

# MAC 2311: CALCULUS 1 ONLINE FALL 2016

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# MAC 2311 – Calculus 1

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## MAC 2311 Online: Calendar, Fall 2016

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>Introduction Module 1</b>	Aug 22 Course Introduction	24	25 Lecture 1	26	27 Lecture 2
<b>Modules 1 &amp; 2</b>	29 Lecture 3	30 Lecture Quizzes 1-2 in Canvas*	31 Lecture 4	Sept 1 HW 1 & Quiz 1 in WebAssign*	2 Lecture 5
<b>Module 2</b>	5 Labor Day	6 LQ 3-4*	7 Lecture 6	8 HW 2 & Quiz 2*	9 Lecture 7
<b>Module 2 Review</b>	12 Lecture 8	13 LQ 5-7*	14 Exam Review	15 HW 3 & Quiz 3*	16 Study for Exam 1
<b>Exam 1 Module 3</b>	19 Exam 1**	20 LQ 8*	21 Lecture 9	22	23 Lecture 10
<b>Module 3</b>	26 Lecture 11	27 LQ 9-10*	28 Lecture 12	29 HW 4 & Quiz 4*	30 Lecture 13
<b>Module 3</b>	Oct 3 Lecture 14	4 LQ 11-13*	5 Lecture 15	6 HW 5 & Quiz 5*	7 Lecture 16
<b>Module 3 Review</b>	10 Lecture 17	11 LQ 14-16*	12 Exam Review	13 HW 6 & Quiz 6*	14 Study for Exam 2
<b>Exam 2 Module 4</b>	17 Exam 2**	18 LQ 17*	19 Lecture 18	20	21 Lecture 19
<b>Module 4</b>	24 Lecture 20	25 LQ 18-19*	26 Lecture 21	27 HW7 & Quiz 7*	28 Lectures 22
<b>Module 4</b>	31 Lecture 23	Nov 1 LQ 20-22*	2 Lecture 24	3 HW 8 & Quiz 8*	4 Lecture 25
<b>Module 4</b>	7 Lecture 26	8 LQ 23-25*	9 Veterans Day	10 HW 9 & Quiz 9*	11 Lecture 27
<b>Review Exam 3</b>	14 Exam Review	15 LQ 26-27*	16 Study for Exam 3	17 Exam 3**	18 HW 10 & Quiz 10*
<b>Module 5 Thanksgiving</b>	21 Lecture 28 Withdraw Deadline	22	23 Thanksgiving	24 Thanksgiving	25 Thanksgiving
<b>Module 5</b>	28 Lecture 29	29	30 Lecture 30	Dec 1 LQ 28-29*	2 Lecture 31 HW 11 & Quiz 11*
<b>Module 5 Review</b>	5 Lecture 32	6	7 Final Exam Review	8 LQ 30-32*	9 HW 12 & Quiz 12*
<b>FINAL EXAM: Monday, December 12, 6PM – 10PM EST (schedule a 130 minute time block with Proctor U)</b>					

**\*All dates listed are the final due dates for the quiz, homework, and exam. Work must be complete by 11:59PM EST.**

**\*\*Semester Exams must be scheduled with Proctor U at least 4 days in advance.**  
**Available from 6-10PM EST, in a 100 minute time slot: Exam 1, 9/19; Exam 2, 10/17; Exam 3, 11/17**

## 2. INTRODUCTION

**2a COURSE CONTENT:** MAC 2311 is the first in the three-semester sequence MAC 2311, MAC 2312, MAC 2313 covering the basic calculus. Intended topics will include limits, differentiation, applications of the derivative and introduction of integration.

A minimum grade of C (not C–) in MAC 2311 satisfies four credits of general education requirement and also satisfies the pure math portion of the state Writing/Math requirement.

This is an ONLINE VERSION of MAC 2311 – all content is delivered online. Students view 32 online lectures and complete lecture quizzes in the course management system Canvas, and complete online homework and quizzes using WebAssign. Students are encouraged to post questions and answers on the course discussion board in Canvas. Three semester exams and a final are posted in Canvas and administered through ProctorU.

