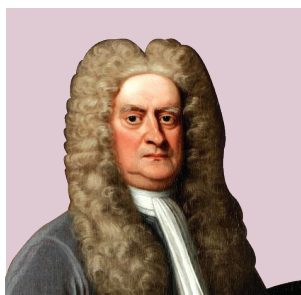




*It is worth noting that the notation facilitates discovery.
This, in most wonderful way, reduces the minds labour.*

- Gottfried Wilhelm Leibnitz

11.1 Introduction



Newton

Gottfried Wilhelm Leibnitz (1646-1716) and Sir Isaac Newton (1643-1727) independently discovered calculus in the mid-17th century. **Leibnitz**, a German philosopher, mathematician, and political adviser, importantly both as a metaphysician and as a logician, was a distinguished independent inventor of the Differential and Integral Calculus. Sir Isaac Newton had created an expression for the area under a curve by considering a momentary increase at a point.



Leibnitz

In effect, the fundamental theorem of calculus was built into his calculations. His work and discoveries were not limited to mathematics; he also developed theories in optics and gravitation.

One cannot imagine a world without differentiation and integration. In this century, we witnessed remarkable scientific advancement owing to the ingenious application of these two basic components of Mathematics. Calculus serve as unavoidable tool for finding solutions to the variety of problems that arise in physics, astronomy, engineering, chemistry, geology, biology, and social sciences.

Calculus deals principally with two geometric problems.

- (i) The problem of finding **SLOPE** of the tangent line to the curve, is studied by the limiting process known as **differentiation** and
- (ii) Problem of finding the **AREA** of a region under a curve is studied by another limiting process called **Integration**.

In chapters 9 and 10, we have studied the differential calculus. In this chapter let us study some fundamentals of integration.

Consider some simple situations illustrated below.

Situation 1

The shortest distance between two points A and B in a plane is the line segment joining the straight line A and B . Suppose it is required to find the line connecting two points A and B that do not lie on a vertical line such that a moving particle slides down on this line from A to B in the shortest time (minimum time). Most of us believe that the shortest distance path in Fig. 11.1(a) will take the shortest time.