**Chapter 4: Introduction to Calculus**

Welcome to Chapter 4 of our high school math textbook, where we will explore the fascinating subject of calculus! In this chapter, you will learn about the fundamental concepts of calculus, including limits, derivatives, and integrals. By the end of this chapter, you will have a solid foundation in calculus and be ready to tackle more advanced topics in mathematics.

### Section 1: What is Calculus?

**Understanding Change**

Calculus is the branch of mathematics that deals with rates of change and the accumulation of quantities. It provides a framework for understanding how things change over time and space.

**Applications of Calculus**

Calculus is used in various fields such as physics, engineering, economics, and biology to model and analyze real-world phenomena. It is essential for solving problems involving motion, optimization, and growth.

### Section 2: Limits

**Introduction to Limits**

A limit is the value that a function approaches as the input approaches a certain value. It is used to describe the behavior of functions near certain points.

**Finding Limits**

Limits can be found algebraically, graphically, or numerically using various techniques such as substitution, factoring, and rationalizing.

### Section 3: Derivatives

**Understanding Derivatives**

A derivative measures the rate of change of a function with respect to its input. It represents the slope of the tangent line to the graph of the function at a given point.

**Computing Derivatives**

Derivatives can be computed using differentiation rules such as the power rule, product rule, quotient rule, and chain rule. They are essential for analyzing functions and solving optimization problems.

### Section 4: Integrals

**Introduction to Integrals**

An integral represents the accumulation of quantities over an interval. It is the reverse process of differentiation and is used to find the total quantity or area under a curve.

**Finding Integrals**

Integrals can be computed using integration techniques such as substitution, integration by parts, trigonometric substitution, and partial fractions. They are useful for calculating areas, volumes, and solving problems involving accumulation.

### Section 5: Practice Problems

**Calculus Practice**

1. Find the limit of $f(x) = \frac{x^2 - 4}{x - 2}$ as $x$ approaches 2.
2. Calculate the derivative of $g(x) = 3x^2 - 6x + 2$.
3. Evaluate the integral of $h(x) = \sin(x)$ from $0$ to $\pi$.
4. Find the derivative of $f(x) = \ln(x^2 + 1)$.
5. Compute the area under the curve $y = x^2$ from $x = 0$ to $x = 2$.
6. Determine the limit of $g(x) = \frac{e^x - 1}{x}$ as $x$ approaches $0$.
7. Calculate the derivative of $h(x) = \sqrt{x^2 + 1}$.
8. Evaluate the integral of $f(x) = \frac{1}{x}$ from $1$ to $e$.
9. Find the derivative of $g(x) = \cos(x) - \sin(x)$.
10. Determine the area between the curves $y = x^2$ and $y = 2x$ on the interval $[0, 2]$.

### Section 6: Conclusion

Congratulations! You've completed the introductory chapter on calculus. With your newfound knowledge of limits, derivatives, and integrals, you are well-equipped to explore the exciting world of calculus further. Practice solving problems and seek to understand the concepts deeply. Stay curious and keep exploring the beauty of mathematics!

Now, it's time to delve deeper into calculus with topics such as applications of derivatives, techniques of integration, and differential equations in the following chapters!