**2b PREREQUISITES:** MAC 2311 assumes that you have essential precalculus skills (both algebra and trigonometry) necessary to succeed in calculus. Students should be able to do arithmetic without a calculator.

To enroll in MAC 2311, you must have earned a grade of C or better in MAC 1147 (or its equivalent, both MAC 1140 and MAC 1114), earned calculus credit through an exam or earlier coursework, or have taken the ALEKS placement assessment and attained the required minimum score. You may take the ALEKS assessment through the Student Self Service homepage <https://student.ufl.edu/>; click on Placement under My Online Services. For more complete information, check the page <https://student.ufl.edu/aleksinfo.html>. Note the following paragraph: “The Department of Mathematics encourages you to take the assessment even if you have met one of the prerequisites for MAC 2311. Quite often, your algebra and trigonometry skills may need review and your placement assessment can provide information and specific areas for additional study.” You can check with an advisor in your college or the MAC 2311 course instructors to be sure that you are eligible for MAC 2311.

MAC 2311 begins with a short review of precalculus topics including a short diagnostic test in WebAssign. **You should already be competent in working this material.** We **strongly recommend** that students who are having difficulty with the precalculus review material consider first taking MAC 1147, a four credit precalculus course reviewing essential calculus skills. You may switch courses on the Student Self Service during the drop-add period. **After the drop-add period, the paperwork to move back to precalculus MAC 1147 must be completed through the math department. The deadline is Tuesday, September 6 at 4PM.** Contact the math department, 352-294-2350, for details.

**2c REQUIRED MATERIALS:**

**Textbook: Calculus: Early Transcendentals, 8th Edition by Stewart**

It is required that you have a WebAssign code for doing online homework. There are three ways to purchase the text and WebAssign access code.

- You have the choice to “opt-in” to WebAssign access and the e-book through CANVAS once classes begin for a reduced price of \$62.50 and pay for these materials through your student account. The opt-in option is the most effective one if you are planning to take only MAC 2311. The link to opt-in will be provided in the course homepage in CANVAS.
- Students who do not “opt-in” will be able to purchase a standalone WebAssign access code through the UF Bookstore (or the WebAssign website directly) for \$96.00. This is not the best option as the price is significantly higher than the “opt-in” price.
- Students who plan to take three semesters of Calculus: MAC 2311, MAC 2312, and MAC 2313 can purchase a multi-term access online via WebAssign for \$125.00 and that includes the e-book. The link will be provided in the course homepage in CANVAS.

**An online purchase at WebAssign should only be considered for those who need multi-term.**

There is also a loose-leaf print version (\$50.00) of the customized textbook available at the UF Bookstore for students who wish to have a printed resource.

**Computer access and requirements:** All assignments should be taken on a computer, not cell phone or tablet, since there may be compatibility issues with Canvas and WebAssign. Be sure you are using a browser that works with WebAssign. Please check for WebAssign browser recommendations: [http://www.webassign.net/manual/student\\_guide/c\\_a\\_system\\_requirements.htm](http://www.webassign.net/manual/student_guide/c_a_system_requirements.htm). Any WebAssign questions should be directed to your TA and/or the WebAssign Student Support, <https://webassign.com/support/student-support/>.

**Calculators:** A graphics calculator and Wolframalpha are useful as a study and learning tool when used appropriately, but they are not essential. **Remember that Calculus is a collection of ideas that are not mastered through calculator skills. No calculators are allowed on exams.**

**2d COURSE CALENDAR:** Check the course calendar and Canvas for due dates and plan your schedule accordingly.

**2e E-LEARNING IN CANVAS:** UF Online’s course management system, is accessed through <http://elearning.ufl.edu/>. Use your Gatorlink username and password to login. All course information including the course homepage, syllabus, and exam information are posted on this site. In addition, there is a mail tool and discussion forum for communication.

