

Mathematics 10360 - Calculus B for the Life & Social Sciences

Fall Semester 2026

Text: CALCULUS (4TH ED) - EARLY TRANSCENDENTALS by Rogawski, Adams & Franzosa
Publisher: W. H. Freeman & Co.

Section	Instructor	Class Schedule	email@nd.edu
1	Arthur Lim	MWF 9:25 - 10:15 HAYE 127	arthurlim
2	Eric Riedl	MWF 2:00 - 2:50 DBRT 129	eriedl

Section	Teaching Assistant	Class Schedule	email@nd.edu
01	Leon Menger	R 11:00 - 11:50 GEDDES B034	leonmenger
02	Leon Menger	R 12:30 - 1:20 DBRT 311	leonmenger
03	Gabe Cantwell	R 2:00 - 2:50 OSHA 109	gcantwel
04	Gabe Cantwell	R 3:30 - 4:20 OSHA 109	gcantwel

Course Website: <http://academicweb.nd.edu/~m10360/>

Most information for this course is posted on its website. These include instructors and TAs office hours and contact information, daily homework information, exam dates and venues, practice exams, and etc.

Calculator Policy: Calculators are **NOT** allowed on any of the quizzes or exams. You may use your calculators for homework and assignments for computing required decimals but all set up and mathematical procedures are to be done **without a calculator**. It is strongly recommended that you do not rely on any of the graphing functions on the calculator unless the question directs you to using a calculator.

Course Grade & Breakdown

	Date	Time	Room	Points
Gateway Quiz	During tutorial for week 02 (10 pts), week 03 (15 pts), & week 04 (25 pts)			50
Midterm Test 01	Thurs Sep 24	8:00am - 9:15am	See website	100
Midterm Test 02	Thurs Oct 15	8:00am - 9:15am	See website	100
Midterm Test 03	Tues Nov 17	8:00am - 9:15am	See website	100
Final Exam	Mon Dec 14	10:30am - 12:30pm	See website	150
Online Hwk & Assignments	Submit online hwk as scheduled on Mobius.			75
Participation	tutorial, class attendance, activities & quizzes			25
Total points:				600

Your final grade will be based on your total score out of 600. All course activities are in-person.

Drop Policies: Each homework assignment will be graded out of 25 points. At the end of the semester **THREE** sets of homework of the lowest scores will be dropped. Homework would still count toward 12.5% of your grade.

Weighted Midterms: There are three midterm tests each worth 100 points. At the **end of the semester**, we will re-weight the three midterm scores so that lowest scores earns up to 25% of the 300 points, the middle scores earns up to 35% of the 300 points and the highest scores earns up to 40% of the 300 points. The sum of the weighted scores gives you your midterm total out of 300 points.

There are three midterm tests each worth 100 points, Gateway quiz01 (10 pts), Gateway quiz02 (15 pts), Gateway quiz03 (25 pts), and final exam worth 150 points.

Missed exams or quizzes: A student who misses an examination or quiz will receive **zero points** for that exam or quiz. If you have a valid excuse (illness, excused athletic absence, etc.) for missing an exam, please contact your section professor ASAP (preferably before the exam) to schedule a makeup exam. If you missed any tutorial work or quizzes, you must contact your TA immediately too.

Honor Code: Examinations, homework, assignment and quizzes are conducted under the honor code. While collaboration in small groups in doing homework is permitted (and strongly encouraged) in this course, copying is not. In particular, **copying from the Student Solutions Manual is a violation** of the Honor Code. Exams are closed book and are to be done completely by yourself with no help from others.

Homework & Assignments: Online Homework and assignment problems are assigned daily. Their schedule is listed on the course website. We do not accept any late homework or assignment unless you have a documented medical or university excuse. Exceptions are handled case by case. You are encouraged to work on these problems in groups, but all online homework and assignments must be turned in individually. Remember that you **will not learn anything by simply copying another student's work, solution manuals or AI generated work**. The main purpose of homework and assignments is to help you learn the material and assess yourself. Experience shows that students who take their homework seriously do very well in the course because they have a better understanding of the material. For detailed homework and assignment instructions, please see attached information.

