## Problem Overview:

The National Weather Service releases nearly a hundred weather balloons daily to monitor weather patterns in US and its territories. These balloons drift as far as 125 miles and reach altitudes of nearly 40,000 meters. The balloons are made from neoprene and can be filled with either hydrogen or helium. Over a 48 hour period, the sun heats and cools the gases and cause the balloons to rise and fall. The altitude of a weather balloon as a function of time is modeled by the following polynomial equation:

$$altitude = C_A\, t^4 + C_B\, t^3 + C_C\, t^2 + C_D\, t + C_E$$

For both gasses (hydrogen or helium): $C_A = -0.12$, $C_D = 4100$, and $C_E = 220$. (think C++ constants).

For hydrogen: $C_B = 12.0$ and $C_C = -380.0$, and for helium: $C_B = 12.2$, and $C_C = -380.5$.

Using this model, the altitude of a weather balloons using each of the gases is shown below.
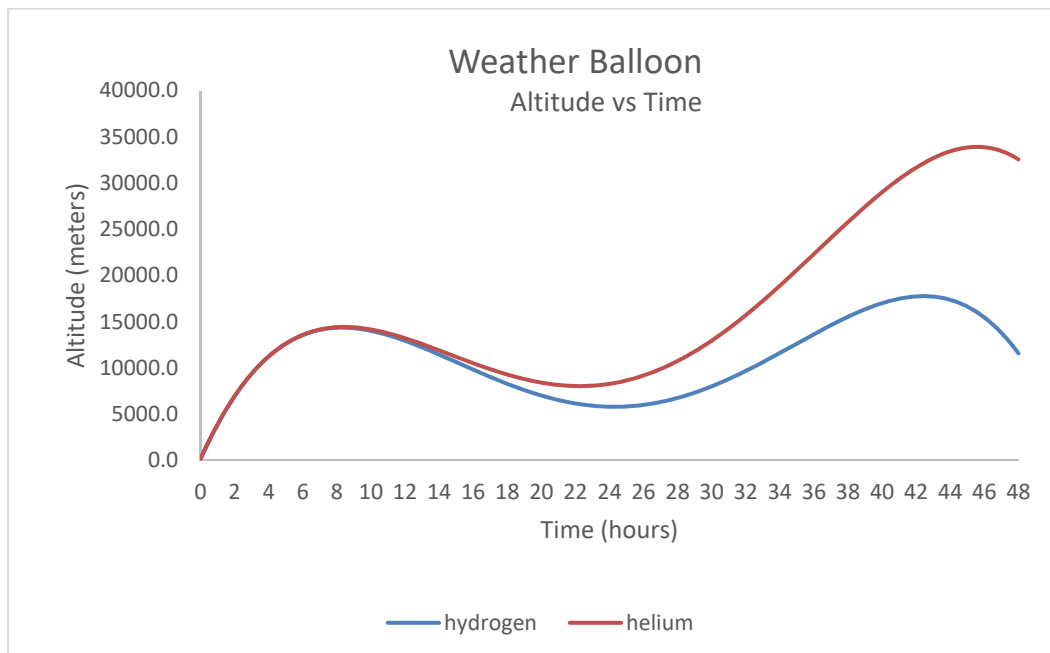
As you can see, throughout the 48 hour period, balloons with both gases have two peak altitudes and one valley altitude (i.e. low point) between these two peaks. However, for the two gasses, the height of these peaks and valley, and the time that they occur, are different.

Code Design Specifications:

Design, code and test a procedural C++ program, the calculates the value for, and time of occurrence, of, the two peak and one valley altitudes for a weather balloon given the gas it is filled with.

- The program has one string input, <u>hydrogen</u> or <u>helium</u>. This inputs are NOT case sensitive, so the input hydrogen, HYDROGEN, Hydrogen, or HyDroGeN are all legal inputs.

- Based on the gas type entered, the program should loop from time=0 to time=48 in 0.01 hour increments to locate the values of the two peak altitudes and the times at which they occurred.
- Using the values of time from the previous step, the program should loop from the time of the first peak to the time of the second peak in 0.01 hour increments to locate the value, and time of, the valley altitude.
- When finished, the program produces an output displaying the altitudes and times for the two peaks and one valley:
  - Example for <u>Hydrogen</u>

    > Enter program input
    >
    > Hydrogen
    >
    > Program output displayed here
    > ```
    > Max_1 : 14363.76 @ 8.29
    > Max_2 : 17778.65 @ 42.42
    > Min   : 5809.26 @ 24.28
    > ```

  - Example for <u>Helium</u> (of in this case HeLiuM)

    > Enter program input
    >
    > HeLiuM
    >
    > Program output displayed here
    > ```
    > Max_1 : 14445.53 @ 8.42
    > Max_2 : 33924.63 @ 45.58
    > Min   : 8048.01 @ 22.25
    > ```

- If an illegal string is entered, the program should display an error message and terminate.
  - Example:

    > Enter program input
    >
    > Swap
    >
    > Program output displayed here
    > ```
    > ERROR... Illegal Gas Type
    > ```

- Note, all output value should be displayed with two-decimal point of accuracy (i.e. precision).

Grading Criteria:

- Your grade for this Coding Challenge is based on the complete and accurate implementation of the design specifications (80%) and adherence to proper coding style and commenting guidelines (20%).
- Late projects are penalized 10% per day they are late.