Homework 3

Ch En 263 – Numerical Tools

Due date: 5 May 2020

Instructions

- For the problems in Excel, submit a workbook named "LastName_FirstName_HW3.xlsx" where each worksheet tab is named "Problem_1", "Problem_2", etc.

- For the problems in Python, submit a separate file for each problem named "LastName_FirstName_HW02_ProblemXX.py" where XX is the problem number.

- For your convenience, optional Excel and Python template files are available on the course website.

- If needed, a supplementary handwritten or typed document can be submitted via pdf on Learning Suite with the name "LastName_FirstName_HW3.pdf".

- **Please report how long it took you to complete the assignment (in hours) in the "Notes" section on Learning Suite.**

Problems

1. Convert the following quanitites to the specified units. Try to do this without looking up any of the "Big 13" unit conversions. Record your answer in an Excel worksheet.

   (a) 60 mi/hr to m/s

   (b) 72°F to °C

   (c) 1×10^{-3} kg/(m·s) to slug/(ft·s)

2. Use Excel for the following. Record your typed answer in a text box in the worksheet.

   (a) Which data type would be the best for representing the number 5×10^{-14}?

   (b) Type the number 2000 in cell `A1`. In cell `A2`, enter the formula $= \text{A1} + 5 \times 10^{-14}$. What is the result to 16 decimal points?

   (c) Copy and paste the formula in cell `A2` down the `A`-column so that you have a cumulative sum. Cell `A3` should have the formula $= \text{A2} + 5 \times 10^{-14}$, and cell `A4` should have the formula $= \text{A4} + 5 \times 10^{-14}$, and so on. What is the value to 16 decimal points at cell `A51`? What should the value be?

   (d) Repeat the procedure from parts (b) and (c) using 5×10^{-11} in column `B`. What is the value to 16 decimal points in cell `B51`? What should the value be?

   (e) Comment on the reason for any difference between your answer in parts (c) and (d)

3. Do the following in Python and print the result to the console

   (a) Convert Avagadro's number to an integer.

   (b) Convert the speed of light in vacuum (in m/s) to a string.

   (c) Convert 5/3 to a float.

4. In the last homework, you were introduced to the Redlich-Kwong (RK) equation of state

$$P = \frac{RT}{V-b} - \frac{a}{V(V+b)\sqrt{T}}$$

where V is molar volume, $R = 8.314$ J/(mol K) is the universal gas constant and

$$a = 0.427\frac{R^2 T_c^{2.5}}{P_c}, \qquad b = 0.0866\frac{RT_c}{P_c}.$$

Given that $T = 370$ K, $V = 7.2$ L/mol, $P_c = 4.898 \times 10^6$ Pa, and $T_c = 150.86$ K.

(a) Convert T, V, P_c, T_c and R to English units (slug, ft, s, °R) at the top of a Python file. Include comments that indicate their units. Try and do this without looking up the unit conversions.

(b) Calculate a, b, and P and print the value of these variables to the console along with their units using an expression like:

```
a = #### (units)
```

(c) Convert P to psi (psi $= $ lbf/in^2) and print it to the console.

5. Use Excel for the following. Use cells to make the calculations, and record your written answers in a text box. Suppose you would like to evaluate the product

$$x = \left(3.7 \times 10^{109}\right) \times \left(5.4 \times 10^{245}\right) \times \left(2.1 \times 10^{37}\right).$$

(a) Try and evaluate the expression directly. Why are you not able to do this?

(b) Use the property of logarithms that $\log_b(NM) = \log_b(N) + \log_b(M)$ to find $\log_{10}(x)$. Now, determine the value of x. *Hint: You can use the expression =log10(Value) to evaluate a logarithm in Excel.*