# Relative Extrema and Critical Numbers

If $f(c) \geq f(x)$ for all x in a neighborhood about the point c, then $f(c)$ is a *relative maximum* ($f(c)$ is the highest point, of other points nearby, on the graph).

If $f(c) \leq f(x)$ for all x in a neighborhood about the point c, then $f(c)$ is a *relative minimum* ($f(c)$ is the lowest point, of other points nearby, on the graph).

Example 1: List the relative maxima and minima from the following graph.
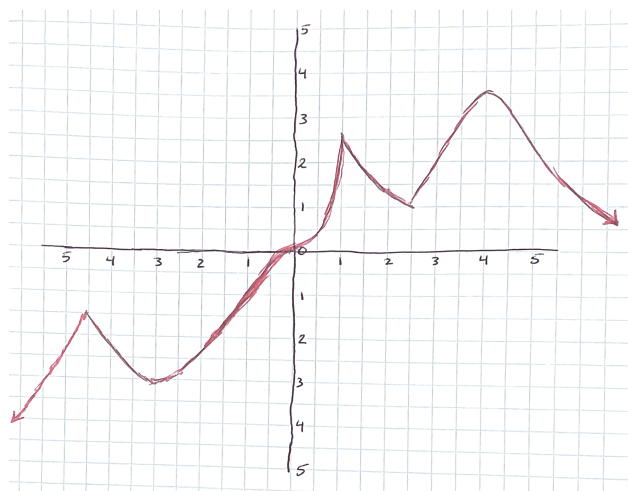
- Notice that maxima and minima occur where the derivative is zero or where it does not exist (as an example, if $f(x) = |x|$, then $f'(0) =$DNE).
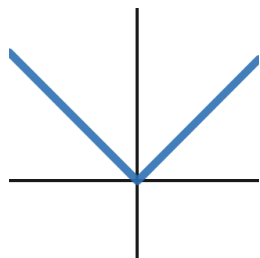
- Look at the origin in the graph in example 1. Notice that the derivative being zero at a point does not necessarily mean that there is a maximum or minimum at that point.

Critical Numbers

Let c be a point in the domain of f. If $f'(c) = 0$ or $f'(c) =$DNE, then c is a *critical number (point)* for the function f.

Example 2: Find the critical numbers of $f(x) = 2x^3 + 9x^2 + 12x$.

Example 3: Find the critical numbers of $y = 3x^2 - \frac{4}{x^2}$.

Example 4: Find the critical numbers of $g(x) = 4x^3 e^{3x}$.

DIY

1. Find the critical numbers of the following function.

$$f(x) = \frac{2x^2 + 1}{3x}$$