MAC 2311: CALCULUS 1 ONLINE SUMMER C 2023

SYLLABUS/CALENDAR

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Course homepage is located on Canvas, http://elearning.ufl.edu.

IMPORTANT: While taking this class online, you MUST take the exams through Honorlock in Canvas on the dates shown on the course calendar and you MUST have steady internet access. You may receive a score of ZERO on the test if your internet connection drops during the test, for which a make-up exam may not be offered.

MAC 2311 − Calculus 1 Course Policies and Syllabus

MAC 2311 Online: Calendar, Summer C 2023

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	May 15 First Day of Classes **Start Module 1** **Lecture 1**	16 **Lecture 2**	17 **Lecture 3**	18 **Lecture 4**	19 LQ 1-4	20
21	22 **Start Module 2** **Lecture 5** Quiz 1 (L1-4)	23 LQ5	24 **Lecture 6**	25 LQ 6 / HW 1	26 **Lecture 7**	27
28 LQ 7 / HW 2	29 **Holiday**	30 **Lecture 8** Quiz 2 (L5-7) LQ 8 / HW 3	31 **Lecture 9** HW 4	June 1 LQ 9 / HW 5 Quiz 3 (L8-9) Practice Exam 1	2 **EXAM 1**	3
4	5 **Start Module 3** **Lecture 10**	6 **Lecture 11** LQ 10	7 LQ11 / HW 6	8 **Lecture 12**	9 LQ 12 / HW 7	10
11	12 **Lecture 13**	13 LQ 13 / HW 8 Quiz 4 (L10-12)	14 **Lecture 14**	15 LQ 14 / HW 9	16 **Lecture 15**	17
18 LQ 15 HW10-11	19 **Holiday**	20 **Lecture 16** Quiz 5 (L13-14) LQ 16 / HW 12	21 **Lecture 17**	22 LQ 17 / HW 13 Quiz 6 (L15-17) Practice Exam 2	23 **EXAM 2**	24
25	26 SUMMER BREAK	27 SUMMER BREAK	28 SUMMER BREAK	29 SUMMER BREAK	30 SUMMER BREAK	July 1
2	3 **Start Module 4** **Lecture 18**	4 **Holiday**	5 **Lecture 19**	6 **Lecture 20** LQ 18-19	7 HW 14	8
9	10 **Lecture 21** LQ 20 / HW 15 Quiz 7 (L18-19)	11 LQ 21 / HW 16	12 **Lecture 22** HW 17	13 LQ 22	14 **Lecture 23** HW 18 Quiz 8 (L20-22)	15
16 LQ 23 / HW 19	17 **Lecture 24**	18 LQ 24 / HW 20	19 **Lecture 25**	20 LQ 25 / HW 21 Quiz 9 (L23-25) Practice Exam 3	21 **EXAM 3**	22

23	24 **Start Module 5** **Lecture 27**	25 LQ 27	26 **Lecture 28** HW 22	27 LQ 28	28 **Lecture 29**	29
30 LQ 29 / HW 23	31 **Lecture 30**	August 1 LQ 30 / HW 24	2 **Lecture 31** Quiz 10 (L27-29)	3 LQ 31	4 **Lecture 32** HW 25	5
6 LQ 32 / HW 26	7	8 HW 27	9 Quiz 11 (L30-32)	10 Practice Final Exam	11 **FINAL EXAM**	12

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

*Semester Exams must be completed using Honorlock. They will be available from 10:00AM-10:00PM (You must submit your exam by 10:00PM in order to not be late).

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 31 online lectures and complete lecture quizzes, online homework, and quizzes in the course management system Canvas. 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 Honorlock.

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; click on Placement under My Online Services. For more complete information, check the page 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 an instructor to be sure that you are eligible for MAC 2311.

MAC 2311 begins with a short review of precalculus topics including a 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 ONE.UF during the drop-add period.

2c REQUIRED MATERIALS:

Textbook: We will be using the online open-source textbook **OpenStax: Calculus Volume 1** which can be found at https://openstax.org/details/books/calculus-volume-1. There is no purchase required to use this book.

