

PROFESSOR	<p>Dr. Rebekah B. Johnson Yates</p> <p>OFFICE: Library 131</p> <p>OFFICE HOURS: posted on course webpage</p> <p>If you need to make an appointment to see me outside of office hours, please send me an email suggesting several times between 9:30 AM and 4:20 PM that will work for you.</p> <p>In person is the best way to contact me. Email is the next best way.</p>
LOCATION/TIME	<p>Tuesdays and Thursdays 10–10:50 AM in Library 140.</p>
MATERIALS AND COMMUNICATION	<p>All assignments will be posted on our class website https://facultysites.houghton.edu/rebekahyates/CalculusAndProblemSolving.htm. Announcements will be posted there and/or communicated by email, so you should check your Houghton email at least once a day during the semester. If you miss class, it is your responsibility to determine what you have missed by checking the website and asking a classmate.</p> <p>You may find it helpful to have a graphing calculator at times. If you do not already own a graphing calculator (or even if you do), you are welcome to use Desmos.com in class when instructed to do so as long as you are not distracted by other things on the device you're using for Desmos.</p>
READINGS	<p>We may occasionally have readings from some free online textbooks. These two can serve as good reference texts: <i>Apex Calculus</i> (http://www.apexcalculus.com/) and <i>Calculus: Volume 1</i> by OpenStax (https://openstax.org/details/calculus-volume-1)</p>
DESCRIPTION	<p>Catalog Description: “Covers the skills and conceptual foundations necessary for success in Calculus II with a broader focus on mathematical problem solving. Fulfills General Education Abstract and Quantitative Reasoning requirement. Liberal Arts. Prerequisite: MATH 171 or 181, or previous experience with calculus and permission of instructor.”</p> <p>Note: since this is a two-credit course, you should expect to spend at least four hours per week outside of class studying and doing problems for this course.</p>
COURSE GOALS	<p>In this course, we will strengthen calculus foundations and skills from Calculus I and strengthen problem solving skills to prepare students to succeed in Calculus II and future math courses. In this course, you will</p> <ol style="list-style-type: none">1. review the terminology and techniques of calculus and use them for computations involving derivatives and integrals.2. understand the connections among and between the key concepts of calculus, as shown by applying theorems, solving problems, and communicating about the ideas using mathematical language.3. apply calculus to problems in real-life settings.4. actively investigate and do mathematics individually and cooperatively; this will require you to analyze concepts and critically evaluate solution methods to generalize ideas and solve problems in novel situations.5. appreciate the beauty of mathematics and reasoning as a gift of God.

ESSENTIAL
LEARNING
OUTCOMES

This course fulfills the General Education Mathematics core course requirement and contributes to students' progress on the following Essential Learning Outcomes at Houghton:

2. Practice scholarship informed by a Christian view of the world with integrity and respect for all.
4. Demonstrate intellectual and practical skills including critical reasoning, effective and creative communication, and quantitative thinking through application to progressively more challenging problems and projects.
5. Demonstrate depth of knowledge of the content, purposes, methods, and limitations of a specific discipline and apply it to complex projects.
6. Practice ethical decision-making, creative problem-solving, and teamwork for service and leadership in the home, workplace, church, and community.

IN-CLASS
PARTICIPATION

You are expected to attend class, be prepared for class, and actively participate in all class activities. At the end of the semester, you will submit a proposed participation grade with written justification using the guidelines below. Note: I reserve the right to assign a different grade than you give yourself if I judge that you have graded yourself incorrectly.

- **To earn an A**, you should complete all assigned reading and exercises and be ready to present each day for all but at most 2 days, you should regularly comment usefully on others' presentations and ask questions that highlight key ideas, and you should contribute ideas and listen carefully to others during group work.
- **To earn a B**, you should complete all assigned reading and exercises and be ready to present each day for all but at most 5 days, you should regularly comment usefully on others' presentations and ask questions that move the class discussion forward, and you should contribute ideas and listen carefully to others during group work.
- **To earn a C**, you should complete all assigned reading and exercises and be ready to present each day for all but at most 7 days, you should listen carefully to and occasionally comment usefully on others' presentations and ask questions and offer insights during class discussions, and you should contribute some ideas and listen carefully to others during group work.
- There is no description for a **D or F** because these grades represent a fundamental breakdown of expectations. A D represents a meaningful but unsuccessful attempt at earning a C or above. An F represents such a severe lack of engagement, effort, or understanding that there is no evidence of meaningful progress (credit to David Clark and Robert Talbert for this paragraph).

SELF
EVALUATIONS

Each student will write a self evaluation twice through the course and at the end of the semester. More details on each assignment will be given at least a week before the assignment is due. After you have written your self evaluation, you will have a one-on-one meeting with me to discuss your progress in the course and goals for the remainder of the course.

DAILY WORK

Most class days, you will have two parts of an assignment. These will be posted on the course webpage.

