Derivatives have many applications. In physics and other sciences, we often want to find the point where a function has a maximum or minimum. Derivatives enable us to find them, that is, *extrema*.

# Extrema – Minimum and Maximum values

“Extrema” is an encompassing vocabulary term.

## What extrema are

Maximum (value) – the greatest, largest value of a function. Plural: maxima.

* Local maximum – the maximum of a function in an interval.
* Absolute maximum – the maximum of a function across its entire domain.

Minimum (value) – the least, smallest value of a function. Plural: minima.

* Local minimum– the minimum of a function in an interval.
* Absolute minimum– the minimum of a function across its entire domain.

Extremum (value) – a maximum or minimum value of a function. Plural: extrema.

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| Extrema: | Maximum (largest) | Minimum (smallest) |
| In an interval | Local maximum | Local minimum |
| Across the domain | Absolute maximum | Absolute minimum |

## Properties about extrema

Extreme Value Theorem (theorem) – If a function is continuous on a closed interval , then there is an absolute maximum and an absolute minimum for the function in that interval .

Fermat’s Theorem (theorem) – If a function has a maximum or minimum at , and if the derivative is defined, then .

Critical number (value) – a number the domain of in function such that or does not exist.

All of these mean that: if a function has a minimum or maximum at , then it has a critical number at , so either or does not exist.

## How to find extrema

The closed interval method (method) – a method for finding the extrema of a function in an interval .

1. Find the critical numbers of in the interval .
2. Find the values of at those critical numbers.
3. Also, find the values of at and .
4. The smallest value is the minimum, the largest is the maximum.

# What would you say?

* What is an extremum? Which extrema are there?
* What are extrema called in an interval? Across a function’s domain? What properties do they have?
* What do derivatives tell us about extrema? What is a critical number? How do you find them?