Writing Homework Assignments in Mathematics

One of the largest cultural shifts in college mathematics courses is instructors’ expectation for written homework assignments. Where in the past, you may only be asked for a numerical answer to a mathematics problem, in your college mathematics course you are required to formally write up a complete solution to your homework problems. The purpose of this guide is to convey common expectations for written homework and provide some a process for meeting these expectations.

Expectations

Your mathematics instructors expect written homework assignments to be correct, clear, and complete. Homework assignments that meet these expectations become a resource for you in your preparation for exams. It is easy to forget ideas and strategies two weeks later after you’ve moved on to a new chapter. Well written homework assignments help you remember how to solve problems. Well written homework assignments are part of the learning process itself. In order to achieve correctness, clarity, and completeness of answers, you will need to understand that mathematics at a deeper level.

Correctness

Correctness means that the answer you give is the precise and true answer to the question. You should check your answer by looking over your calculations and your logical deductions. If you can plug your solution back into an equation to verify your solution, you should do this as well. It may be possible to test whether your answer works for small or convenient numbers. This will not prove your answer is correct, but it will give you some evidence for correctness. Every solution must include a justification of why your answer is correct.

Checklist for Correctness:
1. Did you check your calculations for arithmetic errors?
2. Did you attempt to verify your answer?
3. Does your answer fit with other things you know?

Clarity

Clarity of your written solutions has two components: clarity of presentation and clarity of ideas. A clearly presented solution indicates the question, is written legibly, and is formatted on the page in a way that enhances understanding. Indicate your answers clearly, for example, by boxing or highlighting them.

In order to show clarity of ideas, solutions should tell the reader the key ideas, define variables, and reference outside results. If you are graphing something, clearly label your axes and indicate clearly what you are graphing. If you introduce variables or functions to solve a problem, tell the reader precisely what each variable represents or function is by describing the input and output of the function.
A solution is more than a string of calculations. Even if the problem requires many calculations, you need to justify important steps. Your reader should be able to follow your calculations. If you are referencing an outside result, remind the reader what the result says or is. For example, justifying a result by saying “by Taylor’s Theorem” is better than “by Thm. 5.3”, but “by Taylor’s Theorem, which describes how to approximate functions with polynomials” is even better.

In addition to justifying your steps, a clear solution uses symbols appropriately to enhance the readers understanding. Equal signs mean “is equal to” not “this is the next step” or “I hope these are the same”. Use equal signs to tell the reader that two expressions are the same. You can use arrows to convey the idea of “this is the next step”. Using symbols appropriately makes calculations clearer. It can be fun to try use many symbols, but clear use of symbols helps people understand your work.

There is a connection between clarity of presentation and clarity of thought. Often an incomplete understanding of the mathematics leads to a muddled or mixed up presentation of the solution. The strategy or algorithm you are using to solve a problem must be clear to both you and the reader. Every solution strategy has steps, and you should format your solution to make each step clear. Organizing your solution to reflect the strategy reinforces your understanding of the strategy. Clearly presenting solutions is part of the learning process.

Caution: Instructors may vary in how they want written homework to be presented. You should always make sure you understand each mathematics instructors’ expectations for clarity. Most instructors will have expectations for clarity close to the expectations described in this section.

Checklist for Clarity:
1. Is your name on every page?
2. Is your homework stapled or otherwise packaged?
3. Have you indicated your answers clearly, for example by boxing or highlighting your answers?
4. Have you used equal signs appropriately?
5. Have you clearly indicated which questions you are answering?
6. Does the formatting of the solution on the page guide the reader to important steps and ultimately to your answer?
7. Are complicated steps described or otherwise justified?
8. Have you defined or labeled your variables and/or axes?
9. Have you reread the solution pretending you are not the writer of the solution?
10. Is the formatting of the solution aesthetically pleasing? Have you given credit to any sources (human or otherwise) used?" But then a brief note about acknowledging sources would be needed in the text.

Completeness
A complete solution includes all the information necessary help a reader understand your thought process and solution strategy. A complete solution includes a rephrasing of the problem that you solved. Completeness means that a solution is self-contained
and understandable with minimal outside material. Your solution must accurately reflect your thinking about, strategy, and understanding of a mathematical problem.

Checklist for completeness:
1. Does the solution restate or otherwise indicate the problem that is solved?
2. Are there any steps that you are unsure of?
3. Does the solution tell the reader the strategies or logical framework of the solution?
4. Have you indicated any questions you have about your solution to the instructor?
5. Have you asked a classmate to judge whether the solution makes sense to them?
6. Have you give credit to any sources (human or otherwise) used?

