Mathematical Methods in the Physical Sciences II

Syllabus

Summer 2025 **Math 184**

§A. What is this class?

Math 18400 is the second in a sequence of mathematics courses for students in the physical sciences (such as physics, chemistry, statistics, and engineering) focusing on Multivariable and Vector Calculus. Think of it as a greatest hits album from Calculus I and II, but a remixed version for higher dimensions!

In real life, most processes depend on more than one input – if you have ever filled out a tax form, you know just how many... The same is true all the way from quadratic equations to rocket science. So, whether we do optimization using differentiation or calculate volume using integration, it's all for functions of more than one variable. To make sure the new analogues make sense, we introduce some new ideas, such as parametric curves and vector fields, along the way. By the end of the course, everything slots into place like an IKEA furniture set, and you will realize that there is essentially one big theorem, generalizing the Fundamental Theorem of Calculus, that ties it all together.

Please make use of my office hours and plan to work hard. **Since this is a 5-week summer session, you can expect a significantly higher workload than a typical quarter, so make sure that you stay on top of your assignments and get help early.** Begin studying for the checkpoint quizzes well in advance. Put your good study habits into practice by reviewing formulas and working through extra problems when necessary, so that you can identify weaknesses and seek help. Remember that part of doing real math is productive failure: you'll try things that don't work; learn something from that failure; try something new that works a bit better, and… after a while, you will figure it out, and come out with a much more robust understanding of the structure of mathematics.

§B. Key Information

Class Meetings

MWF 10:00 AM - 12:00 PM (CST), see Canvas for Zoom link.

How to contact me

- **Email:** subhadip@uchicago.edu
- **Office:** Eckhart 120B [over Zoom in Summer]

Office Hours

See Canvas for up-to-date hours. You can also email me to set up an individual meeting.

Required Study Materials

- **Textbook:** We will mainly use lecture notes and activities written especially for this class. You can use Calculus Volume 3 - OpenStax as a reference. The text is open-source and freely available online. You do not need to purchase any textbooks.
- **Computing and Graphing Software:** We will use CalcPlot3D and DESMOS 3D for in-class demonstrations.

Class announcements

- **Available on:** `https://canvas.uchicago.edu/courses/64685`
  Check Canvas and your UChicago email at least once before and after each class.

§C. Prerequisites

The prerequisite for this course is

- Math 18300, or
- (Math 15300 or 13300 or 16300 or 16310) and (Math 19620 or Math 20250 or Stat 24300), or
- placement into Math 18400.

Please direct all inquiries about placement or enrollment to mathadvising@uchicago.edu. If you have met the prerequisites but are concerned about your preparedness level for this course, please reach out to me.

§D. Learning Objectives

Upon completion of this course, you will

- develop core skills in mathematical thinking, such as problem solving, reading, writing in the language of mathematics, and clearly communicating logical arguments;
- build both geometric and analytical intuition for core concepts in multivariable differential calculus, such as partial derivatives, gradients, and Lagrange multipliers;
- be able to compute and interpret integrals over scalar fields, including double, triple, line, and surface integrals;
- understand concepts related to vector fields, such as divergence, curl, flux across curves and surfaces;
- be able to compute integrals related to vector fields, such as work integrals, and be able to interpret their physical meaning;
- apply the fundamental theorems of vector calculus, such as Green's, Stokes's, and the divergence (Gauss's) theorem.

Note: While a major focus of the course is computational, it is a mathematics course, and as such, abstraction, logical reasoning, and proof will be crucial to our understanding of the material. Computational, algebraic, and geometrical perspectives will be balanced throughout the course to provide a comprehensive understanding of the material from multiple, mutually reinforcing representations.

§E. Components of the course, a.k.a. What do I need to do every week

Our course employs a methodology known as the Mastery-Based Grading System, also referred to as Standards-Based or Learning-Based Grading, in which most graded work does not have a point value or percentage. Instead, you earn your grade by showing **appropriate engagement** with the course (including active participation and appropriate civil conduct in classes and tutorials, as described below) and **demonstrating evidence of skill on the course standards** that describe the major ideas covered by each quiz. These standards are listed in section L and may be updated throughout the quarter.

When you submit most work, I will evaluate it relative to the quality standards made clear on each question. If your work meets the standard, then you will receive full credit for it. Otherwise, you will get helpful feedback and, on most items, the chance to reflect on the feedback, revise your work, and then reassess your understanding.

