Welcome to Calculus 2! (Math 2300-014)

- Instructor: Jun Hong (PhD student)
- Teaching Assistant: Paul Lessard (PhD student)
- Learning Assistant: Colin Tweedy
- Official Course Website
- Our Website
- Quizzes and lectures will be different across the sections; however, everyone gets the same assignments and exams.
- Read the syllabus before you sign it.
- Sign and turn-in the last page of the syllabus by Friday, August 31st.

Grades

- Projects (5%. Worksheets on Thursdays.)
- Online Homework (5%. Lowest two grades dropped. Check WebAssign.net for the varying due dates on the assignments.)
- If you don't have a WebAssign account, E-mail Jeff (math-help@Colorado.edu). Include your full name, student ID, and the section number (we are section 014).
- Written Homework (10%. 2 dropped. Due Thursdays.)
- In-class Activities and Take-home Work (5%. 2 dropped.)
- 3 Midterm Exams (15% each.)
- Final (30%)

In-class Quizzes

- Daily quizzes using Socrative. (Except Thursdays)
- Bring a tablet or a laptop.
- Graded on participation.
- Use your full name.
- Room Name: HONG5824
- Go to https://socrative.com/ and complete the first quiz.

Take-home Quizzes and Handouts

- We'll have either a take-home quiz or a set of handouts.
- Take-home quiz solutions will be posted on the Google Calendar.
- Handout solutions are on the main website.

Take-home Work: Week 1

- There are **three** handouts:
  - Antiderivative Review
  - Practicing mechanics of u/du substitution
  - Identifying Integral Substitutions.
- They are due this Friday, August 31st.
- For the handout titled, "Identifying Integral Substitutions," fully evaluate the integrals.
- For #10, you have to substitute twice.

Lecture Notes

- A skeleton version of each lecture will be available on the Google Calendar before class.
- Completed version will be available after class.

Mathematics Academic Resource Center (MARC)

- Large room: casual setting, lots of desks with power outlets, free tea and coffee.
- Good place to socialize, meet people, and get work done.
- Math tutors are on the perimeter of the room, paid by the university to help students.
- Location: Math 175
- Hours:

  Monday – Thursday 9 AM – 8 PM
  Friday 9 AM – 3 PM

Expectations

1. Respect one another.
2. Coming to class means you are here to work. I reserve the right to ask you to leave if you are either disruptive or doing coursework unrelated to calculus.
3. You are responsible for clearing up any confusions you might have in class by either seeking help or studying.
4. Be honest with your work.
5. Take care of your health! 

Questions?

1. Talk to me after class
2. Come to office hours or talk to me during my MARC shift
   - MARC Hour: Fridays 1:00 – 1:50 PM.
   - MARC Location: Math 175
   - Office Hours: Mondays and Wednesdays 1:00 – 1:50 PM.
   - Office Location: Math 360
3. Email
   - Jun.s.hong@Colorado.edu

Rules of Differentiation (Review)

$$\frac{d}{dx}(x^n) = n x^{n-1}$$

$$\frac{d}{dx}(\ln x) = \frac{1}{x}$$

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

$$\frac{d}{dx}(a^x) \text{ where } a > 0.$$

$$= \ln(a)\, a^x$$

$$\frac{d}{dx}(\arctan x) = \frac{1}{1+x^2}$$

$$\frac{d}{dx}(\arcsin x)$$

$$= \frac{1}{\sqrt{1-x^2}}$$

Rules of Differentiation (Review)

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

$$\frac{d}{dx}(\cos x) = -\sin x$$

$$\frac{d}{dx}(\tan x) = \sec^2 x$$

$$\frac{d}{dx}(\cot x) = -\csc^2 x$$

$$\frac{d}{dx}(\sec x) = \sec x \cdot \tan x$$

$$\frac{d}{dx}(\csc x) = -\csc x \cdot \cot x$$

Rules of Integration (Review)

$\int x^n \, dx$ where $n \neq -1$.

$= \frac{x^{n+1}}{n+1} + C$

C constant of integration. This is the information you "forget" when you differentiate.

$\int x^{-1} \, dx = \ln|x| + C$

$\int e^x \, dx$

$= e^x + C$

$\int a^x \, dx$ where $a > 0$.

$= \frac{a^x}{\ln(a)} + C$

$\int \frac{1}{1+x^2} \, dx$

$= \arctan(x) + C$

$\int \frac{1}{\sqrt{1-x^2}} \, dx$

$= \arcsin(x) + C$

Rules of Integration (Review)

$$\int \cos x \, dx = \sin x + C$$

$$\int \sin x \, dx = -\cos x + C$$

$$\int \sec^2 x \, dx = \tan x + C$$

$$\int \csc^2 x \, dx = -\cot x + C$$

$$\int \sec x \tan x \, dx = \sec x + C$$

$$\int \csc x \cot x \, dx = -\csc x + C$$

Indefinite Integral Domino Chain

- Get in a group of 4 or 5 and start matching the top half of a domino with the bottom half of another domino.
- Split the work: 5-6 cards per person.
- You will need a scratch paper to work out the integrals.
- They should form a chain; when finished, they become a loop.
- You got 10 minutes.

5.5 The Substitution Rule (Review)

4 The Substitution Rule If $u = g(x)$ is a differentiable function whose range is an interval I and f is continuous on I, then

$$\int f(g(x))g'(x)\,dx = \int f(u)\,du$$

① Look at the problem and pick a suitable u.

② Use implicit differentiation to relate du and dx.

③ Make the substitutions and integrate.

④ Re-substitute and write the answer in terms of x.

5.5 The Substitution Rule (Review)

Calculate $\int e^{5x}\,dx$.

$u = 5x$

$du = 5\,dx$

$\frac{du}{5} = dx$

$$\int e^{5x}\,dx = \int e^{u}\,\frac{du}{5}$$

$$= \frac{1}{5}\int e^{u}\,du$$

$$= \frac{1}{5}e^{u} + C$$

$$= \frac{1}{5}e^{5x} + C$$

5.5 The Substitution Rule (Review)

Calculate $\int \tan x \, dx$ (Method 1: Splitting)

Recall: $\tan x = \frac{\sin x}{\cos x}$

$$\int \tan x \, dx = \int \frac{\sin x}{\cos x} \, dx$$

Let u be the denominator.

$u = \cos x$

$du = -\sin x \, dx$

$-du = \sin x \, dx$

$$\int \frac{\sin x}{\cos x} \, dx = \int \frac{\sin x \, dx}{\cos x}$$

$$= \int \frac{-du}{u}$$

$$= -\int \frac{du}{u}$$

$$= -\ln|u| + C$$

$$= -\ln|\cos x| + C$$

5.5 The Substitution Rule (Review)

Calculate $\int \tan x \, dx$ (Method 2: Multiply by 1)

Since $1 = \frac{\sec x}{\sec x}$, $\int \tan x \, dx = \int 1 \cdot \tan x \, dx = \int \frac{\sec x}{\sec x} \tan x \, dx$

$= \int \frac{\sec x \tan x \, dx}{\sec x}$

Let u be the denominator.

$u = \sec x$

$du = \sec x \cdot \tan x \cdot dx$

$\int \frac{\sec x \tan x \, dx}{\sec x} = \int \frac{du}{u} = \ln|u| + C$

$= \ln|\sec x| + C$

Q: Are these two answers equivalent?

Summary

- Reviewed differentiation and integration formulas
- U-substitution examples and techniques