Class Attendance: A student who accumulates more than 3 unexcused absences may be given an F grade. You can also be awarded negative points for unexcused absences.

Classroom Policies: Please do your best to show up on time and quietly enter the room if you are late. Please remember to respect your peers who are here to learn. Indeed, class disruptions will **not** be tolerated and offending parties will be asked to leave. During lectures you are encouraged to actively participate by answering and asking questions.

Study Tips are attached and also posted at the course website (<http://academicweb.nd.edu/~m10360/>). Please review it. The key point is to start early and be consistent.

Getting Help: You can get help for mastering the course material from the avenues below. More information can be obtained from the 10360 course website; click on "TUTORING & HELP" or go directly to

http://academicweb.nd.edu/~m10360/tutor_help.html

It is important that you get help soon when you have difficulty with the course. The earlier you meet with your instructor and TA, the more we can do to help and advise.

• **Instructor & TA's Office Hours** - We highly encourage students to visit their professors/TAs when they have questions. Students can attend any office hours available, not just those of their section professors. See office hour schedule here:

<http://academicweb.nd.edu/~m10360/instructors.html>

• **Calculus B Tutoring Sessions:** These are walk-in tutoring sessions that runs Sunday through Wednesday. See schedule posted here:

<http://academicweb.nd.edu/~m10360/instructors.html>

• **Learning Resources Center (LRC) & Mathematics Help Room** are posted here:

<https://math.nd.edu/undergraduate/student-resources/math-help-rooms/>

Please note that instructors and tutors are **NOT** there to do your homework. In fact, tutors are instructed to guide you to the answer and not do your homework. Please do not ask the tutors to grade your homework, and be specific about what you want to discuss.

MATH 10360 Classroom Etiquette

A productive environment of teaching and learning depends on respect, consideration, and cooperation. Maintaining this environment is a shared responsibility of everyone in the classroom. Behavior is considered disruptive if it impedes teaching or interferes with other students' opportunities to learn. Disruptive behavior will be addressed by the instructor or TA and may affect a student's grade in the course (minor deductions per occurrence, up to a maximum of 5% of the course grade in the case of serial violations). In addition to following course policies and upholding the University Honor Code, students are expected to:

- Be present and focused on relevant course material.
- Treat everyone in the classroom with respect.
- Listen while the instructor is speaking or a classmate is asking a question.
- Refrain from doing work or engaging in activities unrelated to class activities.
- Avoid causing distractions. If you must leave the classroom while class is still in progress, do so quietly.
- Avoid monopolizing discussions.
- Leave phones in your bag.
- Leave computers out of sight. If you use a tablet for taking notes, be prepared to justify its use to the instructor.
- Stop work and turn in quizzes and exams when the instructor says the time is up.
- Never use insulting language or gestures.
- Be mindful of the start time of your class and the end time of the class before yours. When your class time is over, be mindful of the need for students in the next class to be able to enter the class as well.
- Keep appointments that you have made with the instructor.

MATH 10360 Course Work Policy

There are both online homework and paper-pencil assignments for this course.

Written Assignments are due in class according to the schedule posted on the Math 10360 website. The questions and problems to be turned in are posted on the course website. You are expected to submit your written assignment in the following manner:

- Write your name clearly on your homework.
- Your work has to be clearly and logically written, showing the method of solution, not just a final answer.
- Any work falling short of the above expectations may not be graded.

We do not accept any late homework or assignment unless you have a documented medical or university excuse. Exceptions are handled case by case. If you need to attend a school related event, you may turn in your assignment early or arrange to have your peer turn it in on the day it is due.

Online Homework is assigned daily and is posted on the online system Mobius. Due dates are listed there.

- Mobius is accessed through the ND canvas system (<https://canvas.nd.edu/>).
- The ND e-mail address will be used to make all course related announcements. You must check your e-mail regularly daily.

