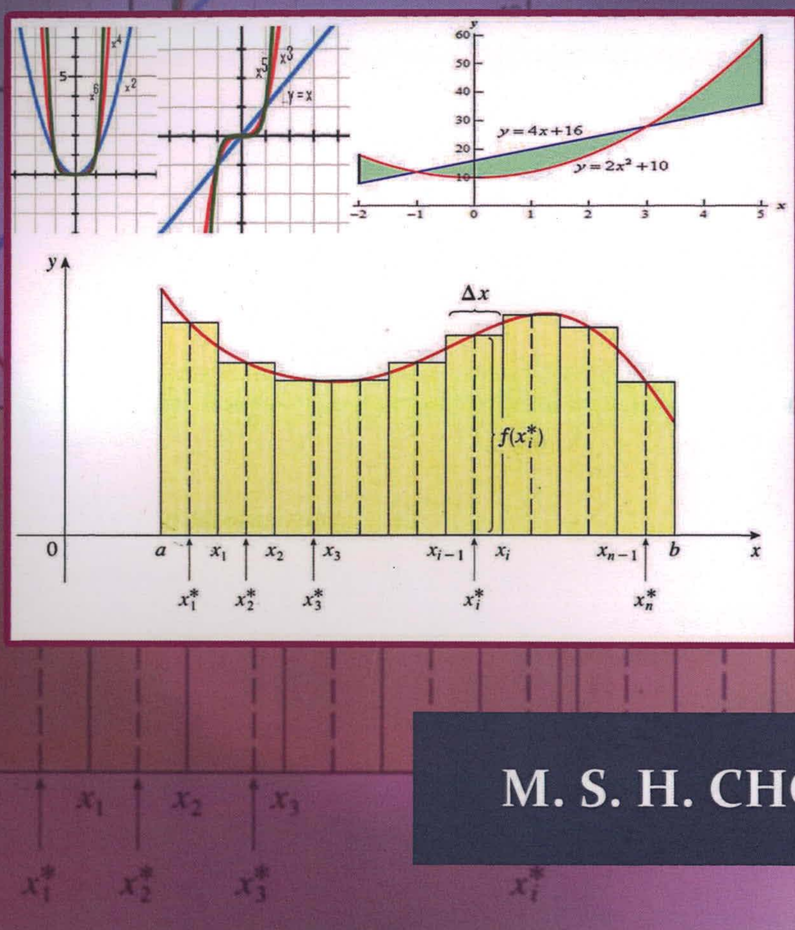
CALCULUS WITH SINGLE VARIABLE



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CHAPTER 0

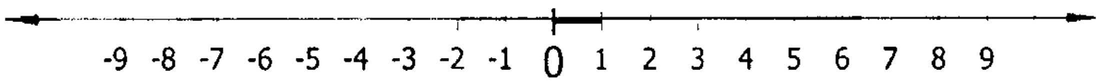
PRELIMINARIES

M. Azram and Messikh Azeddin

0.1 NUMBER SYSTEM AND INEQUALITIES

We will focus on those properties of real and complex number system that are of considerable interest for calculus students. The ancient number system such as Greek and Roman number system were having some shortcoming. Consequently, new number system known as **Natural Number** System denoted as $N = \{1, 2, 3, ...\}$ was introduced. Later on with the introduction of 0, Natural Number System was extended as $W(\textit{Set of Whole Numbers}) = \{0, 1, 2, 3, ...\}$.

The set of **integers** denoted as $Z = \{..., -3, -2, -1, 0, 1, 2, 3, ...\}$ consists of whole numbers and their additive inverse. Its geometric presentation on the Real line is as follows.



Note that a sign with an integer indicates the position of an integer on the Real line. For example, +2 means that integer 2 is two units on the right sides of zero (centre) while -2 means it is two units on the left side of zero. 1, 2, 3,... are positive integers while -1, -2, -3, ... are negative integers. Note that zero (0) is neither positive nor negative. 2, 4, 6, ... are positive even integers while -2, -4, -6, ... are negative even integers. 0 is even integer but neither positive nor negative. An integer $p > 1$ is called a prime integer if it is divisible by ± 1 and itself. Consequently, $p = \{2, 3, 5, 7, 11, 13, ...\}$. Note that 2 is the only even prime.

The set of rational/fractional numbers is defined and denoted as

$$Q = \left\{ \frac{p}{q} | p, q \in Z, q \neq 0 \right\}.$$

For example $\frac{2}{3}$, $\frac{1}{3}$ and $\frac{-2}{5}$ etc. Note that every integer is also a rational numbers with denominator as 1.

$\frac{0}{q} = 0$ where q can be any integer except 0. $\frac{0}{0}$ is an indeterminate form which will be discuss in a later section. $\frac{p}{0}$ is undefined, where p can be any integer except 0. In simple words "division by zero is not possible".

An **Irrational Number** is a real number that is not rational/fractional. Simply, Irrational means **not Rational.** Note that all the rational numbers have decimal expansion which either terminate