All grades are posted in Canvas (except individual WebAssign homework and quiz scores which are accessed in your WebAssign gradebook). You are responsible for verifying that those grades are accurate. **You have one week after a score has been posted to resolve any grade concerns by contacting the course instructor. We will not consider these grade disputes at the end of the semester.**

**Please note:** Important course information is clearly communicated in this course guide and assignments and course materials are easily accessible through the Can-

vas modules. If you cannot find your answer in the resources above, there is also a **Discussion Forum** available in Canvas. Please use this to post questions and to supply answers to your fellow students. Your instructor will check the discussion forum regularly.

**2f LECTURE VIDEOS:** The lecture videos provide the main presentation of course material, and are accessed through the Canvas modules. To stay current with the course, we recommend watching the videos weekly following the schedule posted on the course calendar. **You should watch the lectures and answer the corresponding Lecture Quiz Questions before attempting homework.** You may contact your instructor or post questions on the course discussion board if you need clarification of a topic. The Broward Teaching Center at UF provides online support and is a valuable resource.

**2g SUCCESS:** Other than having a strong precalculus background, success in MAC 2311 depends largely on your attitude and effort. It is not effective to watch a video and copy notes without following the thought processes involved in the lecture. For example, you should try to answer the questions posed by your lecturer. Students who do not actively participate have much more difficulty. For that reason there are lecture quiz questions included in each lecture which you will answer in Canvas as part of your final grade.

However, be aware that much of the learning of mathematics at the university takes place outside of the classroom. You need to spend time reviewing the concepts of each lecture from the videos and textbook **before** you attempt homework problems. It is also important to look over the textbook sections to be covered in the next lecture to become familiar with the vocabulary and main ideas before watching the video. That way you will better be able to grasp the lecture material. As with most college courses, you should expect to spend a **minimum** of 3 hours working on your own for every hour of classroom instruction. **You should therefore plan to spend at least 12 hours each week on this online course including the time spent watching the lecture videos.**

It is critical that you keep pace with the course material as presented in the module for each week. Do not fall behind. Ask questions either on the discussion board or in email with your instructor; do not let misunderstandings go unanswered.

We recommend studying with others, and an important resource to facilitate communication in an online course is the MAC 2311 discussion board in Canvas. You should check the discussion board regularly, posting questions and answers for fellow students. The effort of asking questions and communicating ideas clearly, as well as the practice of writing solutions, are effective tools in helping you better understand calculus concepts. The instructor and for MAC 2311 will also check the discussion board regularly to answer student questions.

**In studying calculus, you must be careful not to let a tutor, friend, or calculator “think” for you. Be sure that you can work problems completely on your own, without help, by the time of a quiz or exam.**

Our hope is that through focused study and practice you will gain a real appreciation for the important concepts of calculus and their application. We want you to succeed in this class! But you must keep up with the course material and take the initiative to get help in time, before you get too far behind. Students with a positive attitude who are intellectually engaged in learning the material will get the most from the course.

**2h STUDENTS WITH LEARNING DISABILITIES:** Students requesting class and exam accommodations must first register with the Dean of Students Office Disability Resource Center(DRC), <https://www.dso.ufl.edu/drc/>. That office will provide a documentation letter to the student to present to the course instructors. This must be done as early as possible in the semester, **at least one week before the first exam**, so there is adequate time to make proper accommodations.

**2i ACADEMIC HONESTY:** Remember that you committed yourself to academic honesty when you registered at the University of Florida by agreeing to the Honor Pledge below:

### **The Honor Pledge**

We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity by abiding by the Honor Code.

On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied:

“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”

**Academic Honesty Guidelines:** “All students are required to abide by the Academic Honesty Guidelines which have been accepted by the University. The academic community of students and faculty at the University of Florida strives to develop, sustain and protect an environment of honesty, trust and respect. Students are expected to pursue knowledge with integrity. Exhibiting honesty in academic pursuits and reporting violations of the Academic Honesty Guidelines will encourage others to act with integrity. Violations of the Academic Honesty Guidelines shall result in judicial action and a student being subject to the sanctions in paragraph XIV of the Student Code of Conduct.”