This feedback loop represents and supports the way that people learn. Learning happens over time, as we revisit ideas and reflect on them. In this class, your final grade will reflect how well you **eventually** understand each topic. You can make mistakes without penalty, as long as you **eventually** demonstrate fluency in the topic.

E.1 Attendance and Engagement

In this class, **showing up is necessary but not sufficient**: true engagement means being present, prepared, and actively participating in your own learning and the learning of your peers. Your best chance to discuss new material, ask questions, and avoid confusion is during class – so, don't miss class!

Being Present

Please show up to class **on time** and ready to engage. **Attendance will be taken.** If you need to miss class for any reason, email me as soon as possible and make a plan to catch up. In particular, you should:

- Watch the recorded class video while reading through the class notes;
- Read the corresponding content from the textbook;
- Try the relevant homework problems *before* seeking additional help from me with the material from that day.

Please do not miss class without contacting me – I don't care whether you think it's a good 'excuse' or not. Just send me an email or reply to mine! This isn't about enforcing perfect attendance; it's about keeping an open line of communication so I can support you effectively. Lack of communication about absences may affect your final grade.

Engaging Actively

We'll be learning together, and the participation of every student – whether in whole-class, small-group, or individual settings – creates the best learning environment for everyone. As a college student and future professional, full engagement is not optional; it's expected.

You can demonstrate your engagement in a number of ways:

- Giving constructive feedback during in-class discussions.
- **Attending synchronous meetings and being on camera while on Zoom.** *If you require an exception, you need to reach out to me directly as soon as possible. Your request may be approved or denied.*
- Asking relevant questions in class, during office hours, or through email.
- Participating in collaborative group work when applicable.
- Creating an inclusive and welcoming class environment for peers.

Consistent effort is the baseline, not the bonus. So, please show up, speak up, and support each other.

E.2 Weekly Homework

Homework will be assigned weekly via Canvas and will be split into two parts: **procedural** and **conceptual**.

Procedural Part

We will be using an online homework system called Edfinity for the procedural part. These can be attempted multiple times without penalty until you are happy with your scores. You will access your Edfinity assignments through Canvas – see the Announcement section for more information.

> **Note:** Each Edfinity assignment score is normalized to be out of 100. Satisfactory completion of Edfinity homework is one of the course standards as described in section L.

Conceptual Part

The problems in the conceptual part will be a little more complex, and are intended to check or further your understanding of the topics. Your solutions to the conceptual problems should be uploaded as a PDF under the appropriate Gradescope link and will be graded by a course assistant. Typing is not required, as long as the scanned papers are legible.

Note: The exam problems will be closer to procedural questions than conceptual ones.

Due Dates

Both problem sets will be assigned daily after each class meeting and will be due in 70 hours (except for the last week). So, you should start working on them as soon as they are uploaded; do not wait until the due date to begin.

E.3 Checkpoint Quizzes

Rather than midterm or final exams, we will have five checkpoint quizzes (including a final 2 hour quiz on the last day of class).

Each quiz will have questions that are directly associated with **all** the course standards (see section L) that have been introduced in class meetings up to that point. Your goal will be to demonstrate your ability to complete each standard at least once throughout the course. If you complete a standard on an earlier test, you do not need to attempt it on later tests.

As such, each new quiz is another opportunity to show your proficiency in the course standards. If you initially struggle with a particular standard, you will have the time and opportunity to study, practice, and try again.

Quiz Schedule

- Jun 23, Monday (Week 2) - Checkpoint Quiz 1 (55 minutes) - Synchronous
- Jun 27, Friday (Week 2) - Checkpoint Quiz 2 (90 minutes) - Take-home
- Jul 7, Monday (Week 4) - Checkpoint Quiz 3 (55 minutes) - Synchronous
- Jul 11, Friday (Week 4) - Checkpoint Quiz 4 (90 minutes) - Take-home
- Jul 18, Friday (Week 5) - Checkpoint Quiz 5 (120 minutes) - Synchronous

Two types of quizzes

Notably, there are TWO types of quizzes, the details of which are given below.

