Northeastern University
College *of* Engineering

Cornerstone of Engineering 1
Fall 2017

HW 6: C++ Homework Assignment 3. Due 10/4/17 by class time.

Objective: Practice working with loops and streams in programming. Plan your programs using pseudocode/flowcharts and test and verify results. Write working C++ programs.

1. Review Chapters 1 – 5, in the Etter C++ text. Review the C++ Videos on Blackboard on loops and streams.

2. Develop a flowchart or pseudocode and then write and execute complete programs to solve the following problems:

Your instructor wants a program that will read in a set of grades from a file called "grade.txt" (see below and is available on blackboard under assignments) and report the total number of letter grades i.e. A, B, C, D and F in the file. You program must use case logic and the "switch" statement. Call your program **"HW3ABCa.cpp"** where ABC is your initials.

"grade.txt"

ABADACAFABCDFFFACDCCBBACBACCCBBAAA
AADBACAFFBBCCDAABBFFAACCBBAACCCCBB

B) Write a C++ program called **"HW3ABCb.cpp"** where ABC is your initials that will solve the following problem:

The pressure of a gas changes as the volume and temperature of the gas vary. We are all familiar with the ideal gas equation of state which relates pressure, specific volume and temperature (Pv = RT) where P is the pressure, v is the specific volume, R is the gas constant and T is the absolute temperature. There are many other equations of state used to describe the relationship between P, v and T. Another common one is the Van der Waals equation of state given as:

$$\left(P + \frac{an^2}{V^2}\right)(V - bn) = nRT$$

where:

P = Pressure (atm) atm = atmospheres
V = Volume (L)
T = Temperature (K)
R = Gas Constant = 0.08206 (L atm) / (mol K) for Carbon Dioxide
a = 3.592 L^2 atm / mol^2 for Carbon Dioxide
b = 0.0427 L / mol for Carbon Dioxide
n = number of mole (mol)

Write a program that will use the Van der Waals equation of state to display in tabular form the relationship between pressure, volume and temperature for carbon dioxide. Inputs to the program include n, the temperature in K, and the initial and final volumes in milliliters and the volume increment between lines of the table. Your program will display a table that varies the volume of the gas from the initial to final volume in steps prescribed by the volume increment. A sample run should look like this:

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Please enter at the prompts the number of moles of carbon dioxide, the absolute temperature, the initial volume in milliliters, the final volume in milliliters, and the increment volume between lines in the table.

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Quantity of carbon dioxide (moles) > **0.02**
Temperature (K) > **300**
Initial Volume (milliliters) > **400**
Final Volume (milliliters) > **600**
Volume increment (milliliters) > **50**

0.02 moles of carbon dioxide at 300 Kelvin

Volume (mL)	Pressure (atm)
400	1.2246
450	1.0891
500	0.9807
550	0.8918
600	0.8178

You should submit along with your source program, a copy of your pseudocode or flowchart **and an output file showing a program sample run. This should be exactly the same information as shown in the DOS window as the program runs.** This means it should reproduce the user inputs exactly and then show the program output. The easiest way to do this is to first set up your program to run using cout and cin to produce the correct program run. Then go back and add the file stream output by using copy and paste everywhere there is a cout/cin pair or a separate cout and change cout / cin to the file stream pointer. An example of two lines of user input and a file stream called outfile is shown below.

```
cout <<  "Please enter room temperature in C  →" ;     //user prompt
cin >> temperature;                                    //get values

outfile <<  "Please enter room temperature in C  →" ;       //copy user input to output file
outfile << temperature;      // change cin to outfile to direct value to file as well
```

Please upload to blackboard by the due date the report containing the following below and the separate *.cpp files for each program.

Title Page. Make a Cover page for this assignment. On the top half, place the standard information: Assignment title, course number and course name, lecture day and meeting time, date (due), and your name. On the bottom half of the page, provide an organized list of contents. With any extra space feel free to include a picture –be creative you are an aspiring engineer!

The body of the report should contain for each problem a copy of your pseudocode or flowchart, the test by hand calculation were appropriate, your program source code .cpp file and a copy of your output file showing a sample runs with the output. There is no memo required for this assignment. You may include a screen shot of your DOS window as well but this is no longer necessary as you are now writing all results to an output file.