The Mathematics Department expects you to follow the Student Honor Code. We are bound by university policy to report any instance of suspected cheating to the proper authorities.

You may find the Student Honor Code and read more about student rights and responsibilities concerning academic honesty at the link <https://www.dso.ufl.edu/sccr/>.

In addition, we remind you that lecture videos are the property of the University/faculty member and may not be used for any commercial purpose. Students found to be in violation may be subject to discipline under the Student Conduct Code.

### 3. TESTING

**3a SEMESTER EXAMS:** During the semester, three tests will be given between on the dates shown on the course calendar. The exams will be given in Canvas and administered through ProctorU. You will take the exam in a 100 minute time slot between 6PM and 10PM. **You must register with ProctorU at <http://go.proctoru.com> for each exam at least 4 days in advance.** See instructions on our homepage in Canvas. Each exam will be scored on a scale of 0 to 100 points.

**3b FINAL EXAM:** A mandatory, comprehensive final examination will be given on Monday, December 12. You will need to register with ProctorU at least 4 days in advance to schedule a 130 minute time block between 6PM and 10PM.

**Missing a final exam due to negligence,** however, will result in a **minimum 10-point** penalty.

**IMPORTANT: You may use your final exam score to replace your score for one of the three semester exams if the grade is higher.**

**Note:** You may not use a calculator or any other study aid for exams. Be sure to read the ProctorU handout thoroughly to understand the exam procedures before you start a test.

**3c IMPORTANT EXAM POLICIES:** MAC 2311 requires that students take evening exams through ProctorU online on the listed dates. There are no exceptions to this. Students with conflicts, including regularly scheduled classes or traveling, must make advance arrangements to be present at the test.

**The following applies to all exams:**

(1) Students are responsible for material covered in lectures, reading assignments, and text problems. Questions will test mastery of concepts and include challenging calculation problems. **A command of related algebraic and trigonometric concepts is assumed** (see the Prerequisites, page 13, in this guide).

(2) Bring only the following while taking an exam with ProctorU: two picture IDs (UF Gator One card and your state driver's license) with a **legible signature** and blank scratch paper.

**Cell phones and other electronic devices must be turned off and out of sight. They cannot be on the working area while you are taking an exam. If any such device rings or buzzes, your test will be considered to be compromised.**

(3) ProctorU recommends students to connect with them few days before an exam to check for any internet connection issues and computer compatibilities.

See Section 4f for the Exam Make-up Policies.



## 4. GRADING

**4a COURSE GRADE:** Your course grade is based on 600 points accumulated as follows:

10 WebAssign Quizzes (best 10 of 12)	100
WebAssign Assignments	60
Lecture Quizzes	40
3 Semester Exams	300
Final exam	<u>100</u>
	<b>600</b>

The total sum of points is your numerical score, which will be converted to a letter grade according to the following scale. **The course grade is determined by the number of points you earn, not by the percentage**, and will be strictly enforced. Scores within 0.5 of the next cutoff will round up.

**There will be no additional curve in this course, and extra assignments for individual students to improve a grade are NOT possible.**

A	540 - 600 pts (90%)	C	400 - 439 pts (67%)
A-	520 - 539 pts (87%)	C-*	380 - 399 pts (64%)
B+	500 - 519 pts (84%)	D+	360 - 379 pts (60%)
B	480 - 499 pts (80%)	D	340 - 359 pts (57%)
B-	460 - 479 pts (77%)	D-	320 - 339 pts (54%)
C+	440 - 459 pts (74%)	E	0 - 319 pts

**\*NOTE** A grade of C- DOES NOT give Gordon Rule or General Education credit!

For those taking the S-U option: S [400 - 600 points] U [0 - 399 points]

Approval of the S-U option must be obtained from your instructors. The deadline for filing an application with the Registrar and further restrictions on the S-U option are given in the Undergraduate Catalog.

