Chapters 2 and 3: Input/Output and Mathematical Calculations

In this program, you will create a program that solves a quadratic equation using the Quadratic Formula. The Quadratic formula solves for the roots of a quadratic equation that is in the form of:

$$ax^2 + bx + c$$

The Quadratic Formula is defined as:

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

Your program should prompt the user to enter in the values of a, b and c. These values can be ANY number (including a decimal number). The program should store these values when entered and then calculate the discriminant (the $\sqrt{b^2 - 4ac}$ portion).

The program should then calculate the roots of the equation. Finally, the program should display the original equation, the value of the discriminant, and the values of the roots. See screen shots below.

Use the caret symbol (^) to represent exponentiation when displaying equations.

Ex. 2^2 would be displayed as 2^2

Remember to make sure that the program is well documented with comments!!

NOTES:

The formulas must be written to work in C++. You will need to use parentheses for grouping your operations to ensure the proper order of operations.

To calculate the square of a number you can keep it simple and multiply the number by itself, or you can use the **cmath** library's pow() function.

pow(base, exponent)   ex. 3^2 would be pow(3,2)

To calculate the square root of the discriminant use the **cmath** library's sqrt() function.

For example, to get the square root of 25, the program would need the following:

> double root;
> root = sqrt(25);

> If you print out root, the value would be 5.

EXTRA CREDIT (10 points):

Have your program use the discriminant to determine the number of roots, and only calculate the root or roots if necessary, based on the rules below. You will need a decision control structure for this (chap. 4).

Consider: Is there a simpler formula for calculating the root if there is only one?

1. A discriminant that is positive has two roots
2. A discriminant that is zero has only one root
3. For simplicity's sake, we will say that a discriminant that is negative means the equation has no roots.
   > (Note: a negative discriminant really signifies complex solutions)

For the output, the program should display the original equation, the value of the discriminant, and the values of the root or roots or a message stating there are no roots.

Use the caret symbol (^) to represent exponentiation when displaying equations.

> Ex. 2^2 would be displayed as 2^2

See the extra credit screens shots below for examples.

Examples with two roots:

```
               Welcome to the Quadratic Formula Solver

Please enter in the value of a: 1

Please enter in the value of b: 7

Please enter in the value of c: 12


The equation is 1.00x^2 + 7.00x + 12.00

The discriminant = 1.00

There are two roots and the values are: -3.00 and -4.00

             Thank you for using the Quadratic Formula Solver

Press any key to continue . . .
```

```
Welcome to the Quadratic Problem Solver

Please enter the value of a: 10
Please enter the value of b: -1
Please enter the value of c: -2

The equation is: 10.00x^2 + -1.00x + -2.00

The discriminant is: 81.00

There are two roots and the values are: 0.50 and -0.40

Thank you for using the quadratic problem solver.

Press any key to continue . . .
```

Example with one root (Extra Credit only):

```
               Welcome to the Quadratic Formula Solver

Please enter in the value of a: 1

Please enter in the value of b: 4

Please enter in the value of c: 4


The equation is 1.00x^2 + 4.00x + 4.00

The discriminant = 0.00

There is one root and the value is: -2.00

               Thank you for using the Quadratic Formula Solver

Press any key to continue . . .
```

Example with no roots (Extra Credit Only):

```
               Welcome to the Quadratic Formula Solver

Please enter in the value of a: 1

Please enter in the value of b: 2

Please enter in the value of c: 4


The equation is 1.00x^2 + 2.00x + 4.00

The discriminant = -12.00

There are no roots for this equation!!

               Thank you for using the Quadratic Formula Solver

Press any key to continue . . .
```