- **Synchronous Quizzes:** These quizzes will take place during our usual class meetings. For quizzes 1 and 3, the first half of the class meeting will still cover new material and will not be a review session.
- **Take-home quizzes:** The Canvas link will be active for a 48-hour period. However, once you start the test, you must finish it within 90 minutes. During this time, you will be required to write the solution for each standard separately on paper (not a tablet) and upload a scanned or photographed copy **in PDF format via Canvas.**

Warning:

- Please inform me well in advance if you are unsure about converting a picture or scan into PDF format. I will only accept files in PDF format.

- Start the upload process when you still have 5-10 minutes left, just in case you encounter any technical difficulties during the upload. Generally, I will not accept email submissions, except in extenuating circumstances.

General Expectations Regarding Solutions

Each solution should clearly explain your thought process and include sufficient justifications. Present your work in a clear and legible manner. Instead of merely demonstrating to your instructor that you have completed the assignment, write as if you are explaining the concepts to a classmate who missed that day of class!

Warning: You may not post problems on the Internet or discuss specific problem details with others. Please email me to ask whether a particular resource is allowed or not. Usage of any generative AI will be considered a **violation of academic integrity** policies.

Missed Quiz

There will be no make-up quizzes. If you miss the deadline for a quiz, you will have the opportunity to complete the course standard again on subsequent quizzes.

§F. Assessment and Grading, a.k.a. How do I earn a grade

Your course grade will be determined by three assessed components of the course: active participation, completion of course standards, and performance on conceptual exercise sets. The requirements to be successful in each component are outlined below, along with a description of how these components are used to determine your final grade.

F.1 Attendance and Engagement

Your participation will contribute to your final course grade as one of the graded components. At the end of the quarter, I will assess your attendance and engagement based on the following rubric:

Level	Description
Full	Attends at least 90% of class meetings live (unless excused); regularly contributes during discussions or in chat; initiates help-seeking (email or office hours); collaborates positively with peers.
Good	Attends at least 80%; participates semi-regularly in class or group work; completes assigned makeup work responsibly when absent; occasionally seeks help.
Satisfactory	Attends at least 70%; generally passive but not disruptive; communicates intermittently and completes most follow-ups.
Minimal	Attends less than 70% of meetings or has ongoing issues with participation or communication without explanation.

F.2 Course Standards

Each standard represents about one day of classwork. They are listed in section L approximately in the chronological order in which we will cover them.

I will maintain a record of your **completed** standards on Canvas. Standards will appear on all tests after the corresponding topic has been introduced in class meetings. If you answer a question incorrectly or do not complete it, it will

be recorded as **Incomplete**. Only the total number of complete standards contributes to your final grade, regardless of whether they need revisions on multiple tests.

Note: You may sometimes get a **Can correct** grade on a standard in a Quiz. This grade indicates work that contains a minor error, and you have the opportunity to resubmit for a regrade. Submit a written report (including a rewritten solution) via the Google form link in Canvas **within a day** after a graded exam is returned to you. If you can convince me that you understand what the error was and how to fix it, then I will update the **Can correct** to an **Complete** for free. If I don't hear from you within a day or I am not convinced, a **Can correct** automatically becomes a **Incomplete**.

You will receive helpful feedback on unsatisfactory work, the chance to reflect on the feedback, revise your work, and then reassess your understanding in the next quiz. My hope is that this method of grading will keep you clearly informed as to the expectations of the class and how well you are meeting them, while also removing the (often distracting) elements of linear grading that use letters or total points. If you have questions or concerns at any time, please feel free to discuss them with me.

Note: One important thing to keep in mind during this class is that you should not be discouraged if you don't earn **Complete** on a standard the first time. That's normal. I'm only interested in what you can show me you can do by the end of the semester. However, do not put off finishing the standards; it will be hard to catch up if you fall too far behind.

A Special Course Standard

There is also a general course standard in section L that is evaluated a bit differently:

S16: Edfinity Homework. I **complete** procedural homework assignments on Edfinity with accuracy and consistency.

For this standard, you can earn a **Complete** grade for an overall Edfinity score of at least 90%. Otherwise, this standard will receive an **Incomplete** grade.

F.3 Weekly Conceptual Exercise Sets

Since these problems are designed to assess your deeper reasoning skills rather than procedural fluency, they are graded on a scale of 0 to 3 instead of a binary scale. The scale should be interpreted as follows:

- 0/3 - Question was not attempted, not completed, or had major errors.
- 1/3 - Question was complete. A reasonable effort but with significant errors, or correctly complete but with insufficient working.
- 2/3 - Question was complete with only minor errors and reasonable working. A minor error can be seen as one that still allows you to demonstrate your relative understanding of the problem as intended.
- 3/3 - Question was complete accurately with clear explanations and work.

