Subject for this video:

Identifying Local and Absolute Extrema on a Graph

Reading:

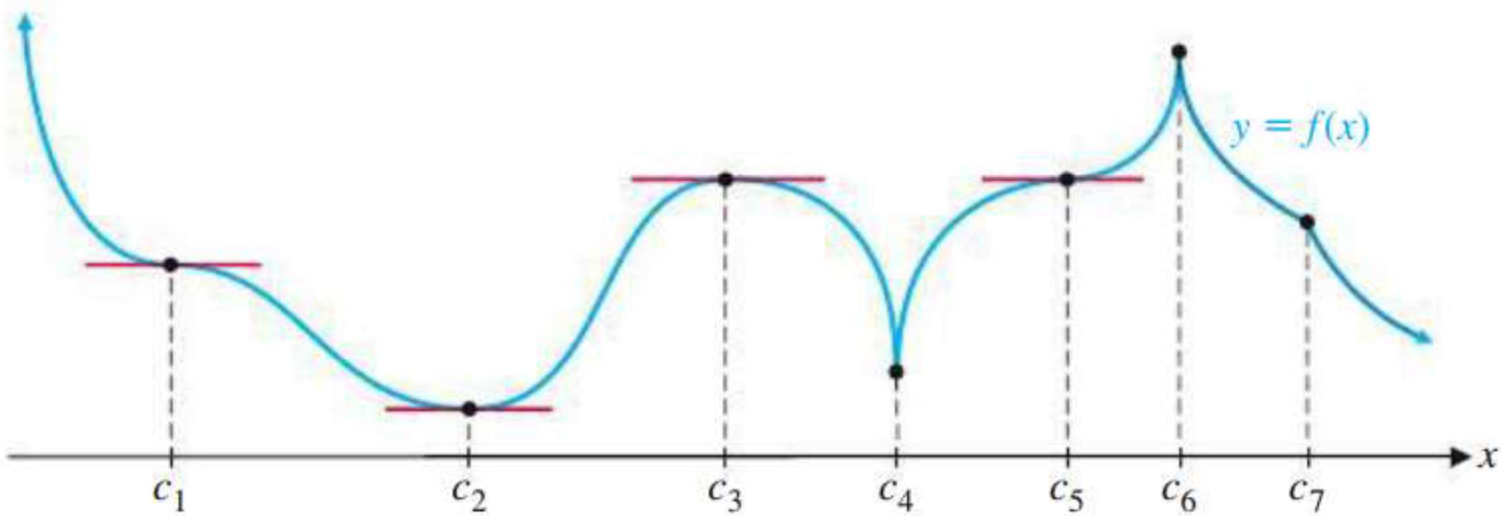
- **General:** Section 4.5 Absolute Maxima and Minima
- **More Specifically:** Pages 296 – 297, and middle of page 299 but no matching examples

Homework:

H61: Identifying Absolute Extrema on a Graph (4.5#9,11,15,17,18)

Useful Section 4.1 concepts discussed in previous videos

When a graph of a function is available, it is easy to notice high and low points on it.



This gave rise to the definition of *Local Extrema* in Section 4.1

Definition of *Local Maximum*

Words: *a **local maximum** for* $f(x)$.

Meaning: a y value $y = f(c)$ such that

- $f(x)$ is continuous on an interval (m, n) containing $x = c$
- The y value $f(c)$ is the *greatest* y value on the interval (a, b).

  That is, $f(c) \geq f(x)$ for all x in the interval (m, n).

Definition of *Local Minimum*

Words: *The* y *value* $f(c)$ *is a **local minimum** for* $f(x)$.

Meaning: a y value $y = f(c)$ such that

- $f(x)$ is continuous on an interval (m, n) containing $x = c$
- The y value $f(c)$ is the *least* y value on the interval (a, b).

  That is, $f(c) \leq f(x)$ for all x in the interval (m, n).

Definition of *Local Extremum*

Words: *a **local extremum** for* $f(x)$.

Meaning: a y value $y = f(c)$ that is a ***local maximum*** or a ***local minimum***

In the current section 4.5, we turn o ur attention to *Absolute Extrema*

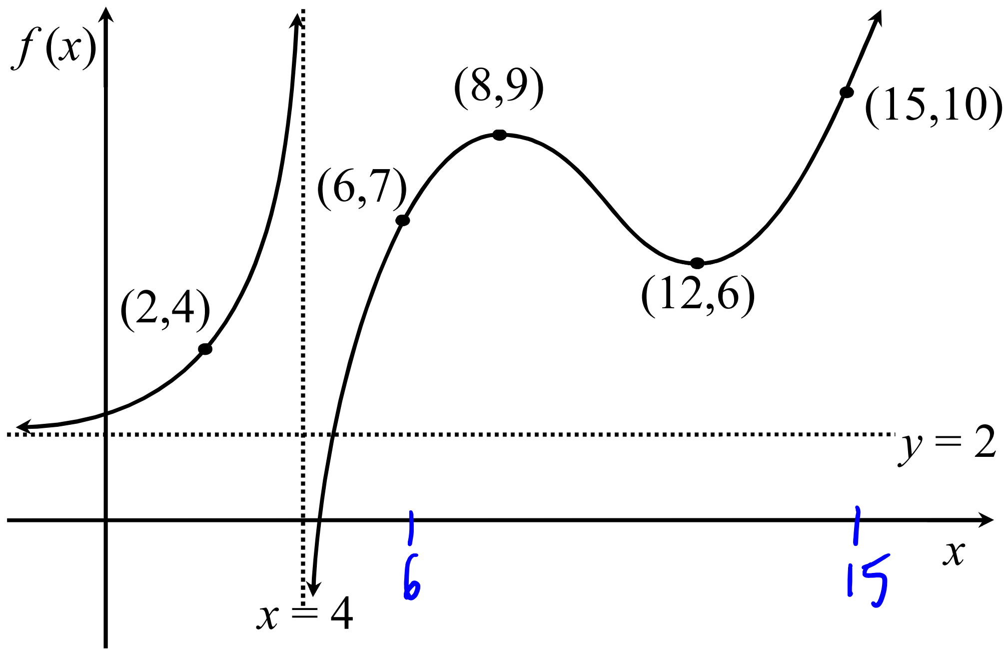
DEFINITION Absolute Maxima and Minima

If $f(c) \geq f(x)$ for all x in the domain of f, then $f(c)$ is called the **absolute maximum** of f. If $f(c) \leq f(x)$ for all x in the domain of f, then $f(c)$ is called the **absolute minimum** of f. An absolute maximum or absolute minimum is called an **absolute extremum.**

[Example 1]
(similar to 4.5#9,11,15,17,18)

The graph of a function $f(x)$ is shown.

Fill in the table below.



Interval	Local Maxes in that interval	Local Mins in that interval	Absolute Max in that interval	Absolute Min in that interval
[6,15]	$f(8)=9$	$f(12)=6$	$f(15)=10$	$f(12)=6$
(6,15)	$f(8)=9$	$f(12)=6$	none	$f(12)=6$
(8,15)	none	$f(12)=6$	none	$f(12)=6$
[12,15]	none	none	$f(15)=10$	$f(12)=6$
$(-\infty, 4)$	none	none	none	none
$(4, \infty)$	$f(8)=9$	$f(12)=6$	none	none

Notice that for some of the intervals, $f(x)$ some of the types of extrema do not occur.

But there is one important situation where some extrema are *guaranteed* to occur.

THEOREM 1 Extreme Value Theorem

A function f that is continuous on a closed interval $[a, b]$ has both an absolute maximum and an absolute minimum on that interval.