All online homework should be done using paper and pencil, and be treated the same manner as written assignments. We encourage you to keep a record of your work for material submitted online; these are helpful when you review for an exam. Usually, you are expected to **complete about 5 to 8** problems of your online homework assigned at the end of each class day. If you have difficulty solving the homework questions please see your TA/professor or visit the listed the math help resources above.

Absolutely no late homework will be accepted. You only need the course textbook and Mobius for this course.

All homework and assignment will be weighted the same. Three homework/assignment with the lowest of scores will be **dropped at the end of the semester**.

Online Homework Submission Policies. All submission due dates for online homework on Mobius are fixed. You are highly encouraged to SUBMIT your homework well ahead of deadlines. We DO NOT accept excuses like: "My computer/Webservers shut down just before I could submit my work on time". Save your answers as you enter them online. This ensures that no work is lost BEFORE the submission deadline. Enough "buffer" time is given to ensure timely submission of your work. All online homework are due are due at 11:59pm at the end of the next class day unless otherwise stated. Exact due dates of online homework are posted on Mobius. In addition, after the deadline of a homework, you can complete a late homework to obtain up to 80% of the full score. Due dates for late copies of homework are also posted on Mobius. We do not encourage late online homework but understand there are times where a break is needed. Please note your scores for any set of homework is the maximum scores of all your attempts for both that set of homework and the corresponding late copy. This means doing problems in the late homework copies as practice will NOT lower your score.

Math 10360 (Calculus B) Syllabus

Text: Calculus (Early Transcendentals) 4TH Edition

J. Rogawski, C. Adams & R. Franzosa

3.8 Derivatives of Inverse Functions

5.7 Further Transcendental Functions

9.1 Application of Exponential Functions - Exponential Growth and Decay

6.1 Area Between Two Curves

6.2 Setting Up Integrals: Volumes, Density, Average Value

6.3 Volumes of Revolution: Disks and Washers

6.4 Volumes of Revolution: Cylindrical Shells

6.5 Work and Energy

7.1 Integration by Parts

7.2 Trigonometric Integrals

7.3 Trigonometric Substitution

7.5 The Method of Partial Fractions

7.7 Improper Integrals

7.8 Numerical Integration

14.1 Functions of Two or More Variables

15.1 Integration in Two Variables

15.2 Double Integrals over More General Region

11.3 Polar Coordinates

15.4 Double Integration in Polar Coordinates (Only)

9.1 Solving Differential Equations

9.2 Models Involving $y' = k(y-b)$

9.3 Graphical and Numerical Methods

9.4 The Logistic Equation (including model with harvesting and Birch's Curve)

9.5 First-order Linear Equations

14.3 Partial Derivatives

14.6 Multivariable Calculus Chain Rule (Appln to Elasticity/Sensitivity)

14.8 Lagrange Multipliers: Optimizing with a Constraint

Notes Geometric Sequences and Geometric Series (Appln to Medicine and Ecology)

10.1 Sequences

10.2 Summing an Infinite Series

10.5 The Ratio Test (no root test)

10.6 Power Series (Application of Ratio Test)

10.7 Taylor Polynomial

10.8 Taylor Series

Basic Algebra Rules

Exponential Rules:

$$a^m \cdot a^n = a^{m+n} \qquad (ab)^m = a^m b^m \qquad \frac{a^m}{a^n} = a^{m-n}; \quad a \neq 0$$

$$a^0 = 1 \quad a \neq 0 \qquad a^{1/m} = \sqrt[m]{a} \qquad \left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}; \quad b \neq 0$$

$$(a^m)^n = a^{mn}$$

Distribution Law:

$$a(b + c) = ab + ac \qquad \frac{a + b}{c} = \frac{a}{c} + \frac{b}{c} \qquad \frac{a - b}{c} = \frac{a}{c} - \frac{b}{c}$$

