INCREASING AND DECREASING FUNCTIONS

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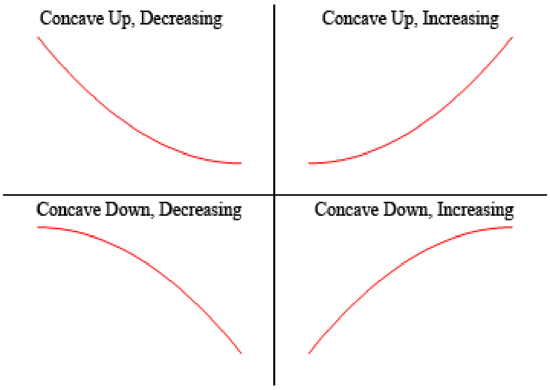
Conditions for Increasing and Decreasing functions



Let I be an open interval contained in the domain of a real valued function 'f'. Then 'f' is said to be
(i) Increasing on I if $x_1 < x_2$ in I $\Longrightarrow$ $f(x_1)$? $f(x_2)$ for all x_1, x_2 ? I
(ii) Strictly increasing on I if $x_1 < x_2$ in I $\Longrightarrow$ $f(x_1) < f(x_2)$ for all x_1, x_2 ? I
(iii) Decreasing on I if $x_1 < x_2$ in I $\Longrightarrow$ $f(x_1)$? $f(x_2)$ for all x_1, x_2 ? I
(iv) Strictly decreasing on I if $x_1 < x_2$ in I $\Longrightarrow$ $f(x_1) > f(x_2)$ for all x_1, x_2 ? I

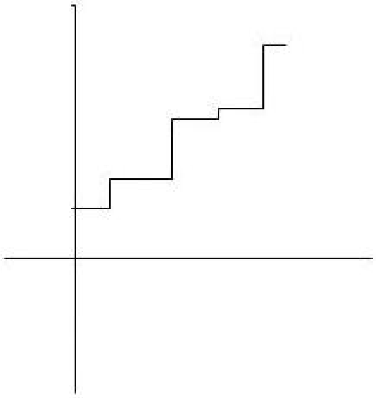
Dependence on Differentiability

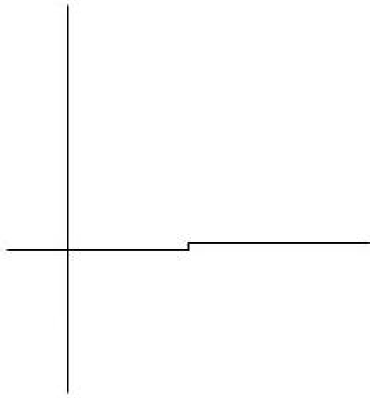
Let 'f' be continuous on [a, b] and differentiable on the open interval (a, b). Then f is increasing in [a, b] if f'(x) > 0 for each x ? (a, b)
(i) f is decreasing in [a, b] if f'(x) < 0 for each x ? (a, b).
(ii) f is a constant function in [a, b] if f'(x) =0 for each x ? (a, b).
Solved Examples:
1) Show that the function given by f(x) = 5x + 19 is strictly increasing on **R**
F(x) = 5x + 19
F'(x) = 5 > 0 for all x ? **R**
Thus f(x) is strictly increasing on**R**

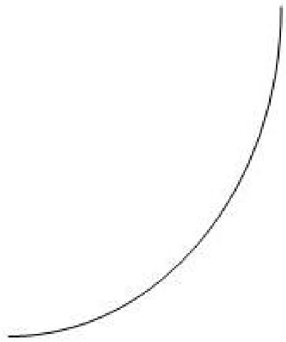
2) Find the intervals in which the function f given by $f(x) = x^2 - 4x + 6$ is
a) Strictly increasing
b) Strictly decreasing
$F(x) = x^2 – 4x + 6$
F'(x) = 2x - 4 -? 2 +?
F'(x) = 0 implies 2x – 4 = 0, x = 2
In the interval (-?, 2), f'(x) = 2x – 4 < 0, so it is strictly decreasing in this interval.
In the interval (2, ?), f'(x) > 0, so it is strictly increasing in this interval

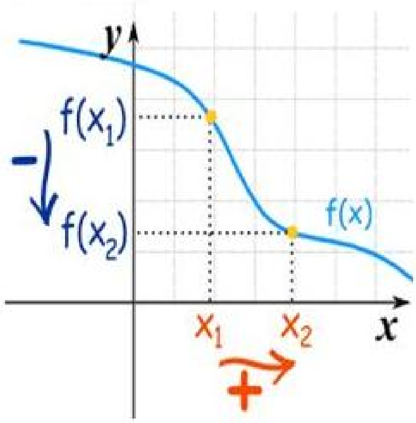
Graphical representation of increasing and decreasing functions

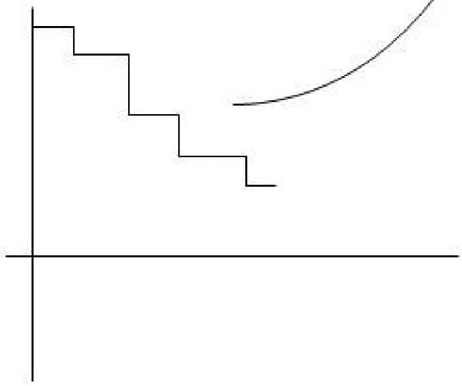
(Increasing function) (Strictly increasing function)





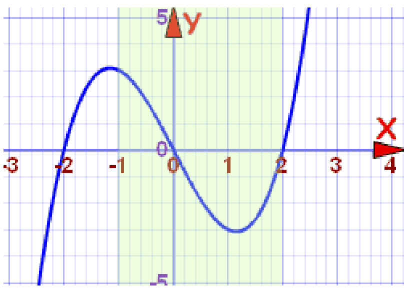






(Strictly Decreasing function) (Decreasing function)

Example: Where the given function is increasing or decreasing:
f (x) = x^3 - 4x, for x in the interval [-1, 2]
Solution:



Starting from -1 (the beginning of the interval [-1, 2]):

At x = -1 the function is decreasing, it continues to decrease until about 1.2, it then increases from there, past x = 2

Within the interval [-1, 2]:

The curve decreases in the interval [-1, approximately 1.2]
The curve increases in the interval [approximately 1.2, 2]

Now try it yourself! Should you still need any help, click here to schedule live online session with e Tutor!

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Reference Links:

- http://en.wikipedia.org/wiki/Interval_(mathematics)
- http://en.wikipedia.org/wiki/Domain_(ring_theory)
- http://en.wikipedia.org/wiki/Continuous_function
- http://www.opensourcemath.org/books/calc1-sage/html/Increasing_decreasing_funct.html

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