Hello everybody, my name is Izuka Ikedionwu, and I will be the Calculus Master tutor this year. I am here to help you excel in Calculus throughout the semester! My biggest tip for learning calculus is doing practice problems! If you are stumped by a practice problem, refer to videos that work the problem and explain the concept! The following is a link to the Baylor Tutoring YouTube page with videos on EACH concept that is covered during Calculus! (https://www.baylor.edu/case/index.php?id=978621) I would love to help you succeed in any way, please feel free to reach out to me at Izuka_Ikedionwu1@baylor.edu.

KEYWORDS: Chain Rule, High Order Derivatives, Trig Derivates

TOPIC OF THE WEEK:

Chain Rule

Chain Rule is a concept used in calculus when multiple operations are happening to a variable, so you must take the derivative of all the different operations happening to the variable and put them together. In more formal language the chain rule is a method for finding the derivative of a composite function, or function made by combining other function. For, example the function \( f(x) = (1 + x)^2 \) is made by the function \( f(x) = (1 + x) \) which is inside the function \( f(x) = x^2 \). As you may remember, the chain rule states that:

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

It is common to forget to include the \( g'(x) \), always be sure to double check for it. **A method I like to use is to start from the outside and work my way inside**. In the problem below the variable \( x \) is inside a trig function and is also being squared so starting from the outside function, \( x^2 \), we take the derivative, then we multiply it by the derivative of the inside function "\( \sin(x) " \) going in.

This is how it would look in a problem \( \frac{d}{dx} (\sin(x))^2 \).

1) \( \frac{d}{dx} 2\sin(x) \)  
2) \( \frac{d}{dx} 2\cos(x) \)

Here is A Baylor YouTube video that demonstrates Chain Rule:  
https://www.youtube.com/watch?v=48gYa80GH2o&t=2s
Highlight #1: Higher Order Derivatives

In this section we are introduced to higher order derivatives, like $f''(x)$, $f'''(x)$, etc. We can describe higher order derivatives as the rate of change of the lower order derivatives, as the tangent line of the graph of a lower order derivative, or as the concavity of a graph (although that isn’t introduced until chapter 4).

What is the second order derivative of $x^2$?

1) $f(x) = x^2$  
2) $f'(x) = 2x$  
3) $f''(x) = 2$

Here is a Baylor YouTube video that demonstrates High Order Derivatives!
https://www.youtube.com/watch?v=lfSNkNIgQ4

Highlight #2: Trig Derivatives

In this section we are introduced to the derivatives of the standard trig functions. The idea of trigonometric derivatives can be intimidating but using the concept of limits that we learned so far, we can use the limit definition to solve for the derivatives. Using the limit definition makes it more complicated than it needs to be, so I recommend that you understand the concept of trig derivatives through graphs and illustrations and simply memorize the trig derivatives for working out problems. The two most important rules to remember for trig are that \[ \frac{d}{dx} \sin(x) = \cos(x) \] and \[ \frac{d}{dx} \cos(x) = -\sin(x) \] some other important rules are

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

Here is a Baylor YouTube video that demonstrates Trig Functions!
https://www.youtube.com/watch?v=wb2Ru7knz8I
CHECK YOUR LEARNING
(Answers below at the end of the document.)

1. \( \frac{d}{dx} \cos (2x) \)

2. \( \frac{d}{dx} e^{4x} \)

3. \( f'(x) = \frac{\sin x}{\cos x} \)

4. \( f''(x) = 3x^3 f' \)

THINGS YOU MIGHT STRUGGLE WITH:

- Chain Rule: Students seem to have a problem recognizing when to use chain rule. Think about what is happening to the variable. If more than 1 thing is happening to it, then you need to use the chain rule.
- Trig Functions: It is easy to forget that the derivative of \( \cos(x) = -\sin(x) \)
- High Order Derivatives: it sounds like a complex topic but it just taking the derivative of a derivative

ANSWERS to check your learning section:

1) \(-2\sin(x)\)
2) \(4e^{4x}\)
3) \(27x\)
4) \(\sec^2(x)\)