Quadratic Factoring:

$$(a + b)^2 = a^2 + 2ab + b^2 \qquad (a - b)^2 = a^2 - 2ab + b^2$$

$$a^2 - b^2 = (a - b)(a + b)$$

Properties of Logarithm:

$$\log_a(MN) = \log_a M + \log_a N \qquad \log_a \left(\frac{M}{N}\right) = \log_a M - \log_a N \qquad \log_a(M)^t = t \log_a M$$

$$\log_a a = 1 \qquad \log_a 1 = 0$$

$$\log_a a^x = x \qquad a^{\log_a x} = x$$

$$\text{Change of Base:} \qquad \log_a M = \frac{\log_b M}{\log_b a}$$

$$\ln(MN) = \ln M + \ln N \qquad \ln \left(\frac{M}{N}\right) = \ln M - \ln N \qquad \ln(M)^t = t \ln M$$

$$\ln e = 1 \qquad \ln 1 = 0$$

$$\ln e^x = x \qquad e^{\ln x} = x$$

Suggestions and Tips for Success in Calculus B

*By failing to prepare,
you are preparing to fail.*
~ Benjamin Franklin

Learning mathematics takes consistent practice. Many of the opportunities for practice are furnished by the homework and assignment problems that you need to turn in regularly. In addition to homework problems, you should also honestly “test” yourself with extra problems in the textbook, and exam reviews. Your performance in these “self-tests” could give you a good gauge of your understanding of the material taught in class.

Aim to achieve ownership of mathematical knowledge.

By that we mean you could:

- (1) Identify the tools needed to solve a given problem.
- (2) Carry out the process of solution in a reasonable time frame without help from a tutor or peer.
- (3) Give a reason for each step in the solution of the problem.
- (4) Obtain insights from your computation besides giving a number.

Although we recognize that some individuals are more gifted in mathematics, **consistency in your learning is still required to improve your chance of success.** Mathematics is a hard subject; for many, much has to be done just to get by. However, the skills you gain and the opportunities opened to you from your training in the subject will make the challenges you face worthwhile. These skills are required in your future employment. For instance, see:

BusinessWeek: Math Will Rock Your World (Jan 23, 2006)

http://news.bbc.co.uk/2/hi/uk_news/education/6954666.stm

Meet with your instructors (professor and TA) whenever you feel that you are falling behind or have trouble understanding the material to the level listed above. In addition to your instructors, you could also get help from Math department tutoring, and the LRC. For details look up:

http://www.nd.edu/~m10360/tutor_help.html

Ultimately, students need to be able to solve the problems by themselves. But you will be helped by the guided experience provided by the course. Use the resources available to you to support your learning. These resources include your instructor, tutoring services, and practice problems.

Many students in the past have been successful in Calculus.

With that said, we wish to give advice on how you should manage your time, and tips for handling various learning activities of the course, including the examinations.

Getting the Most of Classroom Instruction

Be in class and be prepared to listen attentively and take notes.

Work out all examples discussed in class. You should be able to work these out on your own in a reasonable time frame. Most problems should take no more than 20 minutes if you have grasped the material. You should be able to reason out and explain each step of your work.

Identify the material that you do not understand, and examples that you have a hard time working out or take a long time to complete.

Ask for help immediately. We highly encourage that you clarify any confusion with your instructors before the next class or at least on the same day as the next class. The point is to **promptly resolve any confusion as soon as possible.** You may still need to “test” yourself with a few similar problems after meeting with your instructor.

Completing Your Homework/Assignments

Almost all homework is online. You may have occasional written assignments. Here are some good practices for completing your homework.

Start early to give a good margin of time for completing your assignment. Aim to complete 5 to 8 problems of the assigned homework at the end of each class day. Homework is posted online on Mobius which can be accessed through Canvas. Written homework will also be posted on Canvas.

Mark out those you have confidence doing and those you do not know how to start. Work on at least a couple of them to know how much help you need. Usually, you are expected to complete or at least seriously attempt all problems of your written assignment assigned at the end of each class day.

Attempt those problems that you are confident in completing first. Work on those that you are unsure of. Give yourself a full 20 minutes to seriously attempt these problems.

Ask for help promptly if you still cannot do your assignments. Bring along your scratch work.

File your assignment immediately when it is returned. You will need it for reviewing.

You should have a notebook that organizes your work for each online homework. Work out the questions just like you would a paper and pencil homework and **keep your work for review later as part of your exam preparation.**

Do not wait till the last minute to complete and submit your work online.

