

AP Calculus

3.1 - Absolute & Local Extrema

The max and min values of a function are known as _____ or _____.

The process of finding **extrema** is called _____.

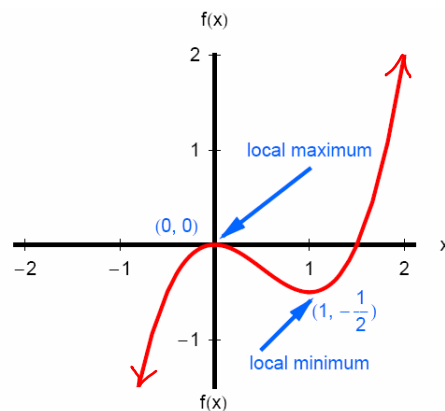
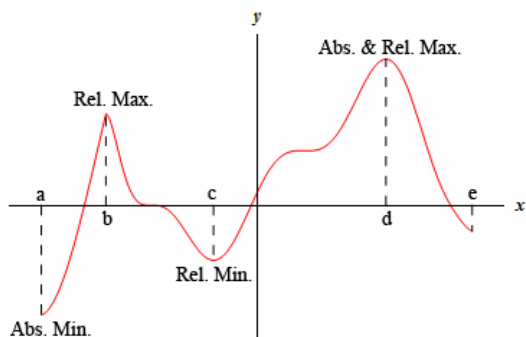
Extreme Value Theorem: Every _____ function f on a _____ interval $[a,b]$, will have a max and min value.

There are two types of extrema. Consider f defined over a closed interval $[a,b]$:

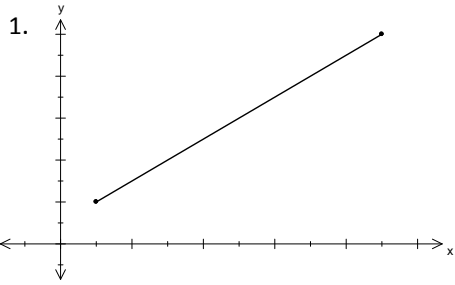
Absolute (Global) If $[a,b]$ contains c and $f(c) \geq f(x)$ for all x in $[a,b]$ then $f(c)$ is an **Absolute Max**.

Relative (Local) If c is **within** some _____ sub-interval of $[a,b]$ and $f(c)$ is the largest value in that open interval, then $f(c)$ is a **Local Max**.

Does every function f have a max or min value?



Finding Extreme Values Graphically.

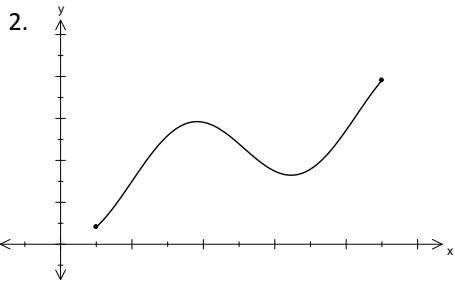


Absolute Max :

Absolute Min :

Local Max :

Local Min :

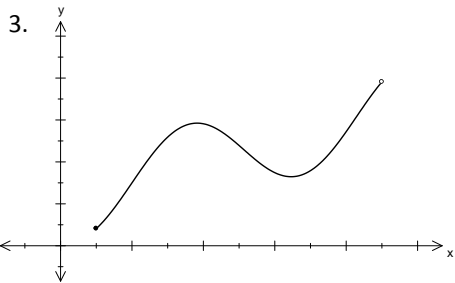


Absolute Max :

Absolute Min :

Local Max :

Local Min :

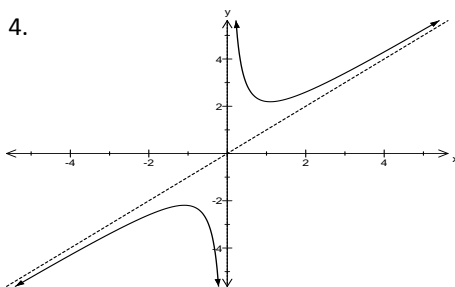


Absolute Max :

Absolute Min :

Local Max :

Local Min :

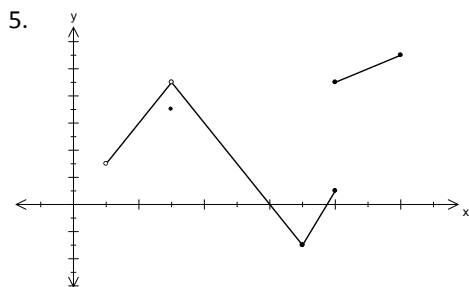


Absolute Max :

Absolute Min :

Local Max :

Local Min :



Absolute Max :

Absolute Min :

Local Max :

Local Min :

Finding Extreme Values Analytically.

Consider a continuous function f defined for all x on a closed interval $[a, b]$.

The endpoints of a closed interval can only provide _____ max or min.

Local max or min can only occur in an _____ interval contained within $[a, b]$.

Local max or min occur when the graph looks like: _____ or _____ or _____

→ The **tangent line** at a **local extremum** either has slope: _____ or _____.

Critical Value A number c , in the domain of f , is a **critical value** if either i) _____
or ii) _____

→ **Fermat's Theorem** If $f(c)$ is a local extremum then _____.

→ To find all extrema of f : i) Find $f'(x)$

ii) Find x where $f'(x) = 0$ and $f'(x) = \text{undefined}$ → **Critical Value(s)**

iii) Find value of f at each critical value and compare.

Examples

1. Find the critical values of $f(x) = x^3 - 9x^2 + 24x - 10$. (NC)
2. Find the critical values of $f(x) = |x + 1|$. (NC)
3. Find all extrema of $f(x) = 2x^3 - 15x^2 + 24x + 7$ on $[0, 6]$. (NC)
4. Find absolute max and all local max of $f(x) = 1 - (x - 1)^{\frac{2}{3}}$ on $[-1, 2]$. (NC)
5. Find all min/max of $f(x) = \sin x \cos x$ on $[0, \pi]$. (NC)
6. Find all extreme values of $f(x) = x^2 - 8 \ln x$ on $[1, 4]$. (TI-83)

Assignment: 4.1, P.226 PQ: 1 – 6, #1 – 21, 23 – 55 odd