Introducing Calculus to High School Students

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When you first took mathematics, the study was primarily concerned with the "arithmetic" - a subject dealing simply with such elementary operations in mathematics as addition, subtraction, multiplication and division. The arithmetical concepts were then explored further by introducing algebra, which provided answers to most everyday mathematical problems. After learning algebra, you almost became an independent person, who could handle the complexities of a shopping spree all alone!

The geometrical concepts probably were introudced along with the algebraic, and so you began to appreciate the beauty of nature. Geometry provided another dimension to the abstract mathematical knowledge. However, to meet the future challenges of the world of math, you had to pursue yet another investigation - the so-called study of "trigonometry." Trigonometry utilized the knowledge of algebra and geometry and made you a more matured teen-mathematician. All this because you were now studying higher math, or the advanced math, as some people put it.

You have thus studied arithmetic, algebra, geometry and perhaps trigonometry as well in this sequence; have you given any further thoughts as to what subject in math would be next, and why? Both algebra and geometry have provided valuable service in finding solutions to many problems, and they are undoubtedly still irreplaceable when it comes to specific solutions. But, with the progress of science and technology, mathematicians have had to look for yet other means that will account for the instant variations and/or accumulations of the factors influencing the problem. To give you an example, consider the problem of calculating interest. Algebra could be used for the problem if the interest was derived on an annual or even a monthly basis; how difficult would it be if the banks were to allow interest daily, hourly, or instantly? So, to catch on with the changing needs of the society, we must study yet another branch of mathematics, namely, calculus.

Luckily, this new subject has already been developed in great depth. The main objective of this article is to convince you that our studies in mathematics would not only be incomplete, but also incomparable, without the knowledge of calculus.

W. Leibniz (1646-1716) and Isaac Newton (1643-1727) independently invented two different phases of calculus. These are classified as differential calculus and integral calculus respectively. Differential calculus investigates functions and calculates certain limiting values. The central concept here is that of the derivative. The investigation of many problems is unthinkable without the concept of the derivative. Integral calculus, on the other hand, is a limiting process

which determines the area bounded by a curve or the volume enclosed by a surface by approximation techniques. Newton recognized in 1665 that differentiation and integration are inverse problems to each other.

As mentioned earlier, the main reason for studying calculus is that differential calculus and integral calculus both have tremendous applications. Applying the theory of differential calculus, we can find the solutions to maxima or minima problems, study related rates, and sketch the graphs of given functions, while integral calculus can determine arc lengths, surface areas, and volumes. Differential and integral calculus are used jointly to describe some important relationships in mechanics and vector analysis. The applications in mechanics are concerned with the work, moment, centre of mass, et cetera. Vector analysis studies vector fields and flows of physical quantities via the important theorems of Gauss and Stokes.

The basics of calculus are not just useful to professionals in the mathematics area. Academics in many other disciplines, such as engineering, physics, chemistry, biology, economics and medicine, are also dependent upon calculus directly or indirectly.

A basic two-semester course in calculus generally begins with the study of topics such as the *function* and the *limit*. These are the concepts which have given birth to the subject of calculus. A function is a rule which expresses the relationship between two quantities called the variables (independent and dependent variable). Limit is the value which the function approaches as the independent variable "x" approaches a fixed value "a."

Once you realize that in actuality all problems of the world are one function or the other and their instantaneous response is a limit, you will find yourself in the realm of calculus, and having learned some basic rules of calculus which relate to the differentiation and integration techniques, you will find yourself surrounded by numerous applications of calculus as they unfold, one after the other!

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