Your overall score will be calculated as your total score over all questions in all weekly exercise sets. Notably, this means that an exercise set with more questions will contribute more toward your overall grade.

F.4 Final Grade

At the end of the quarter, I am required to submit to the college a letter grade that reflects your overall achievement in this course. Here is how that grade will be determined.

In order to achieve a given grade, you must complete **all four requirements** in that grade's corresponding column. Additionally, any student who completes all four requirements in a corresponding column is guaranteed at least that grade.

Category	A	B	C	D
Attendance and Engagement	Full	Good	Satisfactory	Minimal
Conceptual Homework Credits	At least 80% homework grade	At least 75% homework grade	At least 70% homework grade	At least 65% homework grade
Course Standards (out of 17)	At least 15 completed	At least 13 completed	At least 11 completed	At least 9 completed
Core Standards (out of 7)	At least 6 completed	At least 5 completed	At least 4 completed	At least 3 completed

Note: If you do not meet the **D** requirement for any of the four categories, your grade will be an **F**.

Your base grade is the minimum requirement met across the four categories. From there, your base grade will be increased by a +/- grade based on how close you are to the next higher letter grade. For example, a student with good participation, 13 standards, 4 core standards, and 80% on conceptual homework might earn a **B+**. Similarly, a student with good participation, 14 standards, 5 core standards, and 75% on conceptual homework might earn an **A-**. Please contact me at any time during the quarter if you have any questions about the grading system or would like to review your current progress.

The final decision regarding any changes to these guidelines will be made by the Director and Co-Directors of Undergraduate Studies in the Department of Mathematics and will be communicated to all via Canvas. Any such changes can only (if anything) loosen the requirements from what is given above.

§G. Collaboration Policy

Collaboration and cooperation are extremely helpful in the learning process, and we will have many such opportunities. However, it is often unclear what exactly "collaboration" means when working on assignments. The following section should clarify what my expectations are regarding this and give guidelines for avoiding plagiarism in assignments.

- **Weekly Homework:** On weekly homework problems, you are permitted to discuss big ideas and hints with your classmates, but every step of every solution should be one that you understand yourself and that you have generated on your own.

  Any collaboration should occur only when your collaborator is at essentially the same stage of the problem solution as yourself. In particular, if you have not yet started problem #4 and you ask a friend (who has already completed it), "How did you do problem 4 ?", this counts as **a violation of the university's academic integrity policy**.

  On your written homework, you must indicate who your collaborators are. (If you collaborate with different people on different problems, just say so!)

- **Quizzes:** These must be completed as individual assignments, and collaboration is not permitted.

- **Outside resources:** Unless explicitly permitted, copying outside materials such as solutions found online, web pages, videos, etc., is considered **a violation of the university's academic integrity policy**.

- **Past students or Peer tutors:** On any assignment, basing your work on the efforts of another student who previously completed this course or one like it, or a tutor not specifically approved by me, is considered **a violation of the university's academic integrity policy**.
- **Mathematical tools and software:** *Unless otherwise specified*, you may use a calculator or mathematical software, such as WolframAlpha or Mathematica, to simplify arithmetic of numbers, but NOT to simplify or compute the algebra of functions, including derivatives and integrals. Otherwise, *you should treat software as a human collaborator: you may use it to motivate or check your computational work, but not to generate complete solutions.* You will need to include all steps and details in your submitted work, and these must have been calculated by you without referring to the software.
- **AI Policy:** AI tools (such as ChatGPT, Dall-E 2, PhoenixAI) are permitted only for weekly homework with the same restrictions as above. They are strictly prohibited for take-home quizzes. Unauthorized use of AI tools in take-home quizzes will **violate the university's academic integrity policy.**

G.1 Consequences of academic dishonesty

Violations of academic integrity are serious and will be handled seriously. Resulting punishment could include (at least) taking a zero for an assignment where an instructor has probable cause that cheating or plagiarism has occurred. For more details, regarding academic honesty within the College, please visit the following link: https://college.uchicago.edu/advising/academic-integrity-student-conduct.

