

## APM 153 Assignment Seven – Multi-Step Algorithm in Excel – The Antoine Equation

### Define the Problem

Use a multi-step algorithm in an Excel spreadsheet to calculate the change in the boiling point of water in °C as a function of the change in altitude from 0 to 10,000 meters in 500 meter increments.

### Define Input and Output

The input for the algorithm consists of

- A. A column of numbers from 0 to 10,000 in 500 meter increments
- B. The constants used in the equation relating altitude to air pressure
- C. The constants used in the Antoine equation

The output will consist of two Excel charts (scatterplots) showing

- A. the change in boiling point (on the x axis) versus altitude (on the y axis)
- B. the change in air pressure (in kPa on the x axis) versus altitude

### Two Equations

(1) The relationship between altitude and air pressure from empirical measurements is,...

$$\log_{10}(P) = 1.16686 - 1.55689 * 10^{-5} * h - 6.53731 * 10^{-11} * h^2$$

where P is pressure in psi and h is the altitude in feet. Note that **h** occurs in **two places** in the equation.

(2) The Antoine equation is given as

$$\ln(P) = A - \frac{B}{C + T}$$

where A = 18.3036  
B = 3816.44  
C = -46.13

(3) All **constants** used in the two equations should be stored in cells on the spreadsheet and used as **absolute cell values**.

## Notes

(4) The two formulas are not given in the same units. We discussed how to convert units in Excel in lecture. You will need to convert units to do this assignment properly.

(5) Your spreadsheet should be easy to understand by someone else that does not know what the spreadsheet is doing. You **do not** need to write any “documentation”, it is enough to **write in good, descriptive labels** at the top of each column in the spreadsheet.

## Useful Conversion Factors

1 psi	=	51.701mmHg	1 meter	=	3.28084 feet
1 kPa	=	0.1450377 psi	°C	=	°K – 273.15
1 psi	=	6.894759 kPa			

## What to Turn In

(6) Assignment Seven will be due in lab on Friday, March 24<sup>th</sup>. You will turn in one MS Word document (with page numbers) with the following.

**Part One** - Your algorithm written as pseudocode and as a flowchart

**Part Two** - A copy of your Excel Spreadsheet (without the charts) imported into your MS Word document. If your spreadsheet does not fit, you can resize it to make it slightly smaller.

**Part Three** - The two charts (scatterplots) with titles and axis labels.

## Second Exam and Last Day to Drop

(7) Our second exam currently is scheduled for Friday, March 31<sup>st</sup>.

(8) The last day to drop an ESF or SU class is Tuesday, March 21<sup>st</sup>.

## Spring Break

(9) **Have great Spring Break. Have fun, but please be CAREFUL!**