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. We will be using the online homework system Xronos developed by the Math Department here at UF. As of right now, Firefox is the best browser to use when completing homework online through

Xronos. In particular it has been noted that Safari has some issues with Canvas and Safari will not work for Xronos, so it is recommended that you do not use Safari when accessing assignments on Canvas.

In addition, you will need to use Google Chrome for examinations as they are proctored using the Honorlock proctoring service which requires their Honorlock Chrome Extension.

Calculators: No calculators are allowed on exams. However, a graphing 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.**

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

2e E-LEARNING IN CANVAS: UF Online's course management system, is accessed through elearning.ufl.edu. 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. You are responsible for verifying that those grades are accurate. **You have three days after a score has been posted to resolve any grade concerns by contacting both instructors. 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 Canvas 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 and additional example 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.

Lecture notes outlines: You can download and print them out from each module page in Canvas. It is important that you should have a copy of the lecture notes in order to follow the lecture easier when watching the videos.

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 during online office hours or on the discussion board**; do not let misunderstandings go unanswered. 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. This is YOUR forum, take advantage of it by participating in it.

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://disability.ufl.edu/. The DRC will provide a documentation letter to the student to present to the 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 and the accommodations are not retroactive.

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 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.

2j ONLINE COURSE EVALUATION: Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https:// gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/ public-results/.

2k DIVERSITY AND INCLUSION: The Mathematics Department is committed to diversity and inclusion of all students. We acknowledge, respect, and value the diverse nature, background and perspective of students and believe that it furthers academic achievements. It is our intent to present materials and activities that are respectful of diversity: race, color, creed, gender, gender identity, sexual orientation, age, religious status, national origin, ethnicity, disability, socioeconomic status, and any other distinguishing qualities.

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 Honorlock. You will be given a 90-minute time limit once you start each exam. Each exam will be scored on a scale of 0 to 100 points.

Average/Replace policy: The lowest of the three semester exams will be replaced by the average of the three semester exams. This average/replace policy will help to minimize the impact of a single poor performance.

3b FINAL EXAM: A mandatory, comprehensive final examination will be given on Friday, August 11. This will be given in exactly the same manner as the 3 semester exams except you will have 120 minutes to complete the Final Exam.
Missing an exam due to negligence, however, will result in a **minimum** 10-point penalty.

Note: You may not use a calculator or any other study aid for exams.

3c IMPORTANT EXAM POLICIES: MAC 2311 requires that students take exams through Honorlock 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. We allow a large window of time (10:00AM – 10:00PM US Eastern Time) so that you can arrange a fitting time slot that works for you.

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) In order to use Honorlock and take the Exams you will need a computer/device, webcam, and stable internet access. You will need to be using the Google Chrome browser (https://www.google.com/chrome/) and download the Honorlock Extension for Chrome (www.honorlock.com/extension/install). You can see the Honorlock Student Guide linked below for information on how to download and use Honorlock.

(3) Bring only the following while taking an exam with Honorlock: two picture IDs (UF Gator One card and your state driver's license) with a **legible signature** and blank scratch paper (up to 10 sheets).

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.

Please see the Honorlock Student Guide at Honorlock Student Guide and the best practices guide at Honorlock Best Practices

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

4. GRADING

4a <u>COURSE GRADE:</u> Your course grade is based on the following percentages:

9 Quizzes (2 dropped)	10%
Xronos Assignments (3 dropped)	12%
Lecture Quizzes (4 dropped)	8%
Semester Exams (3 at 15%)	45%
Final Exam	25%

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

A	90.0-100.0%	C	67.0-73.99%
A−	87.0-89.99%	C−*	64.0-66.99%
B+	84.0-86.99%	D+	60.0-63.99%
B	80.0-83.99%	D	57.0-59.99%
B−	77.0-79.99%	D−	50.0-56.99%
C+	74.0-76.99%	E	0.00-49.99%

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

For those taking the S-U option: S [67.0-100%] U [0-66.99%]

Approval of the S-U option must be obtained from both 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: catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

4b <u>VIDEOS and LECTURE QUIZZES:</u> 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 lecture quiz. There will be 4 lecture quiz grades dropped.

