Lab 4 - Math, Format and Random

Directions

- The labs are marked based on attendance and effort.
- It is your responsibility to ensure the TA records your progress by the end of the lab.
- Do each step of the lab in order.
- While completing these labs, you are encouraged to help your classmates and receive as much help as you like. Assignments, however, are individual work. You may not work on assignments during your lab time.
- If you complete the lab early, you should experiment with C++; however, you may leave if you prefer.
- If you do not finish the lab exercises during your lab time, you are encouraged to complete them later to finish learning the material. You will still receive full marks if you arrived on-time and put in your best effort to complete the lab.

1. Expressions

- 1. Create a new VC++ project named lab4. Add a new file named expressions.cpp.
- 2. Run the following code and explain the difference between the output of the two cout statements:

```
int someVal = 65;
cout << "First: "<<someVal<<endl;
cout << "Second: " << static_cast<char>(someVal)<<endl;</pre>
```

3. Knowing the order of operations and implicit/explicit type casting rules is an important skill to be able to do without relying on a compiler.

- For each of the expressions in the following figure, determine (by hand) what value will be stored in the variable.

- Explain all implicit casts, explicit casts, overflows, or underflows.

a) double a = 3.0 + 10 / 20; b) double b = 3.0 + 10.0 / 20; c) double c = 3.0 + static_cast<double>(10 / 20); d) double d = 3.0 + static_cast<double>(10) / 20; e) double e = 3.0 + 10 / static_cast<double>(20); f) long f = 3.0 + 10 / static_cast<double>(20); g) short g = 10000 * 10000;

- 4. For each of the expressions in the above figure, check your answers using the compiler. Copy and paste this code into a program, and after each statement, output the variable to the screen. You may ignore any warnings for the moment.
- 5. Examine the warnings the compiler gave you for the previous code. Compare this to the answers your code produced.

a) Were the warnings a good indication that perhaps something undesirable occurred?b) Was there anywhere that you might have expected (wanted) a warning but did not get one?

6. Understanding:

- 1. What is the difference between floating-point division and integer division. Give an example of each.
- Given the equation double y = 2 / 5; state up to four ways you could change the statement, using only implicit or explicit casting, to make y hold the value 0.4.

2. Mathematical Functions

1. Here's a list of a few of the mathematical functions available in C^{++} .

pow(x,y)	returns	x raised to the y power
sqrt(x)	returns	square root of x
abs(x)	returns	absolute value of x
sin(x)	returns	the sin of x (x is in radians)
asin(x)	returns	the inverse sin of x, result in radians

2. Look at each of the following lines of code and predict what they will output to the screen. Then run them in Visual Studio to check your answers.

```
a) cout << sqrt(9.0);</li>
b) cout << sin(0.0);</li>
c) cout << asin(1.0);</li>
d) cout << pow(-2.0,4);</li>
e) cout << abs( pow(-2.0,4));</li>
f) cout << sqrt( abs( pow(-2.0,4)));</li>
```

 Write a brief program that asks the user to enter two (floating-point) numbers x and y. Then display to the user the **absolute value**, square root, and cube of x, and cube of (x-y). You must use the pow function to calculate the cube.

3. Pythagorean Theorem

- Recall that for a right triangle with sides of length a and b, and hypotenuse of length c;
 c can be found by using the equation a² + b² = c².
- Write a program that asks the user to enter the lengths of the two sides (a and b) of the triangle, and displays the length of the hypotenuse. Use the pow functions to calculate the squares.
- Then add to the program so that it prints out the values of the two non-right angles.
 - In a right triangle the *sin* of an angle can be calculated by dividing the length of the opposite side by the hypotenuse.
 - Use the values you've obtained above and the inverse sin function mentioned in the previous question to calculate the two non-right angles of the triangle.
 - The result will be in radians. Multiply by 57.295 to convert to degrees. This factor may be used multiple times and wouldn't be changed at any point so store it as a constant.
- Use the cout stream manipulator so that all results show a decimal and exactly one digit to the right of the decimal point.

4. Random Numbers

- The srand(x) function, where x is an int, seeds the random number generator in C++. You can then call rand() anytime you want a random integer.
- Write a program that we can use to show the random numbers produced are based on the seed.
 - Ask the user to enter an integer.
 - Use this integer to seed the random number generator. Print out the first four random numbers.
 - Next, have the program reseed the random number generator with the same value and print out the numbers again.
 - Run the program and look at the result. This is why you normally use the time to seed the "random" number generator at the start of the program.
 - Note that you only need to seed the generator once per program. If you are trying to just get random numbers, you would only call srand() once!

5. rand() and Tables

Write a program which does the following

- Seeds the random number generator with the time: srand(time(0)); make sure to #include <ctime>
- \blacklozenge Print a table with titles and three rows of values. The columns will be as follows
 - The row number (first column on the left):
 - Column width: 4 characters, left justified
 - The number x: A floating-point number you produce randomly by dividing a random number by 100.0 and subtracting 163.
 - Column width: 10 characters, right justified
 - \blacksquare abs(x) the absolute value of x
 - Column width: 10 characters, right justified
 - **s** $\operatorname{sqrt}(x)$ the square root of x (What happens if x is negative?)
 - Column width: 10 characters, right justified
 - x-cubed the cube of x
 - Column width: 14 characters, right justified
- All values, except row number, should be printed out with exactly 2 digits after the decimal
- **Example** Output:

Row	Х	abs(x)	sqrt(x)	pow(x,3)
1	80.39	80.39	8.97	519524.56
3	131.36	131.36	11.46	2266675.86
2	116.21	116.21	10.78	1569388.64

Vinderstanding:

- How can you control the formatting of data in a table? What manipulators do you need?
- What happens when sqrt() is given a negative number?

6. Skills and Understanding

You should now be able to answer all the "understanding" questions in the previous sections. Complete the following to get credit for the lab:

- Show the TA the following:
 - Your operational programs which complete all of the above tasks.
 - The TA may ask you to explain any section of the lab, or answer any of the "Understanding" questions.
- **Nothing** is to be submitted electronically or in hard-copy for this lab.