## Handout: *Extreme Values, Critical Numbers*, and the *Closed Interval Method* (Section 4.1)

**Definition of *absolute max value* of a function on a domain D**

**Words:** absolute max value of a function $f$ on a domain $D$.

**Meaning:** a $y$ value $f(c)$ such that $c \in D$ and such that $f(c) \geq f(x)$ for all $x \in D$

**Definition of *local max value* of a function on a domain D**

**Words:** local max value of a function $f$ on a domain $D$.

**Meaning:** a $y$ value $f(c)$ such that $c \in (a, b) \subset D$ and that $f(c) \geq f(x)$ for all $x \in (a, b)$

Definitions of ***absolute min value*** and ***local min value*** are similar, but with $f(c) \leq f(x)$.

**Definition of *Critical Number***

**Words:** critical number of a function $f$

**Meaning:** an $x = c$ that satisfies both of these conditions:

- $f(c)$ exists.
- $f'(c) = 0$ or $f'(c)$ does not exist.

### The *Closed Interval Method*

For finding the abs max value and abs min value for a continuous function on a closed interval.

**Step 1:** Confirm that the interval is closed and that the function is continuous.

**Step 2:** Find the critical numbers of the function.

**Step 3:** Make a 2-column table.

In the left column, put a list of important $x$ values in increasing order:

- left endpoint
- critical numbers in the interval
- right endpoint.

In the right column, put the corresponding $y$ values.

So the table will look like this:

| important $x$ values | corresponding $y$ values |
|---|---|
| $x = a$ (endpoint) | $f(a)$ |
| $x = c_1$ (critical) | $f(c_1)$ |
| $\vdots$ | $\vdots$ |
| $x = c_k$ (critical) | $f(c_k)$ |
| $x = b$ (endpoint) | $f(b)$ |

**Step 4:** Identify the greatest and least $y$ values in the list. These $y$ values are the absolute max value and the absolute min value. Write a clear conclusion in two sentences.