

# Minima & Maxima

## Concepts

Topics covered are:

1. Local Minima and Maxima
2. Absolute Minima and Maxima
3. First & Second Derivative Tests

## Local Minima and Maxima

For a function  $f(x)$ , all the points where the function forms a peak is a local maxima, and all the deepest points of a dip is a local minima.

Mathematically, if the derivative of the function at a point is 0, and it has a *positive* slope before the point and a *negative* slope after the point, it is a **local maxima**.

Similarly, if the derivative of the function at a point is 0, and it has a *negative* slope before the point and a *positive* slope after the point, it is a **local minima**.

## Absolute Minima and Maxima

The maximum value of all the local maxima of a function is called the **absolute maxima** of the function.

The minimum value of all the local minima of a function is called the **local minima** of the function.

## First & Second Derivative Tests

These tests are used to check minima and maxima for a given function. For the **first derivative test**:

1. Find the derivative of  $f(x)$  .i.e.  $f'(x)$
2. Find critical points (points where  $f'(x) = 0$ )
3. For each critical point, use the mathematical way to find minima and maxima.

For the **second derivative test**:

1. Find the derivative of  $f(x)$  .i.e.  $f'(x)$
  2. Find critical points
  3. Find second derivative .i.e.  $f''(x)$
  4. If  $f''(k) > 0$  where  $k$  is a critical point, then  $k$  is a local maxima. If  $f''(k) < 0$ , then  $k$  is a local minima. Use the first derivative test in case of 0.
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## Uses

The concept of Minima and Maxima itself is an application of derivatives. Using this concept, it becomes easy to find where the curve takes a turn, find where the curve attains maximum and minimum values without actually having to look at the curve.