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 <u>XRONOS ONLINE HOMEWORK:</u> The online homework administered on Canvas through Xronos plans to review concepts and provide practice of the lecture material. During the course of the semester, online assignments will be assigned on a routine basis and must be completed before the due dates listed in the course calendar. There will be a total of 3 homework assignments dropped.

The homework problems are graded and your score is immediately available after submitting your work in Canvas. You will have multiple attempts for each problem.

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 ONLINE QUIZZES: Eleven quizzes will be posted in Canvas to be due on the dates listed in the Quiz/HW 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 nine scores will count meaning 2 quizzes will be dropped. **DO NOT wait until the last minute to submit your quiz; we will NOT extend time for computer issues or 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 gradebook.

NOTE: Xronos Homework, Quizzes and Lecture Quizzes account for 30% 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 EXAMS: Three semester exams and a cumulative final exam are given online in Canvas. Your exam grade will be available in Canvas gradebook once your exam is submitted. The MAC 2311 exams are not released to students, but you may request a private online conference or visit any of the instructors' office hours to review your exam within three days of the exam.

4f EXTRA CREDIT: You may earn additional points in the following way:

- A practice exam will be available in Canvas before each exam and 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 exam. You can earn up to 5 extra points toward each respective exam based on your performance on these assignments.

4g MAKE-UP POLICIES AND EXTENSIONS:

- MAKE-UP ASSIGNMENTS: As there are dropped assignments for the Xronos homework, quizzes, and lecture quizzes, there are no extensions on such assignments. Please plan accordingly to finish each assignment as it is due.
- MAKE-UP EXAMS: Students must provide valid documentation for requesting a make-up exam due to a scheduling conflict **by the end of the second week to avoid penalty.** If illness or other extenuating circumstances force you to miss an exam, contact both 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.
- OTHER MAKE-UPS: There are no make-ups on any extra credit assignments.

4h 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 both instructors before finals week for departmental approval 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/department/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.

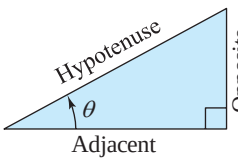
These SLOs are assessed through weekly homework assignments and quizzes, three semester exams, and final exam/.

This syllabus is subject to change. You will be notified if any changes are made.

Updated on 4/20/2023

Definition of the Six Trigonometric Functions

Right triangle definitions, where $0 < \theta < \pi/2$

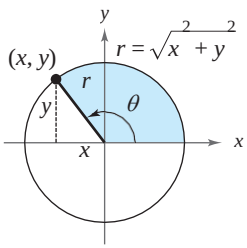


$$\sin\theta = \frac{\text{opp.}}{\text{hyp.}} \qquad \csc\theta = \frac{\text{hyp.}}{\text{opp.}}$$

$$\cos\theta = \frac{\text{adj.}}{\text{hyp.}} \qquad \sec\theta = \frac{\text{hyp.}}{\text{adj.}}$$

$$\tan\theta = \frac{\text{opp.}}{\text{adj.}} \qquad \cot\theta = \frac{\text{adj.}}{\text{opp.}}$$

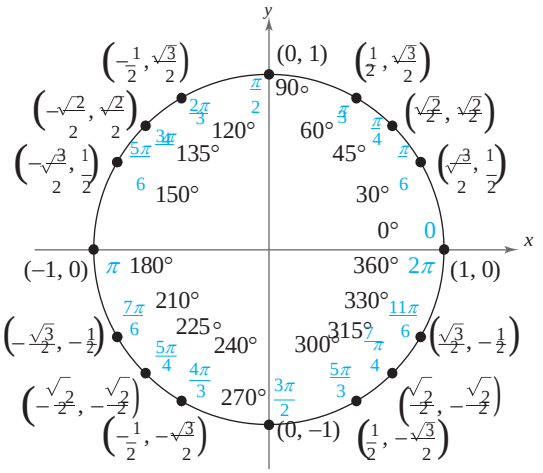
Circular function definitions, where θ *is any angle*