G.2 A positive note

Remember that I want you to be successful. That is, I want you to develop a deep, personal understanding of the material we study so that you become a better student of mathematics who can go on to do well in all of your future endeavors. Every part of this course structure - including both collaborative work and restrictions on collaboration - are intended to help you with this. You will often struggle, and that's intentional - struggle (and eventual success!) is essential to learning. Indeed, productively failing (and learning from it) is part of your final grade.

In all aspects of the course, please understand that I am generous with hints and am always willing to discuss problems with you. I will never simply give you an answer, but I will offer direction and guidance that will assist you in coming up with a solution on your own. This is by far the most satisfying way to solve a problem, and the difficulty is well worth it. You are always welcome to discuss your questions or concerns with me at any time.

§H. Classroom Norms

H.1 'Growth', not 'Ability'

There is a very prevalent belief that you are either "good" or "bad" at math, and if you are "bad" at it, then you will always be bad at it no matter how hard you try. This is extremely false, and the mathematics community bears a lot of responsibility for perpetuating this myth. In reality, mathematics is just like any other discipline or skill: you can improve more and more with practice.

We are all capable of growth in mathematics. You should measure your success in this class by how much your understanding of the concepts has improved over the course of the quarter. Also, math is very hard, so you should expect to struggle with the material! When you struggle, you are learning and growing. Not all people show their struggle in equal ways, so you should always be wary of judging your progress based on your perception of your peers' struggle. You are probably doing better than you think.

Note: This is an Easter egg. The passphrase is 'IKEA' without the quotes.

H.2 Respecting Each Other

We are not all coming to this class with the same privileges, resources, time, and knowledge. It's really important to keep this in mind when working with each other on homework assignments and during class meetings. **It is our strong belief that as a community, mathematicians and scientists need to do a much better job of making our disciplines more accessible to people of all races, genders (including gender non-conforming folks), sexual identities, and class backgrounds.** While this is a priority for us in the classroom, we do not claim to know how to best honor this commitment, but we are eager to listen, adapt, and learn. So **we are very open to feedback from students when it comes to making the course more accessible and inclusive to all identities.**

It's also important to think about how to respect one another when working together in groups. It's not equally easy for all of us to speak up in a large group, and the voices of historically underrepresented/marginalized students are most easily drowned out in group work. So please keep this in mind when working together. Here are some concrete examples of positive collaborative behavior:

- Making sure everyone who wants it has the opportunity to speak frequently. This can mean checking in with each other to make sure everyone is following along and contributing when they have an idea.
- Respecting people's pronouns and other aspects of their identity.
- Making sure that everyone's ideas are acknowledged when writing up the final solution to a problem. When working in groups, solutions often evolve organically; an idea might pop into your head and you may think it's yours and yours alone, but perhaps you only arrived there because of something else that someone already said. Pay attention to what people are saying and try to learn from one another.

We will do our best to check in with folks periodically during the quarter. If at any time in the quarter, you find yourself in a group of students for which the above behaviors aren't being practiced and people aren't feeling respected, please let me know.

§I. Helpful Resources

I.1 Office Hours

Office hours are really Student hours! They are an opportunity for you to stop by your instructor's office and ask questions. I have specifically set this time aside in order to give personalized help to individual students. Any and all questions are welcome, whether you are working on a homework question, have questions on a broader concept discussed in class, or potentially even questions beyond the scope of the course.

Typically, students misunderstandings in mathematics are initially small, but due to the constructive nature of math, a small misunderstanding can compound as concepts are utilized together. Students who frequently attend office hours and actively engage by asking questions are able to continually resolve their small misunderstandings, resulting in sustained improvement.

I.2 Academic Accommodations

If you require any special academic accommodations, please provide me with a copy of your Accommodation Determination Letter (issued by the Student Disability Services office) as soon as possible, so we can discuss how your accommodations may be implemented in this course. If you are in the process of obtaining accommodations, please inform me as soon as possible. More information can be found here: https://disabilities.uchicago.edu/.

I.3 Religious Accommodations

The University of Chicago is home to students of all the world's major religions and, though firmly a secular institution, values the rich diversity of spiritual expression and practice found on campus. It is therefore the policy of the University that students who miss class, assignments, or exams to observe a religious holiday must be accommodated as follows: (i) absences may not be counted as a missed class in any course in which attendance is a measure of academic performance; (ii) reasonable extensions of time must be given, without academic penalty, for missed assignments; and (iii) exams must be reasonably rescheduled without academic penalty. You must inform me in writing of your need to observe a religious holiday reasonably well in advance of the absence, preferably at the beginning of the quarter. More information can be found at the following; https://provost.uchicago.edu/handbook/clause/policy-religious-accommodation-missed-classes-assignments-and-exams.

