Hello everybody, my name is Nathaniel Takle and I will be the Calculus Master tutor this year. These resources are a culmination of the main topics learned each week. These are meant to provide you with explanations and more practice to master Calculus this semester!! Remember: The Tutoring Center offers free individual and group tutoring for this Calculus. **Our Group Tutoring sessions will be Mondays from 5:15-6:15 PM at the Sid Rich basement, room 74**! You can reserve a spot at [https://baylor.edu/tutoring](https://baylor.edu/tutoring). I hope to see you there!

**Keywords:** Limits, Rate of Change, Discontinuities, Solving limits algebraically

- **Chapter 2.1**
  - **Average Rate of Change**
    - Example problem 1) If it takes me an hour and a half to drive the 100 miles to Dallas, what was my average rate of change (average speed) while driving?”
      - Answer on back page
  - Calculating Instantaneous Rate of Change from Average Rate of Change
    - While calculating the average speed I drove while on the way to Dallas can be helpful, I may also want to calculate the specific speed that I was going at some random point on my drive. When doing this I would be calculating the instantaneous rate of change (speed at one moment in particular), rather than the average rate of change (my average speed over the whole drive).
    - If you need a refresher, here is a video of someone going over the concept.

- **Example problem 2)** Estimate the instantaneous rate of change of $B$ with respect to $T$ when $T=20$ and $B=5\sqrt{T}$
• Chapter 2.2
  o Limits
    • Example problem 3) What is the Limit of \( \frac{x^2 - 2x + 1}{x - 1} \) with the limit X goes to 1?
  o One-sided Limits
    ▪ Sometimes the limit of a function may be different depending on which side you come from. In this case, no two-sided (regular) limit exists, but either one-sided limit might still exist
    ▪ Example 4: What are the right- and left-hand limits as X goes to 0 of \( \frac{1}{x} \)

• Chapter 2.3
  o Limit Laws
    ▪ There are several ways that we can manipulate a limit equation in order to make it easier to solve. Several examples are laid out in your book, such as the Sum Law, Constant Multiple Law, and more. This video goes through several of those laws.
    ▪ If you need a refresher, here is a video of someone going over the concept.
      • [https://www.khanacademy.org/math/ap-calculus-ab/ab-limits-new/ab-1-5a/v/limit-properties](https://www.khanacademy.org/math/ap-calculus-ab/ab-limits-new/ab-1-5a/v/limit-properties)
    ▪ Example 5: “\( \lim_{x \to \infty} \left( 1 + \frac{1}{x} \right)^5 \)”

• Chapter 2.4
  o discontinuity types
    ▪ There are several discrete types of discontinuity that can occur in a function, specifically the removable, jump, and infinite discontinuity types.
    ▪ Example 6: “What type of discontinuity is \( \frac{1}{x} \)?”
  o Continuity at a point
A function is continuous at a point if the two-sided limit of the function exists at that point and equals the actual value of the function at that point. A function is continuous in general if it is continuous at every point.

Example 7: “is the function $\frac{1}{x}$ continuous at $x = 1$?”

- Chapter 2.5
  - Solving Indeterminate limits algebraically
    - Many times in calculus we will be faced with a limit which, if solved in a certain way, will result in an indeterminate form (zero over zero or infinity over infinity). While we will eventually learn L’Hospital’s Rule to solve these sorts of problems, for now WE ARE NOT ALLOWED TO USE IT IN CALC 1. The best thing to do is to use rules of algebra to put this derivative in a form that we can find an actual answer for.
    - Example 8: What is $\lim_{x \to -1} \left( \frac{x+1}{x^2-1} \right)^2$?

Commonly missed topics:

Solving intermediate limits algebraically

Limit Laws

Calculating limits algebraically

Example Problems:

1) If it takes me an hour and a half to drive the 100 miles to Dallas, what was my average rate of change (average speed) while driving?

2) Estimate the instantaneous rate of change of B with respect to T when $T=20$ and $B=5\sqrt{T}$
3) What is the Limit of \((x^2 - 2x + 1)/(x - 1)\) with the limit \(X\) goes to 1?

4) What are the right- and left-hand limits as \(X\) goes to 0 of \(\frac{1}{x}\)?

5) Example 5: “\(\lim_{x \to \infty} \left( 1 + \frac{1}{x} \right)^5\)”

6) Example 6: “What type of discontinuity is \(\frac{1}{x}\)?”

7) Example 7: “is the function \(\frac{1}{x}\) continuous at \(x = 1\)?”

8) Example 8: What is \(\lim_{x \to -1} \left( \frac{x+1}{x^2-1} \right)^2\)
1) Answer: 66.67 miles per hour
2) Answer: .5590
3) Answer: 0
4) Answer: the left-hand limit goes to negative infinity while the right-hand limit goes to positive infinity
5) Answer 1
6) Answer: infinite
7) Yes
8) 1/4