

What can the graph tell us about the function?

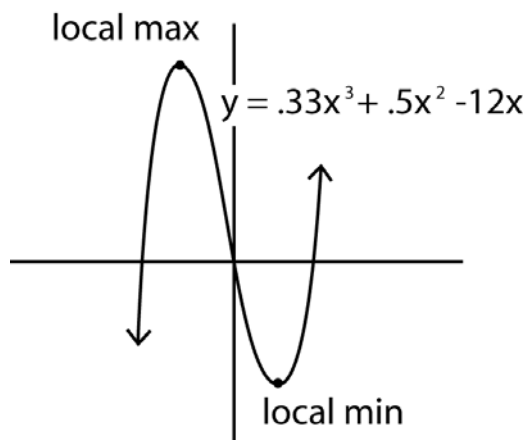
College algebra

Local Extrema, Increasing and Decreasing Functions, Piecewise Functions, Applications
Section 2.1

Definition: Local (or relative) extrema:

A **local minimum** is the point (technically, the y value) on the graph where the y value is **the smallest**, in that area of the graph.

A **local maximum** is the point (technically, the y value) on the graph where the y value is **the largest**, in that area of the graph.



expl 1: Use your calculator to find the local max and min of the function pictured above. Do not just TRACE but rather use the Maximum and Minimum calculator functions.

Worksheet: Finding maximums and minimums on your graphing calculator (82, 83, 85, 86):

This worksheet shows how to find the points of maximum or minimum y values on your graphing calculator. Instructions for the TI83 will work for TI84's.

Use the Minimum (or Maximum) function (under the CALC menu on the TI-83 or 84) to find the smallest (or largest) y value and the x value that makes it.

A more precise way to state this definition:

Suppose f is a function for which $f(c)$ exists for some c in the domain of f . Then

$f(c)$ is a **local (or relative) minimum** if there exists an open interval I containing c such that $f(c) < f(x)$ for all x in I where $x \neq c$; and

$f(c)$ is a **local (or relative) maximum** if there exists an open interval I containing c such that $f(c) > f(x)$ for all x in I where $x \neq c$.

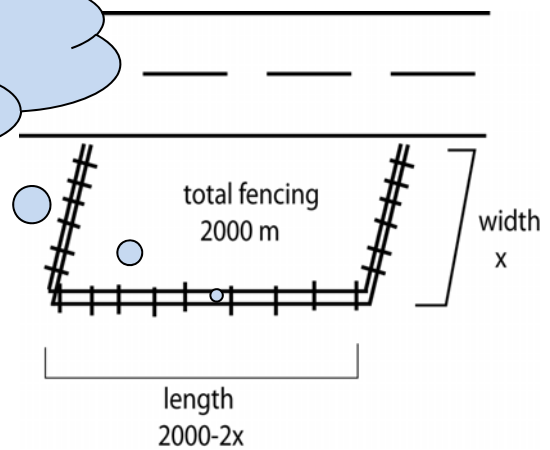
expl 2: A projectile is fired at an inclination of 45 degrees to the horizontal, with a muzzle velocity of 100 feet per second. The height $h(x)$ of the projectile, in feet, is given by

$$h(x) = \frac{-32x^2}{10,000} + x \quad \text{where } x \text{ is the horizontal distance, in feet, of the projectile from the firing point.}$$

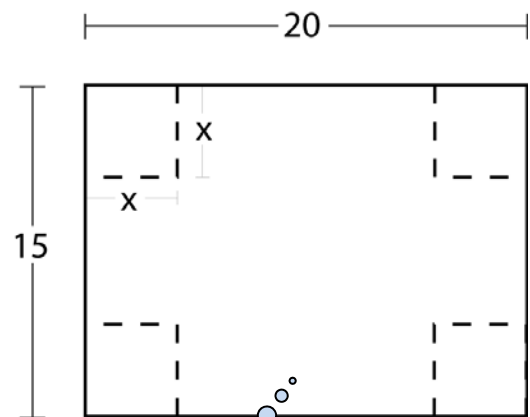
- Graph the function $h(x)$. How far from the firing point will the projectile hit the ground?
- Based on the graph, what is the domain of this function?
- How far from the firing point is the height of the projectile a maximum? What is the maximum height? Include units.

expl 3: A farmer with 2000 meters of fencing wants to enclose a rectangular plot that borders on a highway. If the farmer does not fence the side along the highway, what is the largest area that can be fenced?