$$\sin\theta = \frac{y}{r} \qquad \csc\theta = \frac{r}{y}$$

$$\cos\theta = \frac{x}{r} \qquad \sec\theta = \frac{r}{x}$$

$$\tan\theta = \frac{y}{x} \qquad \cot\theta = \frac{x}{y}$$



Reciprocal Identities

$$\sin u = \frac{1}{\csc u} \qquad \cos u = \frac{1}{\sec u} \qquad \tan u = \frac{1}{\cot u}$$

$$\csc u = \frac{1}{\sin u} \qquad \sec u = \frac{1}{\cos u} \qquad \cot u = \frac{1}{\tan u}$$

Quotient Identities

$$\tan u = \frac{\sin u}{\cos u} \qquad \cot u = \frac{\cos u}{\sin u}$$

Pythagorean Identities

$$\sin^2 u + \cos^2 u = 1$$

$$1 + \tan^2 u = \sec^2 u \qquad 1 + \cot^2 u = \csc^2 u$$

Cofunction Identities

$$\sin\left(\frac{\pi}{2} - u\right) = \cos u \qquad \cot\left(\frac{\pi}{2} - u\right) = \tan u$$

$$\cos\left(\frac{\pi}{2} - u\right) = \sin u \qquad \sec\left(\frac{\pi}{2} - u\right) = \csc u$$

$$\tan\left(\frac{\pi}{2} - u\right) = \cot u \qquad \csc\left(\frac{\pi}{2} - u\right) = \sec u$$

Even/Odd Identities

$$\sin(-u) = -\sin u \qquad \cot(-u) = -\cot u$$

$$\cos(-u) = \cos u \qquad \sec(-u) = \sec u$$

$$\tan(-u) = -\tan u \qquad \csc(-u) = -\csc u$$

Sum and Difference Formulas

$$\sin(u \pm v) = \sin u \cos v \pm \cos u \sin v$$

$$\cos(u \pm v) = \cos u \cos v \mp \sin u \sin v$$

$$\tan(u \pm v) = \frac{\tan u \pm \tan v}{1 \mp \tan u \tan v}$$

Double-Angle Formulas

$$\sin 2u = 2 \sin u \cos u$$

$$\cos 2u = \cos^2 u - \sin^2 u = 2\cos^2 u - 1 = 1 - 2\sin^2 u$$

$$\tan 2u = \frac{2\tan u}{1 - \tan^2 u}$$

Power-Reducing Formulas

$$\sin^2 u = \frac{1 - \cos 2u}{2}$$

$$\cos^2 u = \frac{1 + \cos 2u}{2}$$

$$\tan^2 u = \frac{1 - \cos 2u}{1 + \cos 2u}$$

Sum-to-Product Formulas

$$\sin u + \sin v = 2\sin\left(\frac{u+v}{2}\right)\cos\left(\frac{u-v}{2}\right)$$

$$\sin u - \sin v = 2\cos\left(\frac{u+v}{2}\right)\sin\left(\frac{u-v}{2}\right)$$

$$\cos u + \cos v = 2\cos\left(\frac{u+v}{2}\right)\cos\left(\frac{u-v}{2}\right)$$

$$\cos u - \cos v = -2\sin\left(\frac{u+v}{2}\right)\sin\left(\frac{u-v}{2}\right)$$

Product-to-Sum Formulas

$$\sin u \sin v = \frac{1}{2}[\cos(u - v) - \cos(u + v)]$$

$$\cos u \cos v = \frac{1}{2}[\cos(u - v) + \cos(u + v)]$$

$$\sin u \cos v = \frac{1}{2}[\sin(u + v) + \sin(u - v)]$$

$$\cos u \sin v = \frac{1}{2}[\sin(u + v) - \sin(u - v)]$$

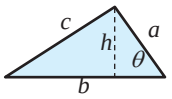
FORMULAS FROM GEOMETRY

Triangle:

