ECE 71 – Engineering Computations in C
Professor Kriehn – Fall 2016

Code Due By: Midnight on Friday, September 30, 2016
Writeup Due By: Class on Tuesday, October 3, 2016

HOMEWORK #11 – Weather Balloons

Weather balloons are used to gather temperature and pressure data at various altitudes in the atmosphere. The balloon rises because the density of the helium inside the balloon is less than the density of the surrounding air outside the balloon. As the balloon rises, the surrounding air becomes less dense, and thus the balloon's ascent slows until it reaches a point of equilibrium. During the day, sunlight warms the helium trapped inside the balloon, which causes the helium to expand and become less dense; thus, the balloon will rise higher. During the night, however, the helium in the balloon cools and becomes more dense; thus, the balloon will descend to a lower altitude. The next day, the sun heats the helium again and the balloon rises. Over time, this process generates a set of altitude measurements that can be approximated with a polynomial equation. Assume that the following polynomial representation represents the altitude or height in meters during the first 48 hours following the launch of a weather balloon:

$$h(t) = -0.12t^4 + 12t^3 - 380t^2 + 4100t + 220,$$

where the units of t are in hours. The corresponding polynomial model for the velocity in meters/hr of the weather balloon is:

$$v(t) = -0.48t^3 + 36t^2 - 760t + 4100.$$

Write a program that will print a table of the time, altitude, and the velocity for this weather balloon using units of meters and meters per second. Let the user enter the start time, the increment in time between lines of the table, and the ending time, where all the time values must be less than 48 hours. After your table is printed out, also print the peak altitude and its corresponding time.

Specifications:
The format for your output table numbers should be `%6.2f` for the time, and `%9.2f` for both the altitude and velocity information. To format your table, use the "\t" (tab) character. For instance, you can use a statement similar to: `printf("%6.2f\t\t%9.2f\t%9.2f\n",time,alt,vel);`
You must use a **while** loop to solve the problem correctly, since floating point numbers are being used.

HINT: You may use the math library and the **pow()** function if you want to. For example, to calculate t^4, use **pow(t,4)**, assuming that your variable for time is called **t**. Be sure to use include the math library in your preprocessor directives, and include the **–lm** linking option when compiling your code.

```
~> hw11.o
Welcome to the Weather Balloon Altitude and Velocity Program.

Enter the Balloon's Starting Time: 1
Enter the Time Increment: 2.2
Enter the Balloon's Ending Time: 10

Weather Balloon Information

Time (hr)        Altitude (m)     Velocity (m/s)

  1.00              3951.88             0.94
  3.20              9829.43             0.56
  5.40             13066.73             0.27
  7.60             14298.57             0.05
  9.80             14092.26            -0.10

Peak Altitude: 14298.57 (m)
Corresponding Time: 7.6 hr
~>
```

 If your program does not follow these specifications properly, the Grader Program will not accept your submission. Develop your I/O diagram and pseudocode, debug your code, and submit **hw11.c** to the Grader Program.

HOMEWORK #12 – Grade Calculation Program

Bunyan Lumber Company needs to create a table of the engineering properties of its lumber. The dimensions of the wood are given as the base and the height in inches. Engineers need to know the following information about the lumber:

$$\text{Cross-Sectional Area} = \text{Base x Height}$$

$$\text{Moment of Inertia} = (\text{Base x Height}^3)/12$$

$$\text{Section Modulus} = (\text{Base x Height}^2)/6$$

The owner just started his business, and wants to know the base length of the wood to be used. The height sizes he has available are 2, 4, 6, 8, 10, and 12 inches. Produce a table with appropriate headings to show these values and the computed engineering properties.

Specifications:
The format for your output table numbers should be %2d for both the base and the height, %6d for the area, and %6.2f for both the moment of inertia and section modulus. To format your table, use the "\t" (tab) character wherever necessary. You must use a **for** loop to solve the problem.

```
~> hw12.o
Enter the base length (in): 2

Lumber              Cross-Sectional          Moment of        Section
Size                Area (in^2)              Inertia (in^4)   Modulus (in^3)
 2 x  2                  4                      1.33              1.33
 2 x  4                  8                     10.67              5.33
 2 x  6                 12                     36.00             12.00
 2 x  8                 16                     85.33             21.33
 2 x 10                 20                    166.67             33.33
 2 x 12                 24                    288.00             48.00
~>
```

If your program does not follow these specifications properly, the Grader Program will not accept your submission. Develop your I/O diagram and pseudocode, debug your code, and submit **hw12.c** to the Grader Program.