For a complete explanation of current policies for assigning grade points, refer to the UF undergraduate catalog:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

**4b VIDEOS and LECTURE QUIZZES:** Viewing the lecture presentations is an important aspect of the learning process. Videos are accessed through the modules in Canvas. There are 2-3 lecture quiz questions to be completed with each lecture and you have 2 tries per each lecture quiz. You may earn up to 40 points by completing lecture quizzes by the specified due date.

You should work these problems as you watch the lectures and then enter your answers directly in Canvas. We encourage you to use the text as well as the videos to help answer these questions.

**4c WEBASSIGN ONLINE HOMEWORK:** The online homework administered on WebAssign is planned to review concepts and provide practice of the lecture material. There are 12 sets of online homework assignments during the semester and they must be completed by the specified due date. Your total score on online homework assignments will count up to a maximum 60 points, but the total number of points available is higher to offset credit lost due to technical difficulties or a missed assignment.

The homework problems are graded by WebAssign and you see your score immediately after submitting your work. You will have multiple attempts for each problem; there are aids and a link to the ebook to help you solve each question.

**Do not try to complete an assignment in one sitting; start early instead of waiting until the due date to avoid missing the deadline.**

**4d WEBASSIGN ONLINE QUIZZES:** Twelve quizzes will be posted in WebAssign to be due on the dates listed in the course calendar. You will have 45 minutes to complete an online quiz; the clock starts from the time you open your quiz. Each quiz will be graded on a scale of 0 to 10 points, and the top ten scores will count, to total up to 100 points. **DO NOT wait until the last minute to submit your quiz; we will not extend time for computer issues or WebAssign server problems.**

Like an in class quiz, you will not know if your answers are correct when you take a quiz and you will not see any results until the due date has passed. After the due date, you may see your quiz scores and review the questions missed in the WebAssign gradebook.

**NOTE: WebAssign Homework, quizzes and Lecture Quizzes account for 200 points of the total to be earned in the course. They are a significant part of your grade, to reflect their importance in understanding course concepts.**

**4e EXTRA CREDIT:** You may earn additional points in the following ways:

- **SYLLABUS QUIZ (3 points):** In Canvas you will find the Start Here page. Watch the introductory video and read the syllabus. After you feel comfortable with the course policies listed, take the syllabus quiz posted in WebAssign for extra credit by May 13.
- **PRECALCULUS DIAGNOSTIC TEST (5 points):** This test provides a review of precalculus skills. It is posted in WebAssign and is due on May 13.
- **COURSE PARTICIPATION (10 points):** We encourage you to utilize TA's virtual office hours and the MAC 2311 Discussion Board regularly to ask and answer questions about course material and homework. You can earn up to 5 bonus points to participate in virtual office hours and up to additional 5 points by posting questions and responding to other students' posts. Questions must be appropriate and relate to course material to earn credits.
- **EXAM PREPARATION (12 points):** An Exam Review will be posted in Canvas for each of the three semester tests. The review will include questions from previous MAC 2311 exams so that you will have a flavor of the type of questions that you will see on the actual test. Detailed instructions for earning extra credits will be posted with the exam reviews.

#### 4f MAKE-UP POLICIES AND EXTENSIONS:

- **EXTENSIONS ON WEBASSIGN HOMEWORK:** While it is a much better strategy to work ahead, occasionally you may fall behind. You can request an extension on WebAssign homework within 2 days after the deadline and you will have 48 hours to complete it after extension request. The extension must submit in WebAssign directly. However, there will be a 20% grade penalty for those problems completed after the original due date for the assignment.
- **MAKE-UP WEBASSIGN QUIZZES:** We offer 2 drops on WebAssign quizzes, so we do not provide make-ups for online quizzes. To allow time for computer issues, it is recommended not to wait until final hours on the due day to start your quizzes.
- **MAKE-UP LECTURE QUIZZES:** There are 47 points available in lecture quizzes but you may only earn up to 40 points, so we do not offer make-ups.
- **MAKE-UP EXAMS:** Students must provide valid documentation for requesting a make-up exam. The request must be approved by the course instructors at least one week prior to the exam date. **If illness or other extenuating circumstances force you to miss an exam, contact the instructors as soon as possible (no later than 24 hours after the exam) for approval to schedule a make-up exam.** We do not consider traveling or lack of internet access as a valid excuse for a make-up exam.