$h = a \sin \theta$

$\text{Area} = \frac{1}{2}bh$

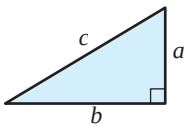
$c^2 = a^2 + b^2 - 2ab \cos \theta$ (Law of Cosines)



Right Triangle:

Pythagorean Theorem

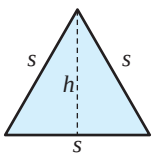
$c^2 = a^2 + b^2$



Equilateral Triangle:

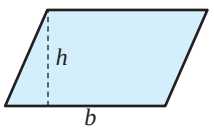
$h = \frac{\sqrt{3}s}{2}$

$\text{Area} = \frac{\sqrt{3}s^2}{4}$



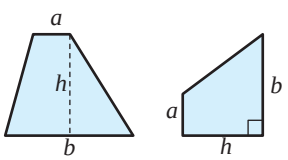
Parallelogram:

$\text{Area} = bh$



Trapezoid:

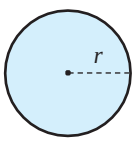
$\text{Area} = \frac{h}{2}(a + b)$



Circle:

$\text{Area} = \pi r^2$

$\text{Circumference} = 2\pi r$

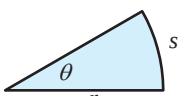


Sector of Circle:

$\text{Area} = \frac{\theta}{2}r^2$

$s = r\theta$

θ in radians



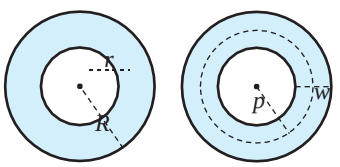
Circular Ring:

$\text{Area} = \pi(R^2 - r^2)$

$= 2\pi pw$

p = average radius,

w = width of ring



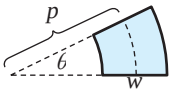
Sector of Circular Ring:

$\text{Area} = \theta pw$

p = average radius,

w = width of ring,

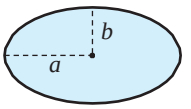
θ in radians



Ellipse:

$\text{Area} = \pi ab$

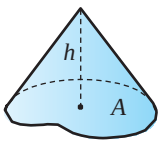
$\text{Circumference} \approx 2\pi \sqrt{\frac{a^2 + b^2}{2}}$



Cone:

$\text{Volume} = \frac{Ah}{3}$

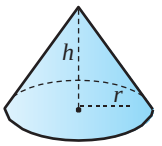
A = area of base



Right Circular Cone:

$\text{Volume} = \frac{\pi r^2 h}{3}$

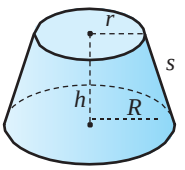
$\text{Lateral Surface Area} = \pi r\sqrt{r^2 + h^2}$



Frustum of Right Circular Cone:

$\text{Volume} = \frac{\pi(r^2 + rR + R^2)h}{3}$

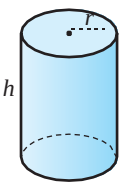
$\text{Lateral Surface Area} = \pi s(R + r)$



Right Circular Cylinder:

$\text{Volume} = \pi r^2 h$

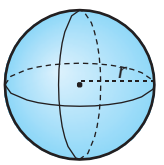
$\text{Lateral Surface Area} = 2\pi rh$



Sphere:

$\text{Volume} = \frac{4}{3}\pi r^3$

$\text{Surface Area} = 4\pi r^2$

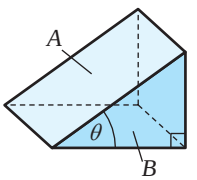


Wedge:

$A = B \sec \theta$

A = area of upper face,

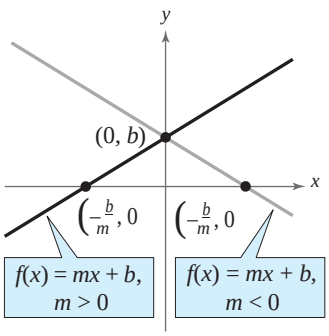
B = area of base



GRAPHS OF PARENT FUNCTIONS

Linear Function

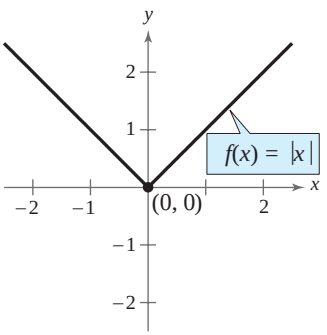
$f(x) = mx + b$



Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$
x-intercept: $(-b/m, 0)$
y-intercept: $(0, b)$
Increasing when $m > 0$
Decreasing when $m < 0$

