

Write a complete C++ program, including comments, to do the following: Your program will compute values of a formula that expresses ans in terms of num. The formula is this:

$$\text{ans} = \frac{-4\text{num}^3 + 8\text{num}^2 + 9\text{num} - 18}{|7 - \text{num}^3| + \sqrt{3\text{num}^2 + 18}}$$

Note that $||$ means absolute value.

Make sure to include `cmath` and to use the absolute value function **abs**. Use the library functions for absolute value and square root; do **not** use the library function for exponentiation.

1. The program should start by printing a message saying "this is the output of my first program".
2. Then it should evaluate the formula starting with num = -4, going up by 0.5 each time until it reaches and processes 3; therefore, it will use these values for num: -4.0, -3.5,..., -0.5, 0, 0.5, 1,..., 2.5, 3.

For each num value, the program should compute the corresponding ans value. It should print these values together with explanations of what the values represent. For example, it should print the string "num = ", then the value of num, the string "ans = ", and the value of ans. Do not print column headings or you can't test your program in CodeLab, since your results won't match mine.

Following each ans value, the program should print a message that says one of three things—and the messages should match these exactly (except for the italics):

If the value of ans is exactly 0, the message should say *result is zero*.
 If the value of ans is positive, the message should say *result is positive*.
 If the value of ans is negative, the message should say *result is negative*.

A typical line of output would look like this (note that some lines will have decimal places and some won't):

```
num = -1.5 ans = 0 result is zero
```

3. Once you have finished using num = 3, the program should print a message (underneath the last line of output) saying "the program is finished". Then the program should stop.

Be sure your results are correct!!! The formula will yield ans values that are positive, negative and zero. The value of the formula will be zero three times.

Hand in a printed copy of your program and a printed copy of the output. You can test the program (without the optionals) in CodeLab, under Test your Assignment 1. Do not submit the program to me if CodeLab says it isn't correct. Once Codelab accepts the program, you can send it to me by email.

OPTIONALS: (5 points apiece) Do the optionals only AFTER your program runs correctly. Hand in a copy of the program WITHOUT the optionals, and a copy with the optionals. Do NOT make your program late while you are trying to do the optionals. Don't try the optionals in CodeLab.

1. Have your program count how many times the value of ans is positive, how many times it is negative, and how many times it is zero. Print these three values together with messages.
2. Have your program find which of the ans values is closest to 0 (either larger or smaller) without actually being equal to 0. Have the program print this ans value and the num value that gives this closest ans value.