Lab 2 operators, basic I/O, conditional statements

NOTE: In all the following exercises, the input entered by the user is highlighted by underline. It is not part of the output from the program.

Q1. Operators, basic I/O

a) Download the program (**`Lab02_Q1.cpp`**). This program computes and outputs the area of a triangle with three sides input by the user. Compile and correct the syntax/logical errors.

Is the program easy to understand? Why/why not?

b) Enhance the program so that the input and output of the program are as follows. Always display two digits after the decimal point. *(Note: The underlined words are user input. You don't need to print it)*

```
Enter the first side:
7
Enter the second side:
8
Enter the third side:
9
The area is: 26.83
```

Hint-1: You can use the following formula to compute the area of a triangle.

$$p = \frac{a + b + c}{2}$$

$$S = (p * (p - a) * (p - b) * (p - c))^{1/2}$$

Hint-2: You can use *sqrt()* to compute square root, e.g. *y=sqrt(x)* returns the square root of x. This function is declared in header <cmath>.

Hint-3: You need to control the float/double printing precisions using *fixed* and *setprecision()*, which are declared in header <iomanip>.

c) Improve the programming style of the program. This includes using:
(i) More meaningful variable name to reflect the purpose of the variable;
(ii) Indentation (use the tab character to indent and shift-tab to move back by 1 level);
(iii) Comments.

Q2. Operators, basic I/O, conditional statements

Write a program that reads 3 integer values (>0) from the user. The 3 values are interpreted as representing the lengths of the three sides of a triangle. The program prints a message saying whether the triangle is *equilateral* (all sides equal), *isosceles* (only 2 sides equal), *scalene* (all sides unequal), or *impossible* (can't form a triangle). A triangle can be formed only if the sum of the length of *any 2* sides is greater than the length of the 3rd side and the length of all the sides of the triangle are *positive*.

Expected Outcomes:

Example 1	Example 2
Enter the value of A, B and C: 3 4 5 Scalene	Enter the value of A, B and C: 3 3 3 Equilateral
Example 3	**Example 4**
Enter the value of A, B and C: 5 5 2 Isosceles	Enter the value of A, B and C: 1 2 10 Impossible
Example 5	**Example 6**
Enter the value of A, B and C: 0 2 10 Impossible	Enter the value of A, B and C: 1 -2 10 Impossible

Hint-1: If you'd like to check for equality, you should not write something like: if (A==B==C), but instead, you should use the && operator: if (A==B && B==C)

Hint-2: The *order* of checking may affect the complexity of your code *(although it still works)*. You may wish to check for impossible cases first and identify the scalene case last.

NOTE: Your program MUST follow the EXACT input/output format!

Q3. Operators, basic I/O, conditional statements

Write a program to solve the quadratic equation

$$ax^2 + bx + c = 0$$

by the following quadratic formula:

$$\boldsymbol{x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$$

Please note that
1) a, b and c are real numbers (data type: double), $a \neq 0$;
2) round all answers to 1 decimal place;
3) you can use sqrt function to compute the square root of a number (e.g., sqrt(16) gives you 4 and sqrt(4)==2);
4) you need to understand what is a complex number:
https://en.wikipedia.org/wiki/Complex_number.
For example, if we want to calculate $\sqrt{-4}$, which is illegal in the square root operation, we may apply the techniques of complex number.

$$\sqrt{-4} = \sqrt{-1 \times 4} = \sqrt{-1} \times \sqrt{4}, = 2 \times \sqrt{-1}$$

And from the definition of complex number, we define that $\sqrt{-1} = i$. So the result of the expression is $2i$.

a) If $b^2 - 4ac = 0$, two equal real roots.
b) If $b^2 - 4ac > 0$, two unequal real roots.
c) If $b^2 - 4ac < 0$, two complex roots are computed. They should be output in the form of "$p + qi$" and "$p - qi$". Among them, $p = -b/2a$, $q = \sqrt{4ac - b^2} \ / \ 2a$

Expected Outcomes

Example 1
Enter the value of a, b and c for quadratic equation: 1 -8 16 The Quadratic Equation has two equal real roots: 4.0
Example 2
Enter the value of a, b and c for quadratic equation: 1 -5 -6 The Quadratic Equation has two real roots: 6.0 and -1.0
Example 3
Enter the value of a, b and c for quadratic equation: 5 8 5 The Quadratic Equation has two Complex roots: -0.8+0.6i -0.8-0.6i
Example 4

```
Enter the value of a, b and c for quadratic equation:
1
12
25
The Quadratic Equation has two real roots: -2.7 and -9.3
```