Absolute Value Function

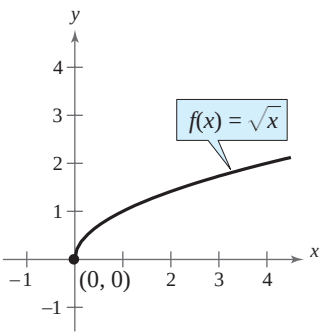
$$f(x) = |x| = \begin{cases} x, & x \geq 0 \\ -x, & x < 0 \end{cases}$$



Domain: $(-\infty, \infty)$
Range: $[0, \infty)$
Intercept: $(0, 0)$
Decreasing on $(-\infty, 0)$
Increasing on $(0, \infty)$
Even function
y-axis symmetry

Square Root Function

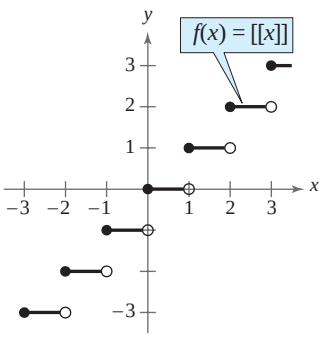
$f(x) = \sqrt{x}$



Domain: $[0, \infty)$
Range: $[0, \infty)$
Intercept: $(0, 0)$
Increasing on $(0, \infty)$

Greatest Integer Function

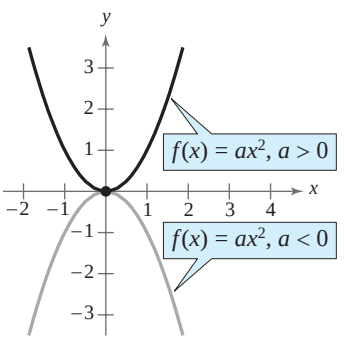
$f(x) = [\![x]\!]$



Domain: $(-\infty, \infty)$
Range: the set of integers
x-intercepts: in the interval $[0, 1)$
y-intercept: $(0, 0)$
Constant between each pair of consecutive integers
Jumps vertically one unit at each integer value

Quadratic (Squaring) Function

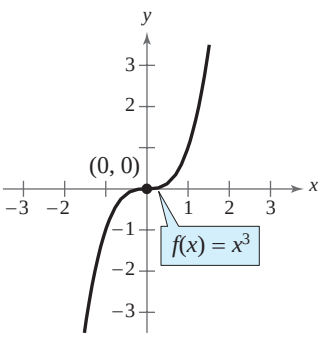
$f(x) = ax^2$



Domain: $(-\infty, \infty)$
Range $(a > 0)$: $[0, \infty)$
Range $(a < 0)$: $(-\infty, 0]$
Intercept: $(0, 0)$
Decreasing on $(-\infty, 0)$ for $a > 0$
Increasing on $(0, \infty)$ for $a > 0$
Increasing on $(-\infty, 0)$ for $a < 0$
Decreasing on $(0, \infty)$ for $a < 0$
Even function
y-axis symmetry
Relative minimum $(a > 0)$, relative maximum $(a < 0)$, or vertex: $(0, 0)$

Cubic Function

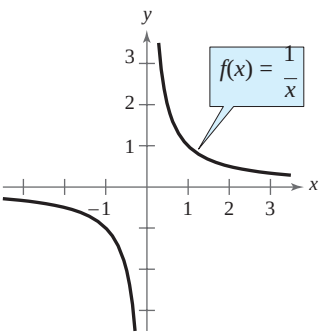
$f(x) = x^3$



Domain: $(-\infty, \infty)$
Range: $(-\infty, \infty)$
Intercept: $(0, 0)$
Increasing on $(-\infty, \infty)$
Odd function
Origin symmetry