4g **INCOMPLETE GRADE:** A student **who has completed a major portion of the course with a passing grade** but is unable to complete the final exam or other course requirements due to illness or emergency may be granted an incomplete, indicated by a grade of “I”. This allows the student to complete the course within the first six weeks of the following semester. The student must contact the course instructors before finals week to sign an incomplete grade contract (<http://clas.ufl.edu/forms/incomplete-grade-contract.pdf>), and must provide documentation of the extenuating circumstances preventing him or her from taking the final exam. **The grade of “I” is never used to avoid an undesirable grade, and does not allow a student to redo work already graded or to retake the course.** See the official policy at <http://www.math.ufl.edu/departement/incomplete-grades/>.

## 5. GENERAL EDUCATION INFORMATION

MAC 2311 has been designated a General Education course that can be counted towards the Mathematical Science (M) requirement.

**Course Objective** – The General Education Objectives for Mathematics courses:

“Courses in mathematics provide instruction in computational strategies in fundamental mathematics including at least one of the following: solving equations and inequalities, logic, statistics, algebra, trigonometry, inductive and deductive reasoning. These courses include reasoning in abstract mathematical systems, formulating mathematical models and arguments, using mathematical models to solve problems and applying mathematical concepts effectively to real-world situations.”

The primary goal of the course is to help students understand and apply the fundamental principles of differential and integral calculus. These objectives are accomplished through the lectures, homework, quizzes and discussion sections.

**Student Learning Outcomes (SLOs)** – The general education student learning outcomes describe the knowledge, skills and attitudes that students are expected to acquire while completing a general education course at the University of Florida.

**I. Content:** Content is knowledge of the concepts, principles, terminology and methodologies used within the discipline. Students demonstrate competence in the terminology, concepts, theories and methodologies used within the discipline.

- Understand the fundamental concept of limit.
- Understand the definition of the derivative and be competent at calculating derivatives using the product, quotient, and chain rules.
- Understand the definition of the definite integral via Riemann sums and gain competence in evaluating them directly from the definition.

**II. Communication:** Communication is the development and expression of ideas in written and oral forms. Students communicate knowledge, ideas and reasoning clearly and effectively in written and oral forms appropriate to the discipline.

- Communicate mathematical findings clearly and effectively using written and/or graphic forms.

**III. Critical Thinking:** Critical thinking is characterized by the comprehensive analysis of issues, ideas, and evidence before accepting or formulating an opinion or conclusion. Students analyze information carefully and logically from multiple perspectives, using discipline-specific methods, and develop reasoned solutions to problems.

- Apply techniques of derivatives and critical thinking effectively to solve applied problems including related rates and optimization problems.
- Analyze properties of functions using derivatives including regions of increase/decrease, inflection points, local maxima/minima.
- Apply the Fundamental Theorem of Calculus to the evaluation of definite integrals and understand the link between differentiation and integration.

These SLOs are assessed through weekly homework assignments and quizzes, three semester exams, and final exam.

## **6. ONLINE COURSE EVALUATION**

Students are asked to provide feedback on the quality of instruction in this course by completing an online evaluation at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open.

## PREREQUISITES FOR MAC2311

This course assumes that you have a sound precalculus background. The following is a summary of some important concepts used in solving calculus problems. The textbook provides a more complete review of these essential topics.