- I. Class Preparation. This may include a short reading assignment, some reflection questions, and some exercises. For the exercises, work individually and then consult with me and other class members outside of class time. You will present some of these to the class, and you will respond to your classmates' presentations with questions, comments, suggestions, and further ideas. As such, you need to complete or at least seriously attempt each of the exercises each class day so that you are prepared to engage in the class discussion around the exercises.
- II. Problems: assigned (almost) each class day after we've discussed the relevant material in class. These more complex problems will be due on Tuesdays (so any Part II problems assigned from the previous week should be turned in together by the beginning of class on Tuesday). Work on these on your own and then, as needed, consult with other class members, Calculus@Night TAs, and me. After your consultations, write up your final solutions entirely by yourself without comparing them with other people's solutions. The solutions you hand in should be entirely your own and should include a sentence stating the names of your collaborators (those with whom you discussed the problem). Note: while you are welcome to use textbooks as resources (but not to copy solutions from them), looking at solutions on the internet and using generative AI is not acceptable and will be reported to the Provost's Office as an academic integrity violation with the accompanying consequences.

The solutions you turn in should be final, polished versions, written in complete sentences where appropriate and explaining your process. See sample solutions at the end of the syllabus for examples. If you do not have a final, polished solution at the due date, write up what you can and turn it in so that you can earn an R and get feedback toward a revision. Not turning something in will result in an N and you will lose the option to revise that problem. Each problem will receive feedback and one of the following marks:

- E**xcellent: the solution/proof uses correct logic, applies appropriate proof techniques well, has excellent clarity, precision, reasoning, flow, organization, and notation.
- M**eets Expectations: the solution/proof uses correct logic with perhaps one or two details unclear, applies appropriate proof techniques well, is easily understandable with reasonable clarity, precision, reasoning, flow, organization, and notation.
- R**evisable: the solution/proof makes a reasonable attempt to address the problem but has several holes, logical flaws, issues with precision, clarity, organization, or notation that require revision.
- N**ot Assessable: there is no reasonable engagement with the problem or the solution is unreadable.

If you earn an R on a problem, you should revise that problem (and you are welcome to consult with me on your revision) and resubmit it on any Tuesday with your new Part II problems for an opportunity to change the grade to an E or M. Important limitation: you may resubmit a maximum of 3 Part II problems (individual problems, not assignments) per week.

Part II problems and revisions must be turned in on paper at the beginning of class on Tuesdays. Each submission should be labeled with the corresponding Daily Work number. Multiple pages must be stapled in order. Solutions that are typed with L^AT_EX (a typesetting system used by the mathematical community and others) may receive a modicum of extra credit.

Late work: Assignments that are not submitted on time will earn an N and cannot be revised without using a token.

ASSESSMENT

Your final course grade will be assigned based on the following table and the guidelines below it. To earn a particular base grade, you must meet the requirements in every category in that row.

Base Grade	Participation grade	Part II	
		% E's	% E's/M's
A	A	20	85
B	B	10	70
C	C	0	55
D	D	0	40

- The guidelines in the table above are the minimum requirements for earning that particular grade; exceeding requirements (e.g., earning an E/M on 100% of your Part II problems) also meets the requirements for that grade. Note: I reserve the right to change the minimums, but I will never increase them; i.e., any change I make will only maintain or benefit the grade this table and the notes below would assign.
- If you do not meet all the requirements for a D, you will earn an F for the course.
- **Plus/minus grades:** If you meet all the minimum requirements for a base grade *and* one of the categories meets the minimum requirements for the next higher grade, you will earn a plus on your grade (unless you already have an A as Houghton does not give A+'s).

TOKENS

You will begin the semester with two tokens that you can use to buy a one-class extension on a problem set or an additional target appointment in a given week. You can earn extra tokens by taking advantage of opportunities announced in class throughout the semester, such as attending a Math and Science Colloquium presentation on a math topic and then writing a few paragraphs about what you learned. Your first opportunity to earn a token is to find a typo in the syllabus and show it to me by the beginning of class Thursday.

ATTENDANCE

If you are unable to come to class, please let me know as soon as possible. Since class time involves your active participation, missing class without a valid excuse will adversely affect your grade.

TECHNOLOGY IN
THE CLASSROOM

Other than using visualization tools as instructed, we will be practicing an electronic-device-free classroom in order to engage deeply with the material and each other. Please turn off your computers, cell phones, and smart watches and stow them in your bag upon entering the classroom and leave them there for the duration of the class unless instructed to use a device for visualization.

ACADEMIC
INTEGRITY

Honesty is the foundation on which all intellectual endeavors rest. To use the ideas of others without acknowledging the authors of those ideas belies the nature and purpose of academic life. At Houghton, where we strive to live out Christian calling and commitment, personal integrity, including academic honesty, should be the hallmark of all our work and relationships. Houghton's full Academic Integrity Policy, including procedures for addressing violations, can be found in the Academic Catalog: <https://www.houghton.edu/undergraduate/majors/academics/catalog/>

Any work or writing you turn in should be your own, and you are responsible for ensuring that you do not copy anyone else's work or writing (this includes not copying things from the internet or using generative AI). See III. Problems for further information about completing assignments.