Rational (Reciprocal) Function

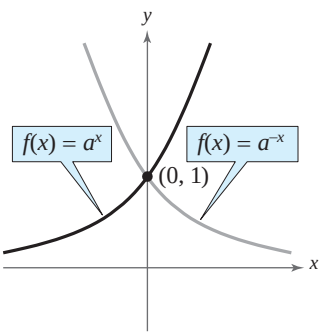
$f(x) = \frac{1}{x}$



Domain: $(-\infty, 0) \cup (0, \infty)$
Range: $(-\infty, 0) \cup (0, \infty)$
No intercepts
Decreasing on $(-\infty, 0)$ and $(0, \infty)$
Odd function
Origin symmetry
Vertical asymptote: y-axis
Horizontal asymptote: x-axis

Exponential Function

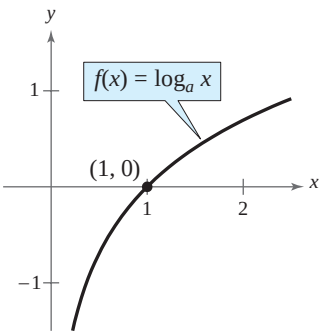
$f(x) = a^x,\ a > 0,\ a \neq 1$



Domain: $(-\infty, \infty)$
Range: $(0, \infty)$
Intercept: $(0, 1)$
Increasing on $(-\infty, \infty)$
for $f(x) = a^x$
Decreasing on $(-\infty, \infty)$
for $f(x) = a^{-x}$
Horizontal asymptote: x-axis
Continuous

Logarithmic Function

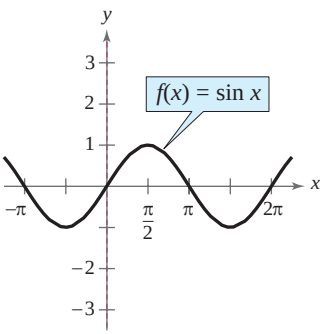
$f(x) = \log_a x,\ a > 0,\ a \neq 1$



Domain: $(0, \infty)$
Range: $(-\infty, \infty)$
Intercept: $(1, 0)$
Increasing on $(0, \infty)$
Vertical asymptote: y-axis
Continuous
Reflection of graph of $f(x) = a^x$
in the line $y = x$

Sine Function

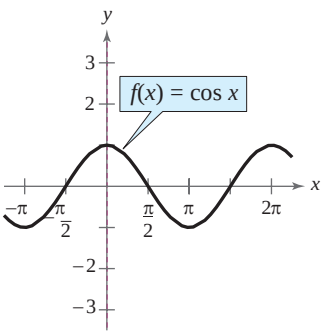
$f(x) = \sin x$



Domain: $(-\infty, \infty)$
Range: $[-1, 1]$
Period: 2π
x-intercepts: $(n\pi, 0)$
y-intercept: $(0, 0)$
Odd function
Origin symmetry

Cosine Function

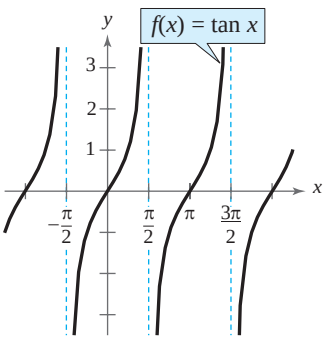
$f(x) = \cos x$



Domain: $(-\infty, \infty)$
Range: $[-1, 1]$
Period: 2π
x-intercepts: $\left(\frac{\pi}{2} + n\pi, 0\right)$
y-intercept: $(0, 1)$
Even function
y-axis symmetry