Preparing for Exams

Give yourself a week to prepare for each midterm (or final) exam. Get all the material you need to go through: (1) Sample exams, (2) Class notes, (3) Homework, and (4) Tutorial material.

There is obviously a lot of material to be covered. However, **learning the course material should be a consistently on-going process** and should NOT take place merely the week before the exam.

Start with the sample exam. Mark out all the problems that you are confident of solving, those for which you need to refresh your memory, and those you totally do not know how to attack.

Attempt as many problems as possible before review sessions.

Ask for help promptly from tutors and instructors. Bring along your attempts and scratch work; they help us see how to best facilitate your learning.

Attend review sessions. Please note that going to the review session alone does not mean that you are ready for the test.

Test yourself with an exam from a previous year. You need to be able to solve a problem by reasoning out each step of the solution.

Look for more practice problems in topics that you are still unsure of.

Access for Calculus B online Homework system Mobius Assessments

The online homework system Mobius is accessed through Canvas. Follow the steps below to logged into Mobius

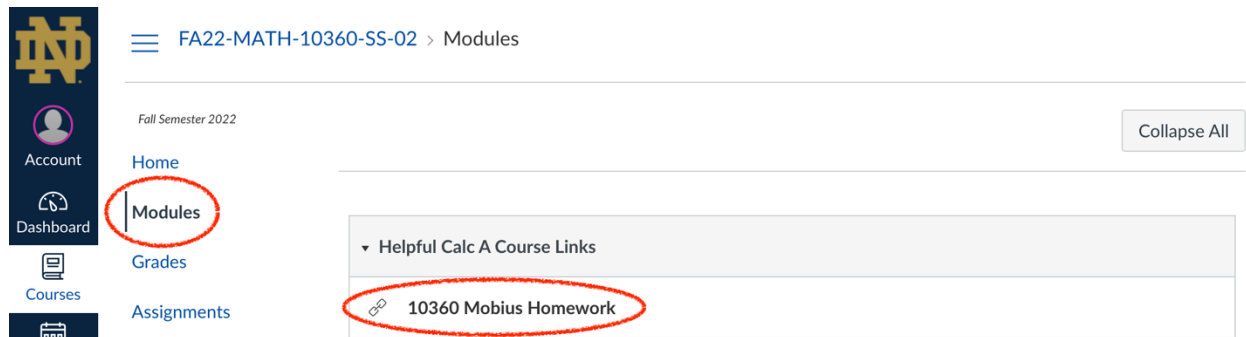
(a) Access Canvas through InsideND by searching for the Canvas App or using the link:

<https://canvas.nd.edu/>

(b) Log into Canvas using your NetID and password.

(c) Find your Canvas Calc B (10360) section for the semester in “Dashboard” on the left.

(d) In your Calc B section, click on “Module”. You will see the link to 10360 Homework in the Mobius Assessment module. See figure below.



(e) Click on the “10360 Homework” link and launch Mobius.

(f) Mobius will launch in a new tap.

(g) There are four units of homework posted so far. Each unit is labelled according to the week the homework is assigned. You can toggle between the units to see the sets of homework available. See figure below. You have 10 attempts for each set of Homework. See figure below.

Class Details

Class Info

Add Child Class

Edit Class Schedule

ChongKeat Arthur Lim (arthurlim@nd.edu)

The Class Message has not been set.
Head to **Class Info** on the left to set the Class Message or to modify it later.
This is a great place to provide general information about the class such as office hours or a syllabus.
(Don't worry, students won't see this warning if you choose to leave the Class Message empty.)