Let x represent the width. Why is the length $2000 - 2x$? What else do we need to know?



expl 4: The piece of cardboard shown below will have x -inch by x -inch corners cut out of it. The remaining flaps will then be folded up to make an open-topped box. Find a formula for the volume of the box and determine the maximum volume that can be made. Round answers to the nearest hundredth.



$$V = l \cdot w \cdot h$$

What are the length, width, and height of the box?

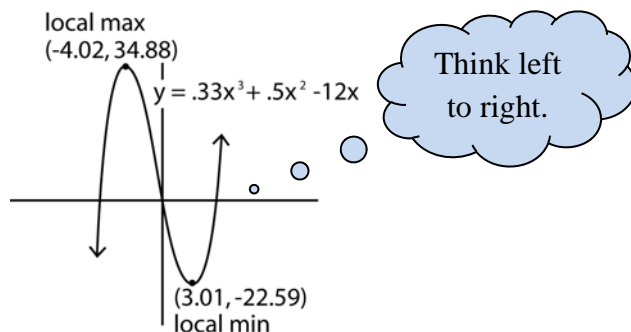
Increasing and decreasing functions

We will investigate where the graph's y values are increasing and where they are decreasing.

We look at **what is happening to the y values as we go left to right** on the graph. And then we **write the intervals of x values** that result in those increasing or decreasing parts of the graph.

We will usually use interval notation.

expl 5: Where is this function increasing and decreasing? Write your answers in interval notation.

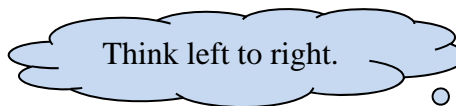


A more precise way to state this definition:

A function is **increasing** on an open interval I , if for all a and b in that interval where $a < b$, we have $f(a) < f(b)$.

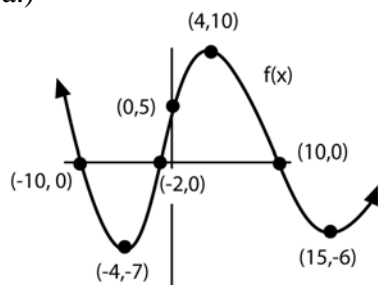
A function is **decreasing** on an open interval I , if for all a and b in that interval where $a < b$, we have $f(a) > f(b)$.

A function is **constant** on an open interval I , if for all a and b in that interval where $a < b$, we have $f(a) = f(b)$.

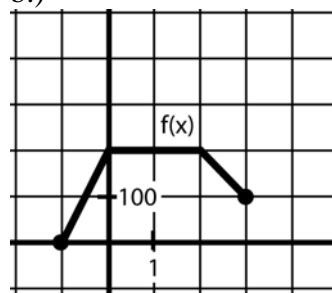


expl 6: For each function below, determine the intervals where the function is increasing, decreasing, or constant. Write your answers in interval notation.

a.)



b.)



Worksheet: Increasing and Decreasing Functions:

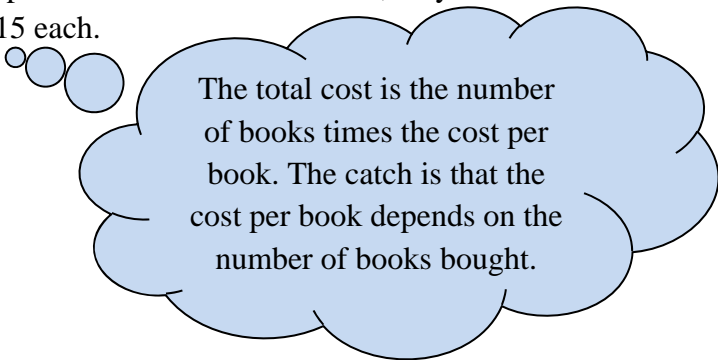
This worksheet will help you see what we mean by increasing and decreasing. We will practice using the interval notation needed and finding the information on the graphing calculator.

Piecewise Functions:

The following is an example of a piecewise function. The idea here is that the function's rule changes depending on which piece of the domain you're in.

expl 7: We are buying books for our school. If we purchase less than 100 books, they are \$25 each. If we purchase 100 or more, they are only \$15 each.

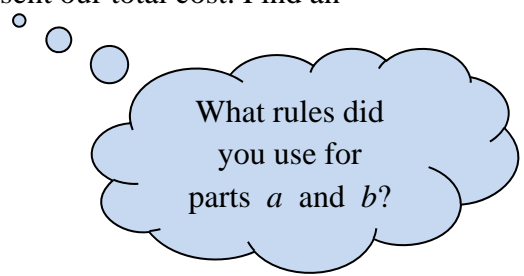
a.) If we buy 30 books, what is our total cost?



