Problem 2

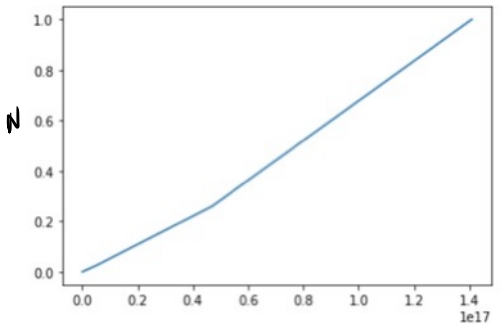
Part A

Write a program to solve for decay products of U238.
Used Radau method from scipy.integrate.solve_ivp

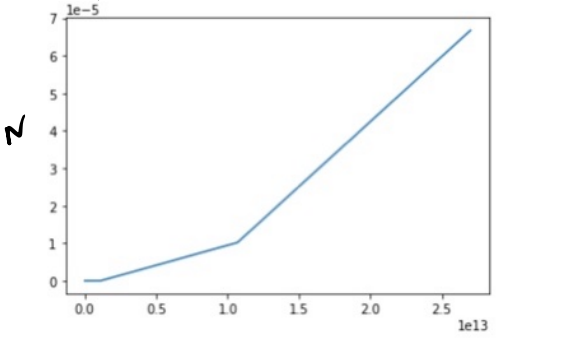
Part B

Plotting the ratio of Pb206 to U238 :

Graph 1: Pb206/U238 over U238 half life



Graph 2: Pb206/U238 over 1E13 second



This makes sense because we start with 100% of U238 and 0% for all other isotopes. The amount of U238 should decrease and Pb206 should increase as U238 decays down to Pb206.

After one half-life of U238, we have approx a 1:1 ratio of U238 to Pb206, which makes sense because all other half lives are relatively short compared to U238

Finding the analytical solution:

$$N\_U238 = \exp(-\log(2) \cdot \lambda_{U238} \cdot t)$$

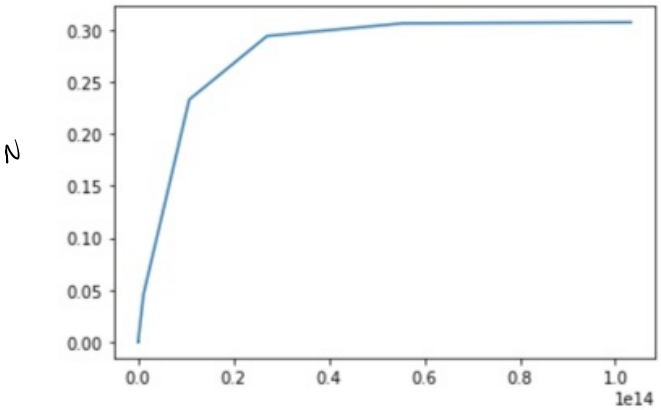
$N\_Pb206 = 1 - N\_U238$ → because we assume that U238 decays instantly to lead.

So analytical ratio is simply, $\frac{N\_Pb206}{N\_U238} = \frac{1 - \exp(-\log(2) \cdot \lambda_{U238} \cdot t)}{\exp(-\log(2) \cdot \lambda_{U238} \cdot t)}$

Taking np.std of analytical compared to my solution, we get:
3.30497×10^{-5} in error.

Plotting the ratio of Thorium 230 to U234:

Graph 3: Th230/U234 over 1e14 seconds



N

t (seconds)

long term average is ~3.257