Units

IMPORTANT: Product Term Tips

Assign Wk01 (8/25)

Assign Wk02 (9/01)

Assign Wk03 (9/08)

Assign Wk04 (9/15)

Assign Wk01 (8/25)

GatewayPrep01

Try Again

Assignment

0.0 / 25.0 (0.0%)

Attempts: 1 / 8

Due: 9/3/25 11:59:00 PM EDT

Diff Review01

Start

Assignment

Attempts: 0 / 8

Due: 9/4/25 11:59:00 PM EDT

Diff Review02

Start

Assignment

Attempts: 0 / 8

Due: 9/4/25 11:59:00 PM EDT

Integration Review01

Start

Assignment

Attempts: 0 / 8

Due: 9/6/25 11:59:00 PM EDT

Diff Review03

Start

Assignment

Attempts: 0 / 8

Due: 9/9/25 11:59:00 PM EDT

Each Exercises is 25 points. The score of the exercise is the highest scores of the attempts you made. The answers of the questions you correctly answered will be saved in each attempt. The questions you gotten incorrect will be regenerated in the next attempt till the 10th attempt. The homework assigned for Week01 are:

GatewayPrep01

Differentiation Review 01, 02, 03 – Three sets and 25 points each.

Integration Review 01, 02 – Two sets and 25 points each.

Gateway Prep – 25 points each. There will be a Gateway prep for each gateway 1, 2, and 3. These are preparation exercises for the Gateway Quizzes in Week02, Week03, and Week04 during tutorial. Complete them before the due dates so you have an idea where you stand for the material tested in each quiz.

You have eight attempts for each question. Correct answers of previous attempts are saved for exercises with no time limit for each attempt.

The due dates are as stated for each homework set (highlighted in red). If the first due date is Aug 30 midnight. This means the work should be done by 11:59pm Aug 30 and the homework will close sometime after 11:59pm Aug 30. We are using the due date to pace your learning so please schedule time to keep the due dates.

After you submitted a set of homework, you can always see the correct answer. In some homework, solution of the graded work by clicking on the score or see details in the gradebook in Mobius. See an illustrative figure below. Please explore the links.

Learn from your mistakes in the provided solution. Understand the rules applied and process of solution but DO NOT just follow a “cook book” process or mere pattern recognition. Every step of the solution has a reason.

The screenshot displays the Mobius LMS interface for a class named "Calculus A Tutors". The top navigation bar includes links for "Class User Manager", "Proctor Tools", "Content Repository", "Gradebook" (highlighted with a red circle and an arrow pointing to a red text annotation), and "External". The "Gradebook" annotation reads: "Another way to see your graded work and solution by clicking on 'See Details'".

On the left sidebar, under "Class Details", there are buttons for "Class Info", "Add Child Class", and "Edit Class Schedule". Below this, under "Units", a unit titled "Fraction Ex (Timed) 25pts - Mon Aug 30, midnight (+ 2hr)" is highlighted in blue. Below this unit, another unit "Equation Ex (Timed) 25pts - Mon Aug 30, midnight (+ 2hr)" is listed.

The main content area shows the user "ChongKeat Arthur Lim (arthurlim@nd.edu)". A message box states: "The Class Message has not been set. Head to **Class Info** on the left to set the Class Message or to modify it later. This is a great place to provide general information about the class such as office hours or a syllabus. (Don't worry, students won't see this warning if you choose to leave the Class Message empty.)".

Below the message is a calendar view for "Aug 15 — 21, 2021". The calendar shows days from Sun 8/15 to Sat 8/21, with Sat 8/21 highlighted in blue.

At the bottom, the assignment "Fraction Ex (Timed) 25pts - Mon Aug 30, midnight (+ 2hr)" is shown with a green checkmark icon. The assignment title is "Fractions Set01". Below the title, the score "0.0 / 10.0 (0.0%)" is circled in red, with a red arrow pointing to a red text annotation: "See your graded work and solution by clicking on your score." To the right of the score is a "Try Again" button. Below the score is a "Policies" button.

Math 10360 – Example Set 01A
Derivative and Integration Review

Basic Properties of Derivatives:

$$[f(x) + g(x)]' \stackrel{?}{=}$$

$$[f(x) - g(x)]' \stackrel{?}{=}$$

$$[c \cdot f(x)]' \stackrel{?}{=}$$

Product/Quotient/Chain Rule. Let $f(x)$ and $g(x)$ be differentiable functions. Derive formulas for the derivatives of $p(x) = f(x) \cdot g(x)$ and $q(x) = \frac{f(x)}{g(x)}$.

