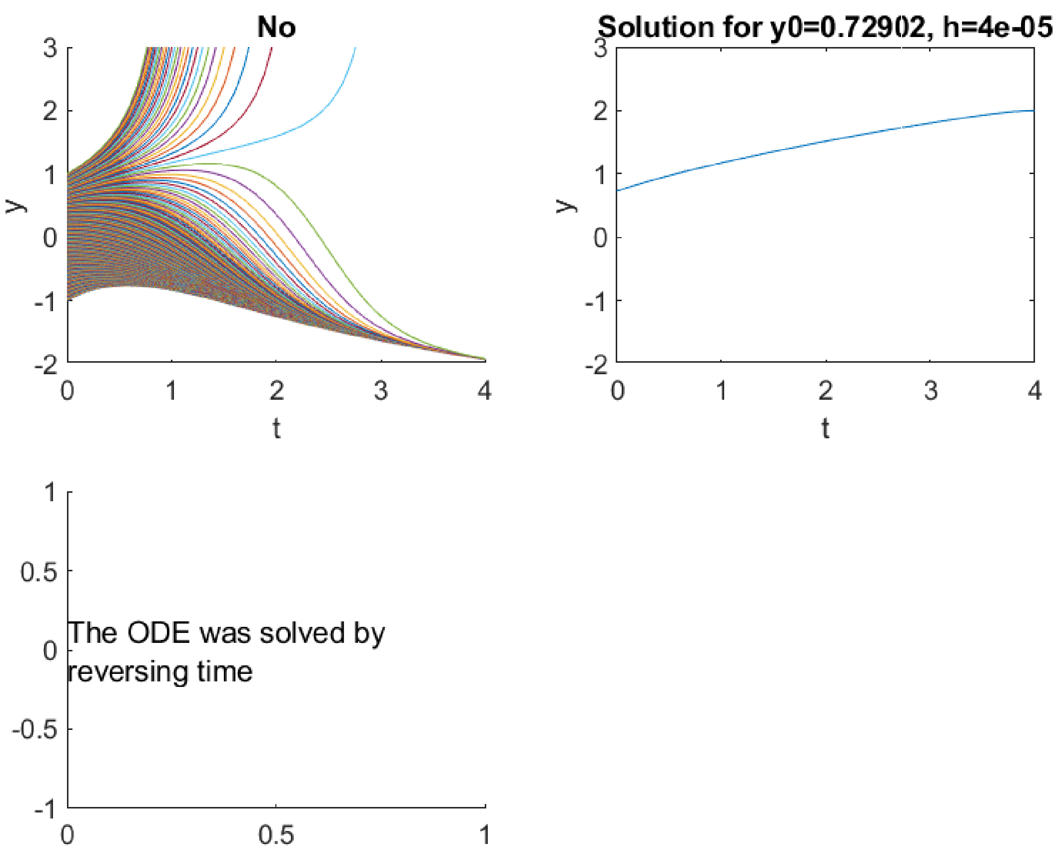
2. Problem 2

In this problem I used a first order Euler's method with some conditional statements that updated the solution a bit differently when the ball hits the ground.



3. Problem 3

In this problem, the ODE solution seems to either go to infinity of go below the x axis for all initial conditions, but there seems to be some initial condition between these two cases. To find that initial condition, I solved the ODE by reversing time. Also, it is not true that we can approximate the solution error by the procedure mentioned in the problem statement, since the estimated error will always be small according to Matlab. However, for the solutions going towards infinity, Matlab gives an estimated error of 0, which is not correct.



4. Problem 4

In this problem, I used a shooting method to solve the boundary value problem for various initial velocities. Instead of solving for the zero of a function, I just did a brute force search over initial conditions. I then plotted the solutions and refined my search accordingly. Pictured below is a solution when $(x'(0), y'(0), z'(0)) = (-.6, .6, 0)$. There are many different solutions that pass through the point $(1, 1, 1)$. The particular solution below is just one such example.