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Topic- Maxima and Minima

## Introduction:

**Maxima and Minima** in Calculus is an important application of derivatives. Maxima and Minima of a function are the points that give the maximum and minimum values of the function within the given range. Maxima and minima are called the extremum points of a function.

The maxima and minima are the most used applications of the derivatives. The maxima and minima provide us with the peaks and valleys of a function.

### **Maxima Definition**

Let  $f(x)$  be a real function defined on an interval  $I$  then,  $f(x)$  is said to have the maximum value in  $I$ , if there exists a point 'a' in  $I$  such that  $f(x) \leq f(a)$  for all  $x \in I$ .

The number  $f(a)$  is called the maximum value of  $f(x)$  in the interval  $I$  and point  $a$  is called the **point of maxima** of  $f$  in interval  $I$ . The maxima of a function are defined as the point in the given interval where the function value is maximum. In other words, maxima is the

highest point on the curve of a function. There are two types of maxima:

- Local or Relative Maxima
- Absolute or Global Maxima

### **Minima Definition**

Let  $f(x)$  be a real function defined on an interval  $I$  then,  $f(x)$  is said to have the minimum value in  $I$ , if there exists a point 'a' in  $I$  such that  $f(x) \geq f(a)$  for all  $x \in I$

The number  $f(a)$  is called the minimum value of  $f(x)$  in interval  $I$  and the point  $a$  is called the point of minima of  $f$  in the interval  $I$ . The minima of a function is defined as the point in the given interval where the function value is minimum. In other words, minima is the lowest point on the curve of a function.

There are two types of minima:

- Relative or Local Minima
- Absolute or Global Minima

### **Types of Maxima and Minima**

There are two types of maxima and minima. They are listed as follows:

- Relative or Local Maxima and Minima
- Absolute or Global Maxima and Minima

### **Relative Maxima and Minima**

The relative maxima or relative minima is the maximum and minimum value which is greater than or lesser than its neighbor.

## **Relative Maxima**

A function  $f(x)$  is said to have a relative maximum at  $x = a$  if there exists a neighborhood  $(a - \delta a, a + \delta a)$  of  $a$  such that

$f(x) < f(a)$  for all  $x \in (a - \delta a, a + \delta a)$ ,  $x \neq a$ .

Here, the point  $a$  is called the point of relative maxima of a function and  $f(a)$  is called as the relative maximum value. The relative maxima is also called as the local maxima of a function.

## **Relative Minima**

A function  $f(x)$  is said to have a relative minimum at  $x = a$  if there exists a neighborhood  $(a - \delta a, a + \delta a)$  of  $a$  such that

$f(x) > f(a)$  for all  $x \in (a - \delta a, a + \delta a)$ ,  $x \neq a$ .

Here, the point  $a$  is called the point of minima of a function and  $f(a)$  is called as the relative minimum value. The relative minima is also called as the local minima of a function.