Product Rule:

$$\frac{d}{dx}(f(x)g(x)) = (f(x)g(x))' =$$

Chain Rule:

$$\frac{d}{dx}(f(g(x))) = [f(g(x))]' =$$

Quotient Rule: $\frac{d}{dx} \left(\frac{f(x)}{g(x)} \right) = \left(\frac{f(x)}{g(x)} \right)' =$

Some Common Derivatives. For any numbers k and n :

$$\frac{d}{dx}(k) \stackrel{?}{=}$$

$$\frac{d}{dx}(x^n) \stackrel{?}{=}$$

(Power Rule)

$$\frac{d}{dx}(\sin(x)) \stackrel{?}{=}$$

$$\frac{d}{dx}(\cos(x)) \stackrel{?}{=}$$

$$\frac{d}{dx}(\tan(x)) \stackrel{?}{=}$$

$$\frac{d}{dx}(\csc(x)) \stackrel{?}{=}$$

$$\frac{d}{dx}(\sec(x)) \stackrel{?}{=}$$

$$\frac{d}{dx}(\cot(x)) \stackrel{?}{=}$$

1. Find the following derivatives

a. $\frac{d}{dx}(x^3 \tan(x)) \stackrel{?}{=}$

b. $\frac{d}{dx}(\sqrt[3]{2x^2 - 5x + 3}) \stackrel{?}{=}$

2. Find the equation of the tangent line to the curve $x \cos(1 + 2y) = 2y^2 - 8$ at the point $(0, 2)$.

(Check $\frac{dy}{dx} = \frac{\cos(1+2y)}{4y+2x \sin(1+2y)}$)

Basic Integrals. For any numbers k and n :

$\int x^n dx \stackrel{?}{=}$ (Power Rule)

$\int \sin(x) dx \stackrel{?}{=}$

$\int \cos(x) dx \stackrel{?}{=}$

$\int \sec^2(x) dx \stackrel{?}{=}$

$\int \csc^2(x) dx \stackrel{?}{=}$

$\int \csc(x) \cot(x) dx \stackrel{?}{=}$

$\int \sec(x) \tan(x) dx \stackrel{?}{=}$

Method of Substitution

3. Find a formula for the function $f(x)$ if its slope is given by the $x \sin(x^2 + 1)$ and the graph of $f(x)$ passes through the point $(1, 2)$.

4. Evaluate $\int_0^1 \frac{x^2 + 2}{\sqrt{x^3 + 6x + 5}} dx$.

Math 10360 – Example Set 01B
Derivative of Exponential & Logarithmic Functions: Section 3.9

Definition of the Natural Log. Consider the area function $f(x) = \int_1^x \frac{1}{t} dt$ for $x > 0$. We call $f(x)$ the logarithm function and denote it by $f(x) = \ln x$. Discuss (a) through (f) below.

a. What can you say about $\ln(1)$?

b. $f'(x) = \frac{d}{dx}[\ln x] = \frac{d}{dx} \left[\int_1^x \frac{1}{t} dt \right] \stackrel{?}{=} \underline{\hspace{2cm}}$ ($x > 0$)

c. $\frac{d}{dx}[\ln |x|] \stackrel{?}{=} \underline{\hspace{2cm}}$ ($x \neq 0$). This gives $\int \frac{1}{x} dx \stackrel{?}{=} \underline{\hspace{2cm}}$

e. Give a sketch of the graph of $y = \ln x$. State clearly the domain and range of $\ln x$. What are the values of $\lim_{x \rightarrow 0^+} \ln x$ and $\lim_{x \rightarrow \infty} \ln x$? Define the value of e using the definition of the natural logarithm.

d. Using the Fundamental Theorem of Calculus, show that $\ln(ax) = \ln(a) + \ln(x)$.

