

Program #1: The Channel

A concrete channel to bring water to Crystal Lake is being designed. It will have vertical walls with the slope of the channel being .0015 feet/foot and a roughness coefficient of 0.014. The depth and width of the channel are to be determined by the user. How deep will the water be when 1,000 cubic feet per second is flowing through the channel? To solve this problem you can use Manning's equation

$$Q = \frac{1.486}{N} AR^{2/3} S^{1/2}$$

Where Q is the flow of water (cubic feet per second), N is the roughness coefficient (unitless). A is the area (square feet), S is the slope (feet/foot), and R is the hydraulic radius (feet).

The hydraulic radius is the cross-sectional area divided by the wetted perimeter. For square channels like the one in this example,

$$\text{Hydraulic radius} = \text{depth} \times \text{width} / (2.0 \times \text{depth} + \text{width})$$

To solve this problem design a program that allows the user to guess a depth and then calculates the corresponding flow. If the flow is too little, the user should guess a depth a little higher; if the flow is too high, the user should guess a depth a little lower. The guessing is repeated until the computer flow is within 0.1 percent of the flow desired.

To help the user make an initial guess, the program should display the flow for half the channel depth.

Inputs:

Depth: integer values between 1 and 50

Width: integer values between 1 and 25

Guess: double values less than the depth of the channel and greater than 1

Corrected Sample Output:

Enter the depth of the channel (0 to 50, whole integers): 10

Enter the width of the channel (0 to 25, whole integers):25

At a depth of 5.0 feet, the flow is 1200.6260 cubic feet per second.

Enter your initial guess ($0 < \text{guess} < 10$) for the water depth
when a flow of 1000.0 cubic feet per second is desired.

Enter guess> 6

Depth: 6.000000 ft Flow: 1567.7881 cf/s Target: 1000.0 cf/s
Difference: -567.7881 Error: -56.7788 percent

Enter guess> 5

Depth: 5.000000 ft Flow: 1200.6260 cf/s Target: 1000.0 cf/s
Difference: -200.6260 Error: -20.0626 percent

Enter guess> 4

Depth: 4.000000 ft Flow: 860.8493 cf/s Target: 1000.0 cf/s
Difference: 139.1507 Error: 13.9151 percent

Enter guess> 4.5

Depth: 4.500000 ft Flow: 1026.9233 cf/s Target: 1000.0 cf/s
Difference: -26.9233 Error: -2.6923 percent

Enter guess> 4.4

Depth: 4.400000 ft Flow: 993.0697 cf/s Target: 1000.0 cf/s
Difference: 6.9303 Error: 0.6930 percent

Enter guess> 4.45

Depth: 4.450000 ft Flow: 1009.9580 cf/s Target: 1000.0 cf/s
Difference: -9.9580 Error: -0.9958 percent

Enter guess> 4.41

Depth: 4.410000 ft Flow: 996.4412 cf/s Target: 1000.0 cf/s
Difference: 3.5588 Error: 0.3559 percent

Enter guess> 4.42

Depth: 4.420000 ft Flow: 999.8157 cf/s Target: 1000.0 cf/s
Difference: 0.1843 Error: 0.0184 percent

GOOD GUESS!

_____ (end corrected sample output)

Error Checking:

On the inputs the width and depth must be between 1 and 50 and 1 and 25 and must be whole numbers. If an incorrect number (out of range) is given then display this error message and exit:

Error: Width and Depth values incorrect

At this point, do not worry about checking for a float entered rather than an integer, we will approach that problem later in the course. Just check the proper integer ranges here.

If the guess is above the depth of the channel display the following error message and then display guess prompt again:

Error: Guesses cannot exceed the depth of the channel

Enter Guess>

Handin

Name your program file Ch5P10.c (as the problem was originally designed from programming problem 10 from chapter 5 of your text). Note that your screen output should match that in this assignment (even spelling) exactly. Automated grading may be applied and will indicate an error if you are off by a character. Appropriate style must be used in writing your program or you will receive zero credit until resubmitted with correct style.

handin graderCST Prog1 Ch5P10.c

[*Note that this is not required, but as you progress in your programming and problem-solving career, this will be important!]: If a guess is given anything other than a number then display the following error message and then you would want to display the guess prompt again. Not a trivial exercise in C, but be aware of the problem for now, if your user gives you a character input:

Error: Guesses must be double value

Enter Guess>