Lab Assignment 2

Wednesday, March 24, 2021

Radiaoactive decay of a nucles is determined by the following equation

$$N = N_0 e^{-\lambda \cdot t} \tag{1}$$

where, N_0 = number of atoms at t = 0 s, λ = decay constant, and N is the number of nuclei that remain after time t.

Question:
Uranium-237 is a radioactive nucleus with a half life of 6.75 days. The molar mass of the nucleus is 237.0487 g/mol. Write a program that implements the law of radioactive decay to calculate the number of atoms which remain after a time t, given that there was 2g of U-237 at time $t = 0$ s. Your program should have the following components.

1. A function to calculate the exponential in equation (1) using Taylor Series Expansion. Calculate the infinite series numerically using *iterative method*, and truncate the series if the percentage of relative error (ϵ_r from page 17 of the notes) falls below 0.01%. Use the function `exp(...)` from `math.h` to calculate the actual value, and hence obtain the true and relative error in each iteration. Tabulate the results.

2. Use this function to calculate how many atoms will remain after 4.869 days. Print this on the screen/terminal.

Useful formulae

$$\text{Half-life, } T_{1/2} = \frac{0.693}{\lambda} \tag{2}$$

$$N_0 = \frac{N_A}{\text{molar mass}}; \qquad N_A = 6.022 \times 10^{23} \text{mol}^{-1} \tag{3}$$