1. Find the area under the graph of $y = \frac{-2}{4x-3}$ for $0 \leq x \leq 1/2$.

Definition of the Natural Exponential Function. Discuss (f) through (i).

f. The inverse $g(x)$ of $f(x) = \ln x$ exists. Why? Sketch the graph of $g(x) = \exp(x)$. It can be shown that $\exp(x) = e^x$ for all real value x .

g. Explain why we may write: (i) $\ln(e^x) = x$ for all x , and $e^{\ln y} = y$ for $y > 0$. Show $\frac{d}{dx}(e^x) = e^x$.

h. Using $e^{\ln b} = b$ ($b > 0$), show that $\frac{d}{dx}(b^x) = b^x \ln b$.

i. Using the change of base formula $\log_b x = \frac{\ln x}{\ln b}$, show that $\frac{d}{dx}(\log_b x) = \frac{1}{x \ln b}$.

- 2.** Find the equation of the tangent line to the curve $y = 4 - 2e^x + \ln\left(\frac{1-x^2}{1+x^2}\right)$ at $x = 0$.

Review Exercise. Complete the following formulas:

Logarithmic Properties

$$\ln(ab) \stackrel{?}{=}$$

$$\ln(a^n) \stackrel{?}{=}$$

$$\ln\left(\frac{a}{b}\right) \stackrel{?}{=}$$

$$\ln(e) \stackrel{?}{=}$$

$$\ln 1 \stackrel{?}{=}$$

$$\ln(e^x) \stackrel{?}{=}$$

$$e^{\ln x} \stackrel{?}{=}$$

Exponential Rules

$$a^n \cdot a^m \stackrel{?}{=}$$

$$\frac{a^n}{a^m} \stackrel{?}{=}$$

$$a^n \cdot b^n \stackrel{?}{=}$$

$$\frac{a^n}{b^n} \stackrel{?}{=}$$

Derivative and Anti-derivative Rules

$$\frac{d}{dx}(\ln x) \stackrel{?}{=}$$

$$\frac{d}{dx}(e^x) \stackrel{?}{=}$$

$$\frac{d}{dx}(\log_b x) \stackrel{?}{=}$$

$$\frac{d}{dx}(b^x) \stackrel{?}{=}$$

$$\int \frac{1}{x} dx \stackrel{?}{=}$$

$$\int e^x dx \stackrel{?}{=}$$

$$\int b^x dx \stackrel{?}{=}$$

Math 10360 – Example Set 01C
Derivative of Exponential & Logarithmic Functions: Section 3.9
Derivative of Inverse Trig Function: Section 5.8

1. By restricting the domain of $\sin x$, $\cos x$, and $\tan x$ define their inverse functions ($\arcsin x$, $\arccos x$, and $\arctan x$). Sketch the graph of each of the inverse functions stating their range and domain.

2. Using chain rule, obtain the derivative of $\arcsin(x)$, $\arccos(x)$, and $\arctan(x)$.

Key Formulas:

$$\frac{d}{dx} (\arcsin x) \stackrel{?}{=}$$

$$\frac{d}{dx} (\arccos x) \stackrel{?}{=}$$

$$\frac{d}{dx} (\arctan x) \stackrel{?}{=}$$

$$\int \frac{1}{\sqrt{1-x^2}} dx \stackrel{?}{=}$$

$$\int \frac{1}{1+x^2} dx \stackrel{?}{=}$$

3a. Find the derivative of (i) $(1+2x)^e$ and (i) $(1+2e)^{x^2}$

3a. (Logarithmic Differentiation) Using the log function, find the derivative of $y = (1+2x)^{\arctan x}$.

4a. Find the derivative of $\arcsin(2x + y^2)$ with respect to x treating y as a constant.

4b. Find the derivative of $\arcsin(2x + y^2)$ with respect to y treating x as a constant.

5. A population $y(t)$ (in units of millions) of bacteria grows according to the rate $\frac{dy}{dt} = \frac{1}{1 + 4t^2}$. Find the total change in the size of the population over the time duration $0 \leq t \leq 1/2$.

6. (Review) Without using a calculator, find the value of each of the following expressions:

a. $\arcsin(\sqrt{3}/2)$

b. $\arcsin(-\sqrt{3}/2)$

c. $\arccos(0.5)$

d. $\arctan(-1)$