Tangent Function

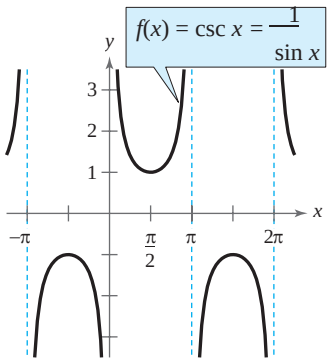
$f(x) = \tan x$



Domain: all $x \neq \frac{\pi}{2} + n\pi$
Range: $(-\infty, \infty)$
Period: π
x-intercepts: $(n\pi, 0)$
y-intercept: $(0, 0)$
Vertical asymptotes:
$x = \frac{\pi}{2} + n\pi$
Odd function
Origin symmetry

Cosecant Function

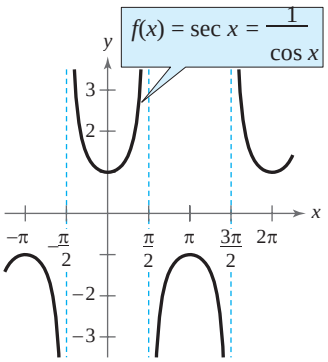
$f(x) = \csc x$



Domain: all $x \neq n\pi$
Range: $(-\infty, -1] \cup [1, \infty)$
Period: 2π
No intercepts
Vertical asymptotes: $x = n\pi$
Odd function
Origin symmetry

Secant Function

$f(x) = \sec x$



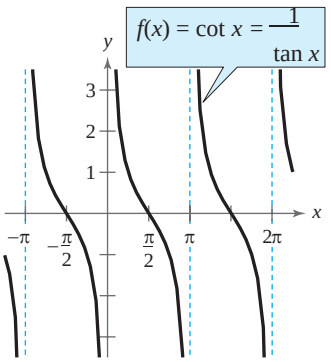
Domain: all $x \neq \frac{\pi}{2} + n\pi$
Range: $(-\infty, -1] \cup [1, \infty)$
Period: 2π
y-intercept: $(0, 1)$
Vertical asymptotes:

$$x = \frac{\pi}{2} + n\pi$$

Even function
y-axis symmetry

Cotangent Function

$f(x) = \cot x$



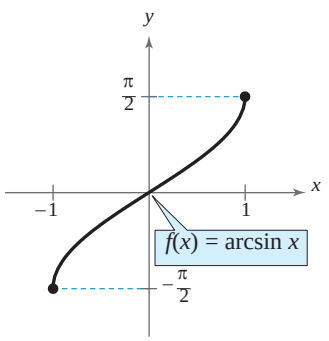
Domain: all $x \neq n\pi$
Range: $(-\infty, \infty)$
Period: π

x-intercepts: $\left(\frac{\pi}{2} + n\pi, 0\right)$

Vertical asymptotes: $x = n\pi$
Odd function
Origin symmetry

Inverse Sine Function

$f(x) = \arcsin x$

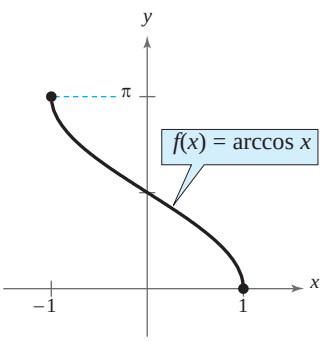


Domain: $[-1, 1]$
Range: $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

Intercept: $(0, 0)$
Odd function
Origin symmetry

Inverse Cosine Function

$f(x) = \arccos x$

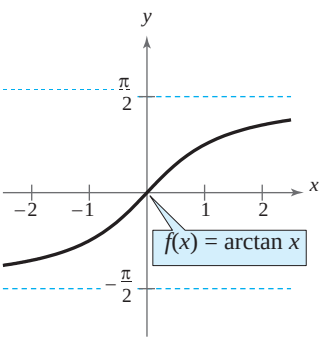


Domain: $[-1, 1]$
Range: $[0, \pi]$

y-intercept: $\left(0, \frac{\pi}{2}\right)$

Inverse Tangent Function

$f(x) = \arctan x$



Domain: $(-\infty, \infty)$
Range: $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

Intercept: $(0, 0)$
Horizontal asymptotes:

$$y = \pm\frac{\pi}{2}$$

Odd function
Origin symmetry