

**Vocabulary**

Suppose  $f(x)$  is a real-valued function with domain  $D$  and suppose  $c$  is a point in  $D$ .

1.  $f(c)$  is an **absolute maximum value** for  $f$  if  $f(c) \geq f(x)$  for each  $x$  in  $D$ .
2.  $f(c)$  is a **(absolute) minimum value** for  $f$  if  $f(c) \leq f(x)$  for each  $x$  in  $D$ .
3.  $f(c)$  is a **local maximum value** for  $f$  if  $f(c) \geq f(x)$  for each  $x$  in  $D$  near  $c$ .
4.  $f(c)$  is a **local minimum value** for  $f$  if  $f(c) \leq f(x)$  for each  $x$  in  $D$  near  $c$ .
5. We say  $c$  is a **critical point** for  $f$  if either  $f'(c) = 0$  or  $f'(c)$  does not exist.

**Key Tools**

**Fermat's Theorem** If  $f(c)$  is a (local or absolute) maximum/minimum value, and if  $f$  is defined on both sides of  $c$ , and if  $f'(c)$  exists, then  $f'(c) = 0$ .

**Extreme Value Theorem** If the domain of  $f$  is a closed, bounded interval, and if  $f$  is continuous, then  $f$  is guaranteed to have both a maximum and a minimum value.

So, to find a maximum or minimum value for a function defined on an closed, bounded interval  $[a, b]$ , look in all of the following locations:

1. The end points.
  2. The critical points.
1. Find the maximum and minimum values of  $f(x) = x - x^{1/3}$  on the interval  $[-1, 4]$ . Determine where those maximum and minimum values occur.

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