I.4 Wellness Resources

UChicago has counseling available both 24/7 and by appointment through http://wellness.uchicago.edu. Additionally, you can access medical care, including 24/7 support from medical professionals to address your healthcare questions.

I.5 Sexual Misconduct Policy

The University of Chicago recognizes that members of the university community are responsible for ensuring that the community is free from discrimination and other forms of sexual misconduct based on sex or gender, including sexual harassment, sexual assault, stalking, domestic violence and dating violence. Faculty are considered "Individuals with Title IX Reporting Responsibilities" of the University and are obligated to report information to the Title IX Coordinator related to sexual misconduct. If you think your rights, or the rights of someone else in the university community, have been violated you can find information on resources and reporting at: https://cares.uchicago.edu/.

Title IX Coordinator: Bridget Collier, Associate Provost & Director (bcollier@uchicago.edu, 773-702- 5671)

§J. Recording and Deletion Policy

The Recording and Deletion Policies for the current academic year can be found in the Student Manual under Petitions, Audio & Video Recording on Campus.

- Do not record, share, or disseminate any course sessions, videos, transcripts, audio, or chats.
- Do not share links for the course to those not currently enrolled.
- Any Zoom cloud recordings will be automatically deleted 90 days after the completion of the recording.

§K. Disclaimer

I reserve the right to make changes to this syllabus if needed. Any changes will be announced to the class in a timely manner.

§L. Math 184 Course Standards

The seven ⍟ marked learning targets are considered the most important ("Core") learning targets. They are not scored differently but are used to determine final grades. See section F.4 for details.

S1. **Graphing and Surfaces.** I can **determine** and **sketch** the graph of a two-variable function, or a curve, plane, and other common quadric surfaces based on an equation, graph, or verbal description, and **interpret** the geometric meaning of level sets.

S2. **Directional Derivatives.** I can **evaluate** the directional derivatives and higher-order partial derivatives of a function and **interpret** them geometrically from a contour plot.

S3. ⍟ **Gradient and Tangent Plane.** I can **use** the gradient to **derive** the equation of the tangent plane to an implicitly defined surface.

S4. **Local Optimization.** I can **locate** and **classify** critical points of two-variable functions by identifying critical points and using the Hessian.

S5. ⍟ **Lagrange Multipliers.** I can **apply** Lagrange multipliers to **optimize** given a constraint, using the extreme value theorem when appropriate.

S6. **Chain Rule.** I can **compute** partial derivatives of composite functions using the multivariable chain rule.

S7. **Line Integrals.** I can **evaluate** line integrals of scalar and vector fields over parameterized curves.

S8. ⍟ **Conservative Fields.** I can **determine** if a vector field is conservative, **find** a scalar potential function, and **calculate** the work done using the Fundamental Theorem of Line Integrals.

S9. **Double Integrals.** I can **set up** and **evaluate** double integrals as iterated integrals for type I and type II regions, and **switch** the order of integration as necessary.

S10. ⍟ **Jacobian and Coordinate Change.** I can **compute** and **interpret** the Jacobian of a coordinate change function, and use it to **transform** and evaluate double integrals.

S11. ⍟ **Green's Theorem.** I can **explain** what the boundary of a region in $\mathbb{R}^2$ means, and **apply** Green's theorem to **convert** line integrals over curves in $\mathbb{R}^2$ to double integrals over two-dimensional regions and **evaluate** either as necessary.

S12. **Surface Integrals.** I can **parameterize** a surface and calculate integrals over parametric surfaces.

S13. ⍟ **Stokes's Theorem.** I can use Stokes's theorem to **convert** line integrals over curves in $\mathbb{R}^3$ to surface integrals and **evaluate** either as necessary.

S14. **Triple Integrals.** I can **set up** and **evaluate** integrals over three-dimensional regions as iterated integrals, and **identify** the most convenient coordinate system or order of integration.

S15. ⍟ **Gauss's Theorem.** I can **calculate** the flux through a surface using Gauss's divergence theorem.

S16. **Edfinity Homework.** I **complete** procedural homework assignments on Edfinity with accuracy and consistency (90%+ overall score).