CAPE Laboratory

Spring Semester 2024 - 2025

Assignment – 1

Objective: Numerical solution of a single nonlinear algebraic equation.

Problem:

Find the molar volume (v) of ammonia at temperature $T = 250\ °C$ and pressure $P = 10$ atm using the Van der Waals Equation of State.

$$\left(P + \frac{a}{v^2}\right)(v - b) = RT$$

$$a = \frac{27R^2T_c^2}{64P_c}, \qquad b = \frac{RT_c}{8P_c}$$

Given: $T_c = 407.5\ K$, $P_c = 111.3$ atm, $R = 0.08206$ L atm mol^{-1} K^{-1}

Use the following numerical methods:

   (a) Fixed-point iteration (Direct substitution method)
   (b) Bisection method
   (c) Newton's method
   (d) MATLAB built-in function `fzero`

Compare the efficiency of these numerical methods in terms of accuracy, computation time and number of iterations.