ACCOMMODATIONS If you have an academic or physical disability that requires accommodations please contact the Academic Support and Accessibility Services in the Center for Student Success located on the first floor of the Chamberlain Center (585-567-9622). With appropriate documentation, you will be afforded the necessary accommodations. For more information about Academic Support and Accessibility Services go to <https://www.houghton.edu/undergraduate/student-life/student-success/>.

T ϵ A TIME Every Monday at 4 PM, the math faculty and any students who want to come will gather in the ϵ Neighborhood outside the faculty offices for hot beverages, goodies, a fun math problem, and conversation (both mathematical and non-mathematical). Please join us! Note: Tea Time is not intended for homework help.

TENTATIVE SCHEDULE This schedule is subject to modification throughout the semester.

Week 1	Introduction to Problem Solving
Weeks 2–4	Limits and Problem Solving
Weeks 5–6	Derivatives and Problem Solving
Weeks 7–10	Applications of Derivatives and Problem Solving
Weeks 11–13	Integrals and Problem Solving
Week 14–15	Exponential and Logarithmic Functions and Problem Solving
12/15–12/19	Final one-on-one assessment meetings, Tuesday, 10:30 AM–12:30 PM

RESOURCES Some possible places to find assistance:

- **Office Hours:** You are welcome to stop by during these hours to ask questions, AND you are also welcome to stop by whenever my office door is open. If you want to be assured that I will be there outside of my office hours, please make an appointment by emailing me with several times that would work for you or by setting it up with me in person. You should make a serious attempt at any assigned problems about which you wish to ask before you come to see me.
- **Fellow Students:** You are welcome to work with each other to understand the material at any time, although the work you turn in should always be what you have written yourself and should acknowledge your collaborators.
- **Calculus@Night:** location and time to be announced. These sessions are a place where you can work on your homework or other practice problems in small groups with a TA available to offer guidance in the form of hints and suggestions. TAs will neither check your answers nor tell you how to do a problem; instead, they will guide you through the process of thinking about a problem and help you arrive at a solution on your own, often by helping you solve a similar problem.
- **The internet:** there are several good websites with calculus help that you are welcome to use for additional explanations as you are working to understand a concept, but you may not use the internet as you are solving problems and writing your solutions. Some options are Paul's Notes (<http://tutorial.math.lamar.edu/>), Interactive Mathematics (<http://www.intmath.com/help/sitemap.php>), and Khan Academy (<http://www.khanacademy.org>).
- **Tutoring:** as a last resort, having tried all the other options above regularly and having faithfully followed the suggestions on the Suggestions for Learning Mathematics handout posted on the course webpage, you can request a tutor from the office of Academic Support and Accessibility Services, located in the Center for Student Success on the first floor of Chamberlain.

Sample Homework

Here are some sample questions and answers. Your style should be similar (using complete sentences and explaining your process). If you use your calculator/computer for a problem, you must describe what you did on your calculator/computer to get your answer. Make sure you write neatly, work down the page (as opposed to from left to right), and organize your work so that it is easy for others to follow. Don't forget to include a statement about any collaborators you had on any problem, and make sure your solutions are ones you wrote yourself without looking at anyone else's solution. **Your solutions should be explained in such a way that your classmates would understand them.**

1. Let $f(x) = 2x^2 + 3x - 4$. Find the derivative of $f(x)$.

Solution: We differentiate to get $f'(x) = 4x + 3$.

2. Find $\lim_{x \rightarrow 1} \frac{x^2 - 1}{x - 1}$.

Solution: Since plugging in $x = 1$ to the fraction results in a zero in the denominator, we cannot use substitution or take the limit of the numerator and denominator to find the limit. Instead, we factor the numerator and compute the limit:

$$\lim_{x \rightarrow 1} \frac{x^2 - 1}{x - 1} = \lim_{x \rightarrow 1} \frac{(x - 1)(x + 1)}{x - 1} = \lim_{x \rightarrow 1} (x + 1) = 1 + 1 = 2.$$

3. A farmer has 2400 feet of fencing and wants to fence off a rectangular field. What are the dimensions of the field with largest area?

Solution: Let x be the width of the field and y be the length of the field, both in feet. Since the farmer has a total of 2400 feet of fencing, both x and y are bounded by 0 and 1200. We want to maximize the area

$$A = xy.$$

Since there are 2400 total feet of fencing, we know that

$$2x + 2y = 2400,$$

so, solving for y in terms of x , we have

$$y = 1200 - x.$$

Thus, we can express the area of the field as a function of x :

$$A(x) = x(1200 - x) = 1200x - x^2.$$

In order to find the maximum area, we take the derivative of $A(x)$ and set it equal to 0, then solve for x :

$$0 = A'(x) = 1200 - 2x,$$

which gives us $x = 600$ as a critical point. If $x = 600$, then $y = 600$ as well, giving the field an area of 3600 square feet. We need to check the endpoints also in order to verify that we have found the maximum area. If $x = 0$, then $y = 1200$ and the field has an area of 0 square feet. Similarly, if $x = 1200$, then $y = 0$, so the area of the field is 0 square feet. Hence, the field with maximum area will be 600 feet by 600 feet.