CALCULUS 12 **COURSE OUTLINE**

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INTRODUCTION:

Welcome to Calculus! This course will be your first taste of post-secondary level mathematics and act as an introductory class to Calc I (Differential Calculus) courses in college or university. Over the next 10 months we will be working with derivatives and their applications with the goal that seeing these topics now in high school will better prepare you next year when you take a differential calculus course.

Hopefully your have already completed Pre-calculus 12; however, taking it concurrently can still lead to success, but it will require you to do some self-study at times as we will be potentially studying certain functions before you see it in Pre-calculus 12. Furthermore, there are topics in pre-calculus that we expect you to be competent in. These included:

- Factoring higher degree polynomials
- Using function compositions
- Trig identities and solving trig equations
- Exponential and logarithmic laws and solving exponential equations
- Graphing polynomials, trig functions, exponentials, radicals, and rational functions.

We will briefly review these topics, but it will be up to you to work ahead in Pre-calculus 12 if necessary.

BASIC EXPECTATIONS:

This course will be a "new" branch of mathematics that will challenge you to think in new ways. To succeed, it is expected that students will attend class regularly and punctually, complete practice work consistently, and use class time effectively.

- Math is collaborative. Each day you will be assigned a new random group to work with.
- We will spend an average of 15 minutes per class working on vertical surfaces to solve problems and build communication skills. This is an opportunity for you to build your understanding and is one of the best ways to learn. Participate!
- To make space in the class and limit distractions, all backpacks and bags will be placed at the front of class once the class begins.
- Phones and other devices are NOT allowed out for any reason. There is a zero-tolerance policy for using distracting devices and you will be asked to leave the classroom if you use it during class time. **This is a One-Strike Policy. You will not be given a warning.**
- If you miss a class, you are responsible for catching up work and keeping up to date. I will provide copies of the notes on the website so that you can be prepared for the next class. Please contact me as soon as you know you will be missing a class.
- Missing a test will typically result in a mark of 0. Exceptions may be granted only with my prior consent, and with official documentation from your parent or guardian supporting your reason for missing the test. In case of a medical emergency, I must be notified within 48 hours of the missed test and be presented with a doctor's note immediately upon your return to school. A physician's note should specifically state that the student was medically unfit to write the missed exam on that day. If a test was missed for legitimate reasons, the weight of the missed test will be transferred to the midterm or final. Make-up tests will, in general, not be provided.
- This is an elective course that you want to be in. You know what appropriate behaviour is and we will choose a set of adjectives that we think our important later this week.

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MATERIALS:

- Students will be issued a copy of the McGraw-Hill Ryerson *Calculus: A First Course* textbook. Lost or unreturned textbooks mean you don't get a yearbook ☹
- Coiled notebook to complete assigned problems in and to write additional notes.
- Three-ringed binder to hold handouts.
- Duo-tang to hold assessments and evidence of learning.
- Pencils, pens, erasers, ruler, white-out, etc.
- A pre-approved scientific non-programable calculator
  - Texas Instruments TI-30XIIS
  - Sharp EL-531X
  - Casio FX-82MS / 85MS / 300MS

  Any other calculator must have less functionality than the above and be okayed by me.
  Absolutely no calculator is allowed that has "Natural Textbook Display" (will have a dedicated fraction button), a "differentiate/integrate" button, or a "SOLVE/CALC" button. They will look something like this:

ASSESSMENT & EVALUATION:

Understanding will be assessed though a combination of tests, quizzes and work done in class and at home. Everything will be marked cumulatively.