### ALGEBRA

1. Basic Geometric Formulas: ( $b$  = base,  $l$  = length,  $h$  = height,  $w$  = width)

Triangle: area =  $\frac{1}{2}bh$

Circle: area =  $\pi r^2$ ; circumference =  $2\pi r$

Parallelogram: area =  $bh$

Rectangular box: volume =  $lwh$

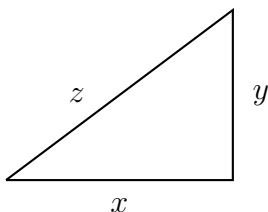
Sphere: volume =  $\frac{4}{3}\pi r^3$ ; surface area =  $4\pi r^2$

Right circular cylinder: volume =  $\pi r^2h$ ; surface area =  $2\pi rh + 2\pi r^2$

Right circular cone: volume =  $\frac{1}{3}\pi r^2h$ ; surface area =  $\pi r\sqrt{r^2 + h^2}$

Facts about similar triangles

Pythagorean theorem:  $x^2 + y^2 = z^2$



2. Basic Functions and their graphs:

$$f(x) = x; f(x) = x^2; f(x) = x^3; f(x) = |x|; f(x) = \sqrt{x}; f(x) = 1/x;$$

$$f(x) = b^x, b > 0 \text{ and } b \neq 1, \text{ such as } f(x) = 2^x$$

3. Factoring:

$$x^3 + y^3 = (x + y)(x^2 - xy + y^2); x^3 - y^3 = (x - y)(x^2 + xy + y^2); \text{ etc.}$$

4. Fractions:  $\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$ , etc.

5. Exponents:  $x^n y^n = (xy)^n$ ;  $x^n x^m = x^{n+m}$ ;

$$\frac{x^n}{x^m} = x^{n-m}; (x^n)^m = x^{nm}$$

6. Roots, including rationalizing the denominator or numerator.

$$\sqrt[n]{x} = x^{\frac{1}{n}}; x^{-n} = \frac{1}{x^n}, \text{ etc.}$$

7. Inequalities and absolute values:

$$|x| \leq a \quad -a \leq x \leq a; \quad |x| > a \quad x > a \text{ or } x < -a$$

8. Equation solving: Finding solutions for  $x$  if

$$ax + b = 0; ax^2 + bx + c = 0; \text{ etc.}$$

9. Logarithms: If  $x > 0$ ,  $\log_a x = y$  if and only if  $x = a^y$

If  $m > 0$  and  $n > 0$ , then

$$\log(nm) = \log(n) + \log(m) \quad \log\left(\frac{n}{m}\right) = \log(n) - \log(m)$$

$$\log(n^c) = c \log(n)$$

## TRIGONOMETRY

### 1. Identities:

$$\begin{array}{lll} \sin(-\theta) = -\sin \theta & \cos(-\theta) = \cos \theta & \tan(-\theta) = -\tan \theta \\ \sin\left(\frac{\pi}{2} - \theta\right) = \cos \theta & \cos\left(\frac{\pi}{2} - \theta\right) = \sin \theta & \tan\left(\frac{\pi}{2} - \theta\right) = \cot \theta \\ \sin^2 \theta + \cos^2 \theta = 1 & \sec^2 \theta = 1 + \tan^2 \theta & \csc^2 \theta = 1 + \cot^2 \theta \end{array}$$

### 2. Sum and Difference Formulas:

$$\begin{array}{l} \sin(A \pm B) = \sin A \cos B \pm \cos A \sin B \\ \cos(A \pm B) = \cos A \cos B \mp \sin A \sin B \\ \tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B} \end{array}$$

### 3. Double Angle Formulas:

$$\begin{array}{l} \sin 2\theta = 2 \sin \theta \cos \theta \\ \cos 2\theta = \cos^2 \theta - \sin^2 \theta = 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta \end{array}$$

### 4. Half-Angle Formulas:

$$\sin^2 \theta = \frac{1 - \cos 2\theta}{2} \quad \cos^2 \theta = \frac{1 + \cos 2\theta}{2}$$

### 5. Trigonometric Values:

$\theta$	0	$\pi/6$	$\pi/4$	$\pi/3$	$\pi/2$
$\sin \theta$	0	1/2	$\sqrt{2}/2$	$\sqrt{3}/2$	1
$\cos \theta$	1	$\sqrt{3}/2$	$\sqrt{2}/2$	1/2	0
$\tan \theta$	0	$\sqrt{3}/3$	1	$\sqrt{3}$	undef