1. ln(1+x) function can be expanded using Taylor series and the expanded series is given below.

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} - \dots$$

Now write a single program to perform the following tasks:

a. Take the value of x and iteration (number of terms) number n and return the approximated value of ln(1+x). [2]

b. Plot the ln (1+x) function for the interval -1<x<=1 with step size 0.1 using the built-in log (x) function. [3]

c. In the same plot (one plot for 1(a) and 1(b)) show five approximated functions for the same interval using different number of terms (1, 3, 5, 20, 50). [5]

d. Draw another plot showing the relative approx. error for each iteration while determining the value of ln(1.5) upto 50 terms. [5]

2. 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 single program which does the following:

- Uses graphical model to estimate the value. [5]
- Uses Secant method and False Position method to estimate the value for ε_s=0.5%. Report the number of iterations for each method while achieving the expected result. [7.5+7.5=15]

Secant Method and False Position method should be implemented as separate functions following the prototype given below:

- Secant method (function , 1st initial guess, 2nd initial guess, expected relative approximation error, max iteration)

- False Position method (function , lower bound of the bracket, upper bound of the bracket, expected relative approximation error, max iteration)

Please note that following the prototypes is mandatory.