Don’t Panic!
Whew! That’s a lot of expectations! You may feel overwhelmed at this point.

These expectations reflect a major cultural change in doing homework assignments. Your instructors understand this, and we want to help you get better at meeting these expectations. You’ll have many homework assignments during your time at CI, which means many opportunities to improve. Like any new skill, writing better homework solutions takes practice. That’s part of the reason your instructors give you many homework assignments.

If you’re used to simply giving answers and being done with an assignment, these expectations can feel daunting. Meeting these expectations require changing the way you do your mathematics homework. For each credit hour in class, you are expected to concentrate for 2-3 hours outside of the classroom meetings. In mathematics courses this outside of class time is largely taken up by homework. Meeting these expectations means that you will need to spend at least 6 hours a week on your homework.

Process

The first section of this writing guide describes Mathematics Instructors’ expectations for weekly homework assignments. This section is designed to help you meet these expectations by describing a process of crafting high quality solutions. The most important thing for you to do to turn in good homework assignments is: Look at the homework assignment early on, and budget time throughout the week to complete it. This will ensure that you can successfully navigate this four-step process: Understanding, Solving, Writing, and Reviewing.

Phase 1: Understanding the Assignment
Before you start working on a problem, you first must understand what the problem is asking. For some problems, where you are asked to perform calculations, it may be clear what the problem is asking. For other more in-depth problems, understanding what the question is asking may be equally as hard as working out the problem.
If you're having trouble understanding the assignment, your instructor, your textbook, your classmates, and even the Internet are all good sources of clarifying information. When you ask your instructor questions about the assignment, try to be as specific as possible. What do you understand about the question, and what aspects of the question are confusing? Have you looked at your textbook for similar problems that clarify the question or problem you are working on? Have you compared your thoughts about what the question is asking with fellow classmates? What tools or strategies could you try out on this problem?

**Phase 2: Solving the Problem**

Once you understand the problem, you should select or craft a strategy to solve the problem. This strategy may have many steps or may be a straightforward calculation. At this point you're doing the work to figure out an answer. You may try a few different approaches before one ultimately works. This is the “scratch work” phase.

Even though you are still trying to solve the problem, it’s important to be careful in your scratch work. Taking shortcuts or doing too many calculations in your head can lead to errors. A good practice in your scratch work is to do only one step per line of calculation. This may seem like you’re slowing yourself down, but you’ll ultimately save time when you look over your calculation for errors.

Once you have a solution, check to make sure the calculations are done correctly and your answer makes sense. At this point it is appropriate to verify your solution with an outside source if at all possible. Convince yourself that your answer is correct before you start writing up your solution.

**Phase 3: Writing up your Solution**

Once you understand the problem and understand the solution, it’s time to package that understanding into a clear, complete, and correct write-up. The final product that you turn in should be separate from your scratch work in Phase 2. In this phase you formally write your solution.

If you were careful in Phase 2, rewiring your solution is relatively easy. Start by writing down the problem you are solving. You can rephrase the problem; it does not need to be word for word the problem from the book. The reader should be able to understand the problem you are trying to solve without referring to the book.

For the solution, outline the strategy you are using to solve the problem and include the calculation that carries out that strategy. Calculations do not speak for themselves. It is important to make brief notes next to your calculations that explain how one line of calculations becomes another. Including these notes will help you in the future when you use your homework as a study resource.

Crafting these solutions is a form of writing. The text and calculations should be formatted for understanding. You need to use sentences and paragraphs. Spelling and grammar is important as well. Use equal signs appropriately. Every equation is a
sentence with the equals sign a verb. The equals sign does not mean “next step” it means “is equal to”.

A well written solution forces you to better understand your problem solving strategy. Writing up solutions is part of the learning process; it helps you organize your understanding of course material. Well written solutions are a learning resource for you when you revisit material before examinations.

Phase 4: Reviewing your Solution
The final phase of the homework process is to look over what you have written. Spend time reviewing your work for clarity, correctness, and completeness using the checklists for each. Make change or additions to create better solutions. When you are satisfied with your work, congratulate yourself. You’ve created a document that clearly reflects your knowledge and understanding. Even more, the process itself has solidified the understanding of course material in your brain. Through this process you become better at mathematics, making the next homework set easier.