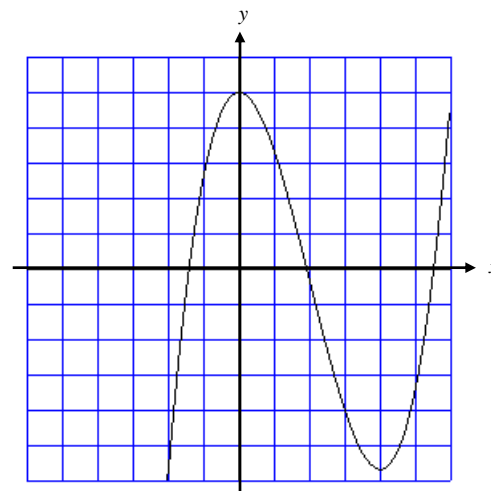


2.1 USING FIRST DERIVATIVES TO FIND MAXIMUM AND MINIMUM VALUES AND SKETCH GRAPHS

Example: Consider the function to the right.

a) List the intervals where this function is *increasing* and *decreasing*.

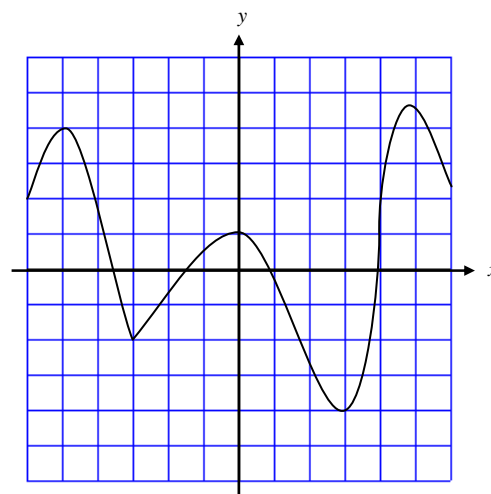
b) A relative maximum (or minimum) value is a function value that is higher (or lower) than all those values “close” to it. What are the *relative maximum* and *relative minimum* values of this function?



Example: Consider the function to the right.

a) List the intervals where this function is *increasing* and *decreasing*.

b) What are the *relative maximum* and *relative minimum* values of this function?



RELATIONSHIP BETWEEN INCREASING/DECREASING and MAXIMUM/MINIMUM

When a function changes from _____ to _____ there is a _____.

When a function changes from _____ to _____ there is a _____.

Our goal now is to figure out how we determine where these changes occur using calculus instead of a given graph.

When a function is _____, the derivative (slope of tangent line) is _____.

When a function is _____, the derivative (slope of tangent line) is _____.

Extrema

Extrema is one word that collectively refers to maximums and minimums. (The singular form is extremum).

Using Calculus, we will find extrema in two locations:

- 1.
- 2.

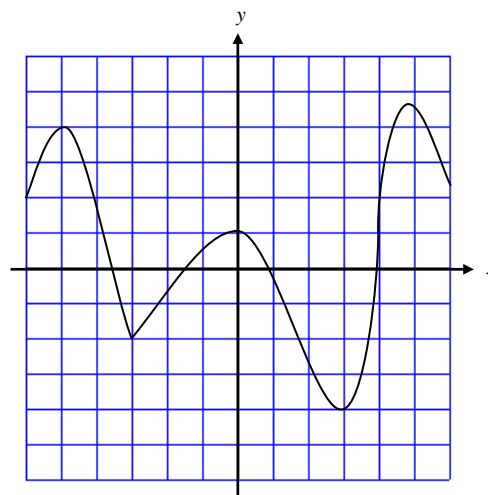
These locations are referred to as **critical values**.

Example: The critical values are _____ values, while the maximums/minimums of the function are _____ values.

In other words, suppose you are looking at the point (2, 70).

The maximum/minimum of the function is _____, and it occurs at _____ .
(This is how you correctly describe extrema.)

Example: Find all critical values of the graph to the right.



Example: Find all extrema on the graph to the right.

TRUE or FALSE:

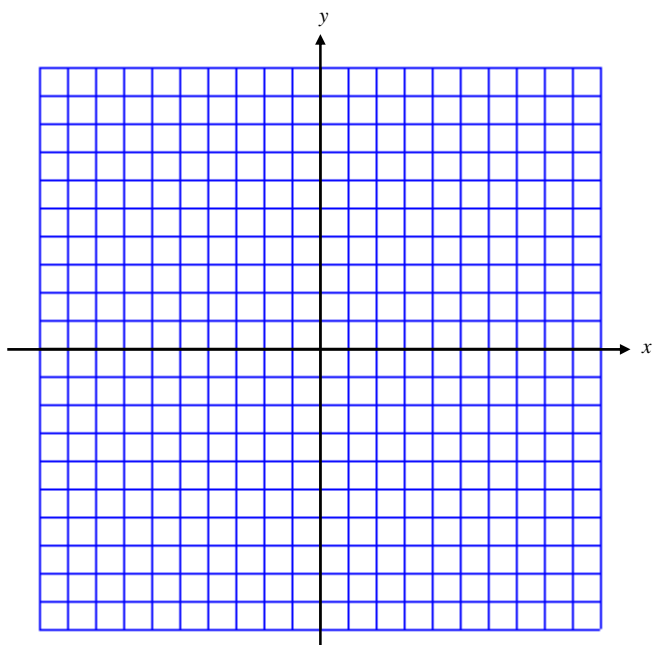
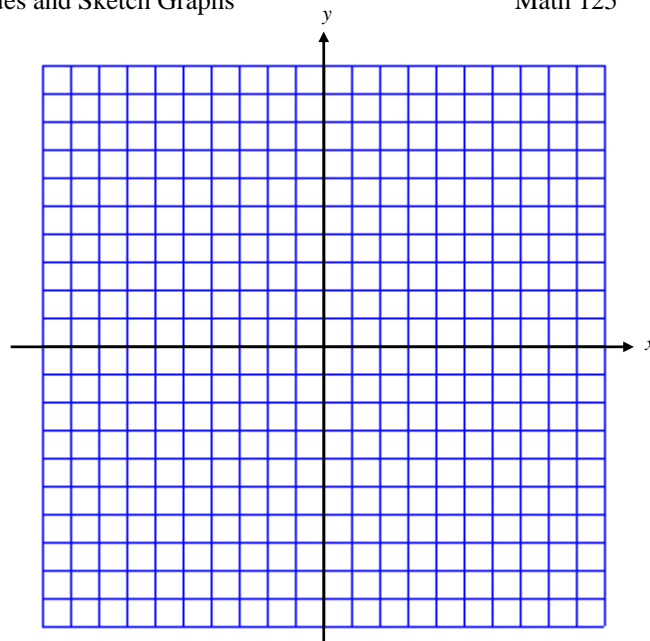
- a) All extrema occur at critical points. _____
- b) All critical points give us extrema. _____

Steps for Finding Extrema

1. Find the critical values.
 - a) Take the derivative
 - b) Find where the derivative _____ or is _____.
2. Use a Sign Chart of the derivative to determine whether or not the critical values give you a relative maximum or minimum.
 - a) If the first derivative changes signs from + to – then there is a relative _____.
 - b) If the first derivative changes signs from – to + then there is a relative _____.
 - c) If the first derivative does NOT change signs, then there is NO extremum there.

Example: Find the extrema and sketch the graph of

$$f(x) = 3x^4 - 4x^3.$$



Example: Find the extrema and sketch the graph of

$$g(x) = 2x - 3x^{2/3}.$$

Example: Find the extrema and sketch the graph of

$$h(x) = \sqrt[3]{x^2 - 9}.$$