The total cost is the number of books times the cost per book. The catch is that the cost per book depends on the number of books bought.

b.) If we buy 200 books, what is our total cost?

c.) Let x represent the number of books we buy and y represent our total cost. Find an expression for y in terms of x .



What rules did you use for parts a and b ?

d.) Use your function to answer the following question. If we buy 150 books, what is our total cost?

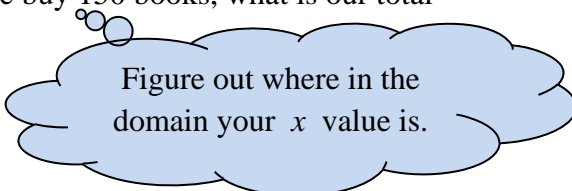
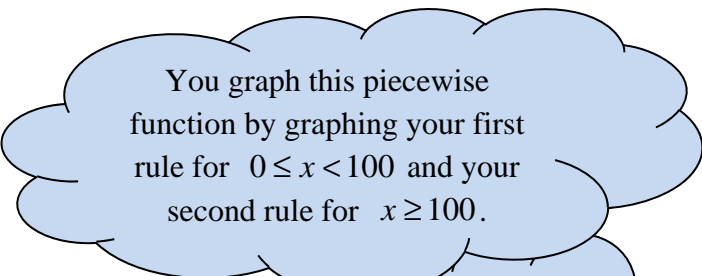
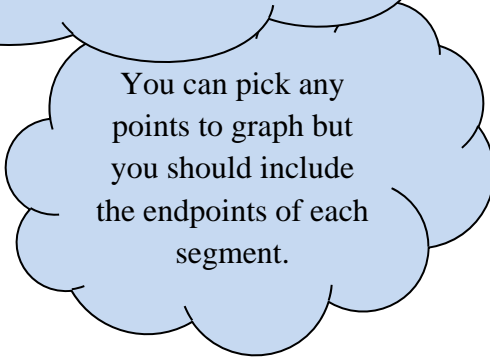


Figure out where in the domain your x value is.

e.) Graph this piecewise function.



You graph this piecewise function by graphing your first rule for $0 \leq x < 100$ and your second rule for $x \geq 100$.



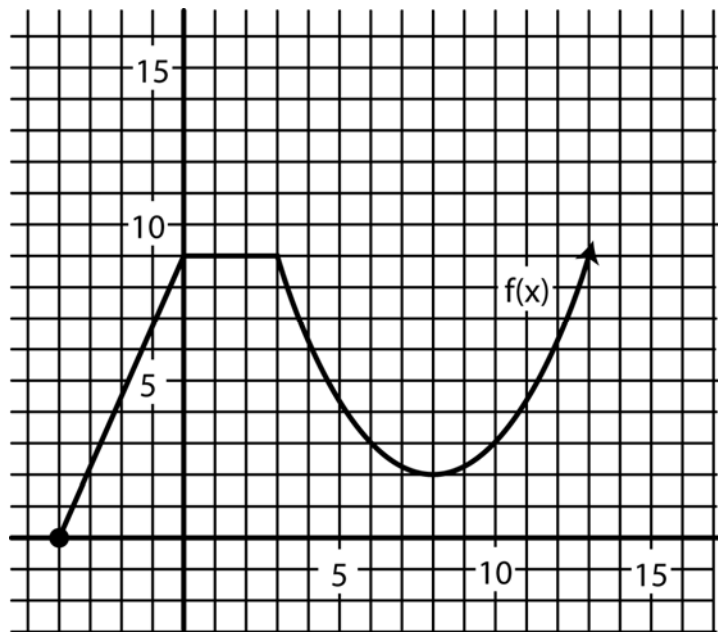
You can pick any points to graph but you should include the endpoints of each segment.

expl 8: For the piecewise function, find the function values $g(-10)$, $g(-15)$, and $g(20)$.

$$g(x) = \begin{cases} x + 5, & x < -10 \\ 3x - 6, & -10 \leq x \leq 0 \\ 7, & x > 0 \end{cases}$$

Figure out where in the domain your x value is.

expl 9a: Determine the domain and range of the piecewise function pictured here.



expl 9b: Find $f(10)$.

Worksheet: Roots and intersections on your calculator:

You will learn how to find the roots (also called zeroes or x -intercepts of the graph). You will also learn how to find the intersection of two functions. Instructions for the TI83 will work for TI84's.