Problem 1

Consider the following function

$$J_n(x) = \left(\frac{x}{2}\right)^n \sum_{k=0}^{\infty} \frac{(-1)^k (\frac{x^2}{4})^k}{k!(n+k)!}$$

In this case, first, you need to draw three graphs as following.

In graph 1: for n=0, and x = 0 to x = 10; increase x by 0.1 with value k starts from 1.
In graph 2: for n=1, and x = 0 to x = 10; increase x by 0.1 with value k starts from 1.
In graph 3: for n=2, and x = 0 to x = 10; increase x by 0.1 with value k starts from 1.

Secondly,
Using the series expansion for Jn(x), find its root for J0(x) to an accuracy of four decimal places by using bisection method. Consider the initial guesses as 1 and 3. The desired level of accuracy is 0.00001.
At first, print the value of x and J0(x) from 1 to 3, increasing by 0.1. Then, ask the user for upper bound and lower bound. If the root finding is possible, print the solution, otherwise print no root is possible. You also need to print the following table in your console view.

iteration	Upper value	Lower value	X_m	$f(X_m)$	Relative approximate error

Lastly,
Draw two graphs from above solution.
In graph 1: the graph of x and relative approximation error.
In graph 2: the graph of no of iteration and relative approximation error.

Problem 2

Conservation of mass can be used to re-formulate the equilibrium relationship as

$$K = \frac{(c_{c,0} + x)}{(c_{a,0} - 2x)^2 (c_{b,0} - x)}$$

where the subscript 0 designates the initial concentration of each constituent. If K = 0.016, ca,0 = 42, cb,0 = 28, and cc,0 = 4, determine the value of x.

(a) Obtain the solution graphically by plotting the value 0 from 20, with increment of 1.

(b) On the basis of (a), solve for the root with initial guesses of xl = 0 and xu = 20 with desired accuracy level of 0.00001 Choose false position to obtain your solution. Ask the user for upper bound and lower bound. Justify your solution if it is not possible.

(c) Compare the relative approximate error between the bisection method and false position method. You need to use the previous problem (Problem 1) solution partially. For comparison, you need to draw the graph of number of iteration and relative approximation error.

<u>Talking with your classmates may result in deduction of evaluation points.</u>