Offline 1: Finding Roots of Nonlinear Equations Using Bisection Method

In a chemical engineering process, water vapor (H_2O) is heated to sufficiently high temperatures that a significant portion of the water dissociates, or splits apart, to form oxygen (O_2) and hydrogen (H_2):

$$H_2O \longleftrightarrow H_2 + 1/2\ O_2$$

If it is assumed that this is the only reaction involved, the mole fraction x of H_2O that dissociates can be represented by

$$K=x/(1-x) * \sqrt{(2p_t/(2+x))}$$

where K is the reaction's equilibrium constant and p_t is the total pressure of the mixture. If p_t= 3 atm and K = 0.05, determine the value of x that satisfies given equation.

Write a python program that does the following (20):

- Draw a graph of the function $f(x)$ using python matplotlib library. From this function, visually find the approximate location of the root. (4)
- Uses bisection method to estimate the value of x for ε_s=0.5%. The bisection method should be implemented as a function having the following parameters: lower bound of the bracket, upper bound of the bracket, expected relative approximation error, and max iteration. The function should return the approximate value of the root. Use the graph plotted in the first step to choose the initial values that bracket the root. (12)
- Modify the above method (as a second function/program) to output a table showing the absolute relative approx. error after each iteration of the bisection method for up to 20 iterations. (4)