

# MTH 252 Lab

## Extrema

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### Purpose

One of the most useful applications of differential calculus is optimization. This lab will focus on finding the extrema of a function, while a future lab will focus on optimizing a situation.

- (a) What is the difference between a local extremum and a global extremum?
- (b) The search for extrema typically begins with critical values. What is a critical value?
- (c) Is an extremum guaranteed to be found at a critical value?

### Prompts

1. Sketch the graph of a function described below.
  - (a) Sketch the graph of a function  $f$  such that  $f$  has a critical value at  $x = 1$  but no extremum when  $x = 1$ .
  - (b) Sketch the graph of a function  $g$  such that  $g$  has a global maximum of 2 and a global minimum of  $-3$ .
  - (c) Sketch the graph of a function  $h$  such that  $h$  has a local minimum of 1 but  $h'(1)$  is undefined.
2. Consider the function  $f(x) = 2x^3 - 3x^2 - 36x + 1$  with domain  $[-4, 0]$ . Find the global extrema of  $f$ . Be sure to show all work that supports your conclusion, and use sentences to describe why you are doing what you are doing.
3. Let  $f(x) = \frac{x^2 - 1}{x^3}$ 
  - (a) Find  $f'(x)$ .
  - (b) What are the critical numbers of  $f$ ?
  - (c) Identify the intervals of concavity for  $f$ .
  - (d) Identify all of the local extrema of  $f$ .
4. Find all of the local extrema of  $f(x) = x\sqrt{2+x}$ .