

PROGRAMMING ASSIGNMENT 0P

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**Purpose**

The purpose of this assignment is to give you practice with writing more expressions for evaluation, some formatting and using Math library functions. You will need to create a program from scratch! Of course you can start with one of the ones you've used already to get a basic sketch. An empty file called "ellipse\_circumference.c" is provided in the public folder (and available as the starter file in Mimir) which can be used to begin your coding. **You MUST submit a file called by the same name: ellipse\_circumference.c otherwise your tests will fail on Mimir.**

**Problem**

The area of an ellipse with major axis **a** and minor axis **b** is given by  $\pi ab$ . The circumference is harder to compute and we have many approximations, so we will use several of them:

- Ramanujan's formula, first approximation:

$$\pi \left[ 3(a + b) - \sqrt{(3a + b)(a + 3b)} \right]$$

- Ramanujan's formula, second approximation:

$$\pi (a + b) \left[ 1 + \frac{3h}{10 + (4 - 3h)^{1/2}} \right]$$

where  $h = (a - b)^2 / (a + b)^2$

- Muir's formula:

$$2 \pi \left[ a^{s/2} + b^{s/2} \right]^{1/s}$$

where  $s = 1.5$

- Hudson's formula:

$$0.25 \pi (a + b) \left[ 3 \left( 1 + \frac{h}{4} \right) + \frac{1}{1 - h/4} \right]$$

where  $h = (a - b)^2 / (a + b)^2$

- Holder mean:

$$4 \left[ a^s + b^s \right]^{1/s}$$

where  $s = \log(2) / \log(\pi/2)$

- David Cantrell's formula:

$$4(a + b) - 2(4 - \pi)ab / \left[ a^{s/2} + b^{s/2} \right]^{1/s}$$

where  $s = 0.825056$

All variables in your program must be of the “float” data type, they are real numbers (do not use double since it will alter the precision of your computations and results will not match with mine).

Your program should prompt and read the major axis “a” and minor axis “b” and then calculate and display the circumference of an ellipse using each of the above formula and tabulate the results. Your program needs to accept just one set of inputs and print the results. Sample input and output files are available. If you have difficulty aligning the textual description in the first column of the table (these are all called “character strings”) use %s format specifier if that helps.

Please read the Output section below carefully to understand how to print your results.

**Use a constant for the value of PI and set it exactly to 3.14159 otherwise your results will not match mine.** Use any functions from the library file math.h that are appropriate.

## Input

The input will come from standard input, that is, from a user at the keyboard. Input prompts must be accurate. You will test input redirected from an input file.

## Output

You need to print two sets of output.

The first set is purely for submission/grading purposes since we will need to match your values with the expected ones. The variables that hold the results of each computation is printed first, one per line using the following format (all six results should be printed, make sure you print 6 decimal digits without specifying any field width, no spaces anywhere in the format):

```
printf("1").6f\n", result1);
printf("2").6f\n", result2);
....
```

The second set of output is to be done neatly using a tabular format. You don’t have to match my output for this set exactly but keep in mind that it has to be neatly formatted. The grading for this output is handled separately from the accuracy of the results.

Output formatting as specified in the sample output files. Output will be sent to standard output (the screen).

## Testing

On all your assignments, including this one, it is crucial that you test your program thoroughly. Sample files provided help your testing and verifying your program output.

Programs that have compile errors and do not run receive 0 points. Do not add additional features that are not being asked for (and don’t change the order of inputs), since your program may not run against test inputs that I have created.

## Details & Comments

Generally, you must follow all the coding style rules as specified below. In particular:

- You must put your name enclosed in a comment box at the top along with a brief description of what the program does, and add any other comments that are appropriate throughout the program.
- Keep lines to a maximum length that’s easy to read.
- You must use good names for any variables you create (a full word that describes what it is there for).

- Details that you do not follow are penalized after other scored items are added up, so even if you got a 100 for the functionality of your program, you can still get a lower score because you did not follow all the other requirements for the assignment.

## Grade Key

Name, comments, input order	<b>5</b>
Correctly computes ellipse circumference (12 points for each method)	<b>72</b>
Constant definition for pi, Use of Math functions, names of variables	<b>8</b>
Output formatting	<b>15</b>