Lab 16

Ch En 263 – Numerical Tools

Due: 14 Mar. 2024

Instructions

- Complete the exercise(s) below, and submit the following files to Learning Suite:
  - Handwritten portion: scan each page (or take a picture) and combine them into a single pdf named: `LastName_FirstName_Lab16.pdf`
  - Excel portion: submit a workbook named `LastName_FirstName_Lab16.xlsx` where each worksheet tab is named "Problem_1", "Problem_2", etc.
  - Python portion: submit a separate file for each problem named `LastName_FirstName_Lab16_ProblemXX.py` where XX is the problem number.
- Warning: the LS assignment will close promptly at 11:59 pm and late assignments will only receive 50% credit.

Lab Exercises

1. The enthalpy of gaseous CO_2 is given by

$$h(T) = h(298.15) + \int_{298.15}^{T} c_p(T)dT.$$

The units of h are J/mol. The heat capacity (J/mol K) is given by

$$c_p(T) = R_g(a_1 + a_2T + a_3T^2 + a_4T^3 + a_5T^4),$$

where $R_g = 8.314$ J/(mol K), and $a_1 = 2.275724$, $a_2 = 0.009922$, $a_3 = -1.04091 \times 10^{-5}$, $a_4 = 6.86669 \times 10^{-9}$, $a_5 = -2.11728 \times 10^{-12}$. Also, $h(298.15) = -393549.1$ J/mol.

Use `scipy.optimize.root` to find the temperature where $h(T) = -362828$ J/mol.

Hints: This will be easiest if you first analytically evaluate the integral.