Week 5
MTH-1321 – Calculus 1

Hello and Welcome to the weekly resources for MTH-1321 – Calculus 1!

This week is Week 5 of class, and typically in this week of the semester. your professors are covering these topics below. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout of the semester.

We also invite you to **look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester**.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours. M-Th 9am-8pm on class days 254-710-4135.

Key words: Chain rule, High Order Derivatives, Trig Derivatives

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Topic of the Week: Chain Rule

- The chain rule is a method for finding the derivative of a composite function (a function made through the composition of other functions) Ex. h(x) = $[\sin(x)]^2$
- How do we find the derivative of a composite function then?
    1. we must identify the inside function and the outside function
        a. The outside function is the one manipulating the inside function
        b. In our example, the inside function is g(x) = sin(x) and the outside function is f(x) = x^2
    2. Then we use the chain rule formula

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

    3. To find f'(g(x)), simply treat g(x) like a variable, do not touch it or modify it
        a. So, for our example the first part of chain rule looks like this: 2(sin(x))
    4. Be careful with finding g'(x) as it is easy to forget it
        a. The final equation for our derivative is: h'(x) = 2sin(x)cos(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.
- The following video shows more examples and goes more in depth about chain rule:
    - https://www.youtube.com/watch?v=48gYa80GH2o&t=2s

Highlight #2: Higher Order Derivatives

- In this section we are introduced to higher order derivatives, such as f''(x) and f'''(x)
- Although they may look scary, they are simply the derivative of a derivative
- For example, to find f''(x), I treat f'(x) like a function and simply take its derivative and so on (f'''(x) is the derivative of f''(x))
- What are applications of higher order derivatives?
    - As we know, a derivative is the slope of the tangent line and the instantaneous rate of change of a function at a certain point
    - So, a higher order derivative simply describes the instantaneous rate of change of a derivative and its concavity (more about concavity in chapter 4)

Highlight #3: 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 limit definition leads us to the following equations:

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

While we can prove all of these equations, the proofs are complicated and unnecessary, so I would recommend committing these to memory

If you do want more information on trig derivatives, please check out this video: https://www.youtube.com/watch?v=wb2Ru7knz8I

Check your Learning

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

2. $\frac{dy}{dx} e^{4x}$

3. Find the second derivative of f(x) = $2x^4$

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

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Thanks for checking out these weekly resources!
Don't forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring ! Answers to check your learning questions are below!

Answers to Check your Learning

1. -2sin(2x)
2. $4e^{4x}$
3. $24x^2$

All images taken from Calcworkshop.com