70% Unit Tests. Will be calculated as regular percentage scores. Each question will be marked heuristically on a scale of how well understanding was demonstrated. For example, consider a question out of 2. They would receive the following scores in the stated situation:

- 0 if there was no understanding shown.
- 1 if they were able to start solving the problem but couldn't finish OR they were able to solve the problem but did not demonstrate enough work OR communicated steps to solve a problem similar but not the given problem.
- 2 if they demonstrated full understanding. On a test there can be at most 2 errors attributed to poor calculation and not poor logic. For example, when asked to solve for x in
  $$(x-3)^2 + x = 3$$
  The first step is to expand. This would a calculator error:
  $$x^2 - 6x + 6 + x = 3 \ OR \ x^2 - 6x - 9 + x = 3$$
  Where the obvious mistake is $3^2 \neq 3 \cdot 2$ and $(-3)^2 \neq -3^2$. If the work is not detailed enough to make the mistake obvious this would not receive a 2. The following is a logical error:
  $$x^2 + 9 + x = 3$$

30% Evidence of Learning. This will include quizzes, worksheets and self-evaluations. When collecting evidence, I will put priority on work done in class. A ranked, but not exhaustive list of what can be used as evidence would be:

1. Work done in class that must be completely independently (like a quiz)
2. Work done in class that is **collaborative** and **demonstrates communication and analysis skills** (board work, helping/teaching classmates, asking questions in class, answering "why/how" questions in class, coming in for extra help as a group)
2. Work done in class that is **independent** and **demonstrates communication and analysis skills** (solving the harder and spicy assigned practice problems, coming in for extra help)
3. Work done in class that **demonstrates solving skills** (answering "what" questions in class, solving the medium-harder assigned practice problems, coming in for extra help)

4. Work done in class that **demonstrates recognizing and applying skills** (answering "when" questions in class, solving the easy assigned practice problems, coming in for extra help)
5. Work done at home without a tutor (practice problems, studying, using extra practice material)
6. Work done with a tutor

All work will be given a mark out of 4, but evidence at the top of the list will have greater weight when determining the final chapter mark. We will be using the following criteria to assess a score. Note a score of 0 is possible if no sensible work is given, and no explanations are provided.

Criteria (Curric Comp)	4 (Extending)	3 (Proficient)	2 (Developing)	1 (Emerging)
Thinking Strategies	Demonstrates ability to **use multiple strategies** and recognize **alternative perspectives**. Shows a strong ability to **determine what is needed** for a problem.	Can **justify explanations but cannot include key questions** that arise or key limitations of the approach. Shows a good ability to **determine what is needed** for a problem.	Can show some **evidence, but it will have internal inconsistencies** or is difficult to follow. Shows the beginning of understanding what is needed for the problem.	The solution has no evidence, but it **can identify what the question asks**. Is only able to identify what is needed when presented with options.
Communication	Work is explained in a **teaching manner**. Mathematical **language used is clear and effective**. Aware and clear about limitations and assumptions. Work need not be perfect, but it must be **well argued, and proper justifications and logic are used.** Does not excluded mistakes made and explains what went wrong.	Work is mostly explained, but **others may not understand** why certain steps were made. The mathematical **language is good but not as clear as it could be** or as effective. Will **make assumptions without enough support or justification**, though valid. Understands that mistakes were made but does not explain why.	Can **describe the problem** and provide a good place to build from. A few instances of effective use of mathematical **language provides a good building point**, but it is overall basic. Is **unable to make proper assumptions** when necessary. Although it may play with the idea that something needs to be said. Has rough ideas why mistakes occurred.	**Does not provide explanations** (this includes a correct answer without explanation). The mathematical **language used is not able to communicate intentions.** Work is **not clear or explicit with any assumptions or limitations** that are contained within it. Is unwilling to even make a mistake or is not able to learn from them.
Modeling and Solving	Provides **insightful analysis** that highlights an underlying design or construction of the problem that can be used to **extend beyond the application given**.	Work **demonstrates the application** of the problem that is specific to what is being asked.	Cannot apply key ideas to the problem but can **show understanding of parts through examples and calculations**.	Is **not able to demonstrate understanding** of the problem. Could recognize **what a proper solution should look like if given options**.

