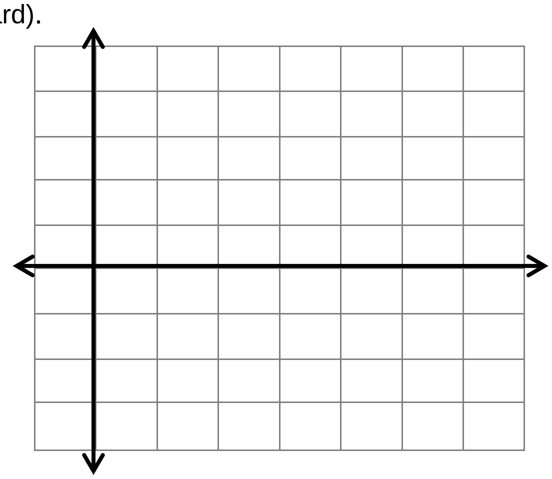
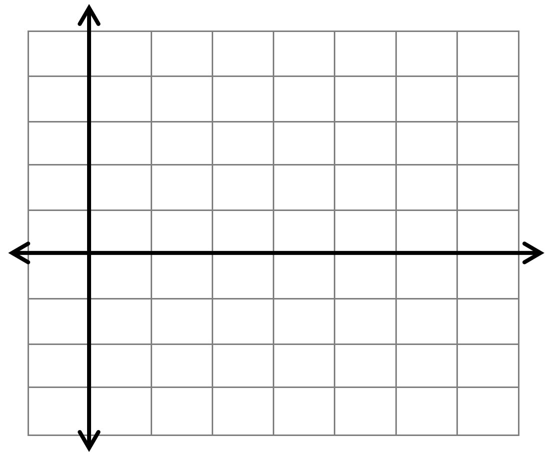
Section 3.3 (Increasing and Decreasing Functions and the First Derivative Test)

Recall that a function is increasing if as x increases (left-to-right) if f(x) or y is increasing (down-to-up). Sketch 2 increasing functions on the left axes and 2 decreasing functions on the right axes (sketch a constant function on the board).





If you examine the derivatives of these functions, you will see that…

- if $f'(x) > 0$ for all x in (a,b) then f is increasing on [a,b]
- if $f'(x) < 0$ for all x in (a,b) then f is decreasing on [a,b]
- if $f'(x) = 0$ for all x in (a,b) then f is constant on [a,b]

<u>Example</u>: Find the open intervals on which $f(x) = x^2 - 4x + 3$ is increasing or decreasing

(note: find critical points where $f'(x) = 0$ or does not exist – why?)

<u>Example</u>: Answer the following (sketch as needed)

What happens if the sign of $f'(x)$ does not change on from the left to the right of a critical point?

What happens if the sign of $f'(x)$ chanes from positive to negative from the left to the right of a critical point?

What happens if the sign of $f'(x)$ chanes from negative to positive from the left to the right of a critical point?

Guidelines for finding increasing decreasing intervals (and relative maxima, minima):

1. Locate critical numbers of f in (a,b)
2. Determine the sign of $f'(x)$ at one test value in each interval
3. Use that information to determine whether a function is increasing / decreasing / constant (and extrema)

<u>Example</u>: Find the relative extrema of $f(x) = x^3 - 3x^2 + 1$ (define concave up and down / inflection points)

<u>Example</u>: Review example 5 in the book and find the relative extrema of $f(x) = \sqrt{4x - x^2}$ (consider the domain of f)

Homework problems: 3,4,5,11,15,19,23,29,35 (required) 16,37,40,86 (recommended)