Important things to remember from Calc 1 as you begin Calc 2. Remember the main goal of Calculus 2 is to learn different techniques and applications for integration.

### Differentiation Formulas:

1. \( \frac{d}{dx}(x) = 1 \)
2. \( \frac{d}{dx}(ax) = a \)
3. \( \frac{d}{dx}(x^n) = nx^{n-1} \)
4. \( \frac{d}{dx}(\cos x) = -\sin x \)
5. \( \frac{d}{dx}(\sin x) = \cos x \)
6. \( \frac{d}{dx}(\tan x) = \sec^2 x \)
7. \( \frac{d}{dx}(\cot x) = -\csc^2 x \)
8. \( \frac{d}{dx}(\sec x) = \sec x \tan x \)
9. \( \frac{d}{dx}(\csc x) = -\csc x (\cot x) \)
10. \( \frac{d}{dx}(\ln x) = \frac{1}{x} \)
11. \( \frac{d}{dx}(e^x) = e^x \)
12. \( \frac{d}{dx}(a^x) = (\ln a)a^x \)
13. \( \frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}} \)
14. \( \frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2} \)
15. \( \frac{d}{dx}(\sec^{-1} x) = \frac{1}{|x| \sqrt{x^2 - 1}} \)

### Integration Formulas:

1. \( \int 1 \, dx = x + C \)
2. \( \int a \, dx = ax + C \)
3. \( \int x^n \, dx = \frac{x^{n+1}}{n+1} + C, n \neq -1 \)
4. \( \int \sin x \, dx = -\cos x + C \)
5. \( \int \cos x \, dx = \sin x + C \)
6. \( \int \sec^2 x \, dx = \tan x + C \)
7. \( \int \csc^2 x \, dx = -\cot x + C \)
8. \( \int \sec x(tan x) \, dx = \sec x + C \)
9. \( \int \csc x(cot x) \, dx = -\csc x + C \)
10. \( \int \frac{1}{x} \, dx = \ln |x| + C \)
11. \( \int e^x \, dx = e^x + C \)
12. \( \int a^x \, dx = \frac{a^x}{\ln a} + C, a > 0, a \neq 1 \)
13. \( \int \frac{1}{\sqrt{1-x^2}} \, dx = \sin^{-1} x + C \)
14. \( \int \frac{1}{1+x^2} \, dx = \tan^{-1} x + C \)
15. \( \int \frac{1}{|x| \sqrt{x^2 - 1}} \, dx = \sec^{-1} x + C \)
**Anti-Derivatives**
- In calculus, an antiderivative, inverse derivative or indefinite integral of a function $f$ is a differentiable function $F$ whose derivative is equal to the original function $f$. This is the building blocks of taking an integral and is important to remember as the basics for this course.

**Integration**
- The process of finding the area under the curve. (This will be the main topic of Calc 2)
- $+ C$ is added to the end whenever the bounds are not known (Indefinite Integral). This is called the arbitrary constant.
- Some important integrals to know are:
  - Integrals of trig functions (Sin,Cos,Tan,Csc,Sec,Cot,Sec^3(Secant cubed))

**U Substitution**
- A way of breaking down an integral in order to make it something we know how to handle.
- We can change the bounds when we do this by plugging the bounds in for $X$ in our U sub.
  - This does not HAVE to be done if you do not want to BUT you will have to substitute everything back (Change the U back to X) if you do not change bounds.

\[
\int (x+1)^2 \, dx, \quad \text{let } u=x+1, \quad \therefore \quad dx=du
\]

\[
= \int u^2 \, du
\]

\[
= \frac{1}{3} u^3 + C
\]

\[
= \frac{(x+1)^3}{3} + C
\]
Derivatives

• Product Rule

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

• Quotient Rule

**Quotient Rule**

If \( h(x) = \frac{f(x)}{g(x)} \)

\[ h'(x) = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2} \]

• Chain Rule

\[ \frac{d}{dx} \left[ (f(x))^n \right] = n(f(x))^{n-1} \cdot f'(x) \]

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

• Memorize Trig Derivatives
  
  o See chart above to see the trig derivatives but I highly recommend knowing the trig derivatives and trig integrals.
Graphing Using Derivatives
- 1st Derivative is Slope at that point (+ = Upward slope, - = Downward Slope, 0 = turning point)
- 2nd Derivative is Concavity (+ Concave up, - Concave down)
  - If 0 for the purpose of the second derivative test it would be inconclusive.
- Using this idea beyond graphing – Finding Mins and Maxes
  - This is used in Physics more than Calc but we use derivatives and how they influence our graph to find our minimums and maximums.
  - To do this we take the derivative of the function and set it equal to 0. This will give us our GLOBAL min or max.

Relationships of Derivatives
- This is in respect to taking the derivative of position(x) with respect to time(t)
- 1st Derivative is Velocity
- 2nd Derivative is Acceleration
- 3rd Derivative is Jerk

Fundamental Theorem of Calculus
- The fundamental theorem of calculus is a theorem that links the concept of differentiating a function with the concept of integrating a function.

\[
\int_{a}^{b} f(x) \, dx = F(x) \bigg|_{a}^{b} = F(b) - F(a)
\]
Types of Discontinuities

These are things that we can come across in Calc 2 and will cause us to have to rearrange the bounds of our integral to account for them if they come up. More importantly these come up with our trig functions especially with asymptotes.

Limits

- In mathematics, a limit is the value that a function "approaches" as the input "approaches" some value.
- More important late in Calc 2 when we understand how fast things grow and how these relate to one another. It is important to know the relationship of exponential functions, exponents, and log functions and how fast these go to 0 or infinity.