Examples: Student A gets 3/4 on two unit quizzes, is working great on the board by being a leader and helping others without doing much written work and asks the occasional thoughtful question. They work great in class but only have time for a couple practice questions. At home they admit they could spend more time studying. They don't have a tutor. They believe they deserve a low A because although their quiz scores are in the proficient range, they have shown extending skills in modelling and communication on the board and by helping their peers and asking questions. They have a goal studying more at home and believe that would help show thinking strategies doing spicy questions.

Student B gets 4/4 on both unit quizzes but they don't communicate with their group and when writing on the board they take over and leave the group behind. Their only evidence is a question on the quiz. They demonstrate solving and modelling skills by working independently in class. They do the rest of the homework at home. They believe they deserve 100%. Instead they get a low A, like the above example because they are showing a strong lack of evidence in a significant area. This student should receive a 100% in the next unit or two because they only need to make small adjustments.

Student C gets 2/4 on their quizzes and does not use class time well. They enjoy the board work and ask questions occasionally but do not have much evidence in class for demonstrating thinking and solving skills independently. They do most of their work with their tutor and only a bit at home. They believe they deserve a C because they passed their quizzes and demonstrate strong communication skills. However, because they make awful use of class time, they do not have much more evidence and most of their work is done with a tutor I struggle to give them anything more than 50%. They need to show that they can do the math in a setting away from their tutor.

COURSE CONTENT: The following is subject to change

Chapter	**Main Topics and Big Ideas**	**Approximate # of Periods**
	September to December – 35 Periods	
FUNCTION REVIEW	• Function Notation • Polynomials • Rational Functions • Piecewise Functions	**4**
	BIG IDEA: Understanding the characteristics of families of functions allows us to model and understand relationships and to build connections between classes of functions.	
CHAPTER 1 **Limits**	• Slope of lines • Limits at a point (both sides) • Instantaneous rate of change	**9**
	BIG IDEA: The concept of a limit is foundational to calculus. Differential calculus develops the concept of instantaneous rate of change	
CHAPTER 2 **Derivatives**	• The derivative of a function • The derivative of function operations (addition/product/compositions) • Implicit Differentiation • Repeated Differentiation	**12**
	BIG IDEA: Differential calculus develops the concept of instantaneous rate of change	

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Chapter	Main Topics and Big Ideas	Approximate # of Periods
CHAPTER 3 **Application of Derivatives**	• Derivatives used in other sciences • Related Rates • Newton's Method BIG IDEA: The concept of a limit is foundational to calculus. Differential calculus develops the concept of instantaneous rate of change	**10**
	January to March – 24 Periods	
CHAPTER 4 **Analyzing Characteristics of Graphs Part 1**	• First Derivative Applications • Increasing/Decreasing • Maximum/Minimum BIG IDEA: Differential calculus develops the concept of instantaneous rate of change	**10**
CHAPTER 5 **Analyzing Characteristics of Graphs Part 2**	• Second Derivative Applications • Asymptotes • Concavity • Curve Sketching BIG IDEA: Differential calculus develops the concept of instantaneous rate of change	**10**
MID YEAR EXAM	• All topics discussed to this point	**4**
	April to June – 24 Periods	
CHAPTER 8 **Derivatives of Exponential Functions**	• Derivatives of exponential and logarithmic functions • Exponential growth and decay • Logarithmic differentiation BIG IDEA: The concept of a limit is foundational to calculus. Differential calculus develops the concept of instantaneous rate of change	**9**
CHAPTER 7 **Derivatives of Trig Functions**	• Derivatives of trig and inverse trig functions • Applications BIG IDEA: The concept of a limit is foundational to calculus. Differential calculus develops the concept of instantaneous rate of change	**9**
CHAPTER 9-11 **Introduction to Integrals**	• Antiderivatives • Differential equations • Area under a curve • Fundamental Theorem of Calculus BIG IDEA: Integral calculus develops the concept of determining a product involving a continuously changing quantity over an interval. Derivatives and integrals are inversely related.	**6**