L1 – Increasing / Decreasing Unit 2
MCV4U
Jensen

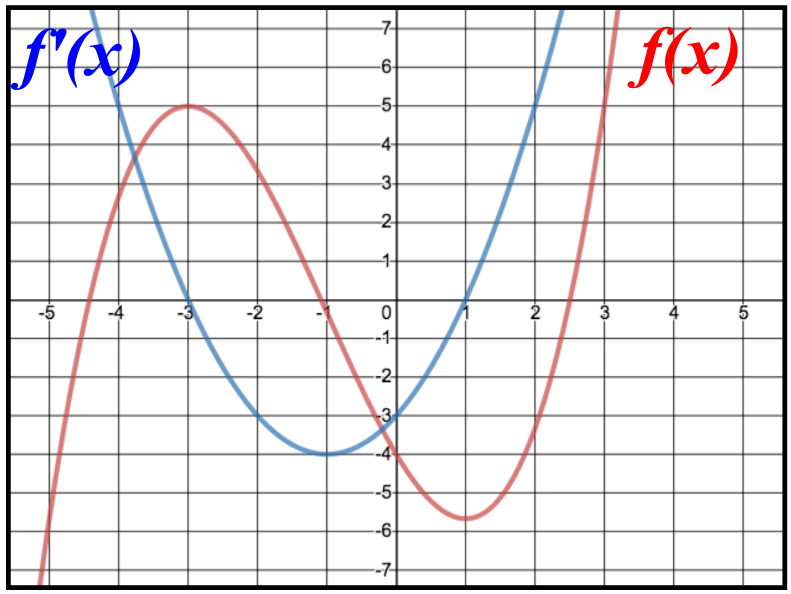
Increasing: As x-values increase, y-values are increasing

Decreasing: As x-values increase, y-values are decreasing

Part 1: Discovery

$f(x) = \frac{1}{3}x^3 + x^2 - 3x - 4$

$f'(x) = x^2 + 2x - 3$



a) Over which values of x is $f(x)$ increasing?

b) Over which values of x is $f(x)$ decreasing?

c) What is true about the graph of $f'(x)$ when $f(x)$ is increasing?

d) What is true about the graph of $f'(x)$ when $f(x)$ is decreasing?

Effects of $f'(x)$ on $f(x)$: When the graph of $f'(x)$ is positive, or above the x-axis, on an interval, then the function $f(x)$ ________________ over that interval. Similarly, when the graph of $f'(x)$ is negative, or below the x-axis, on an interval, then the function $f(x)$ __________________ over that interval.

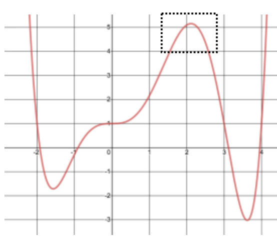
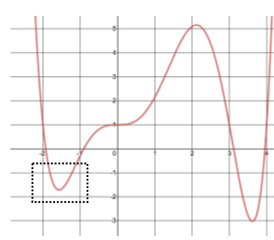
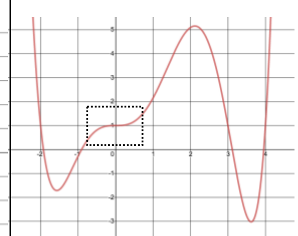
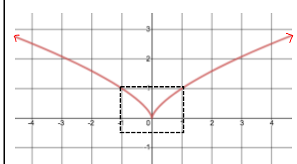
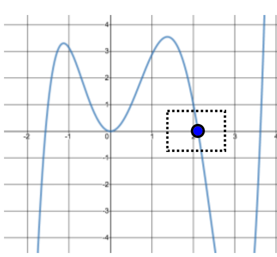
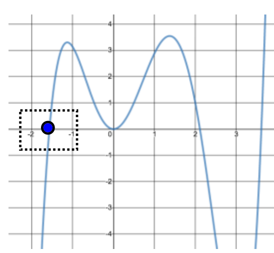
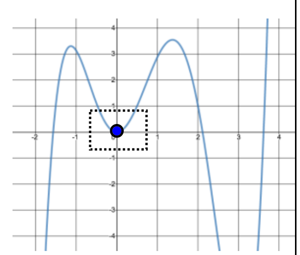
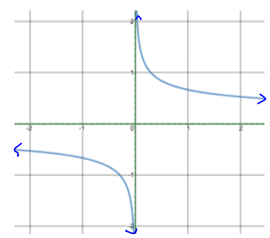
If $f'(x) > 0$ on an interval, $f(x)$ is increasing on that interval

If $f'(x) < 0$ on an interval, $f(x)$ is decreasing on that interval

Part 2: Properties of graphs of $f(x)$ and $f'(x)$

A critical number is a value $'a'$ in the domain where $f'(a) = 0$ or $f'(a)$ does not exist.

A critical number could yield…

	A local max	A local min	Neither	Max/Min at Cusp
$f(x)$				
$f'(x)$				

Conclusion:

Local extrema occur when the sign of the derivative CHANGES. If the sign of the derivative does not change, you do not have a local extrema.

A critical number of a function is a value of a in the domain of the function where either $f'(a) = 0$ or $f'(a)$ does not exist. If a is a critical number, $(a, f(a))$ is a critical point. Critical points could be local extrema but not necessarily. You must test around the critical points to see if the derivative changes sign. This is called the ______________________________________.

Example 1: Determine all local extrema for the function below using critical numbers and the first derivative test. State when the function is increasing or decreasing.

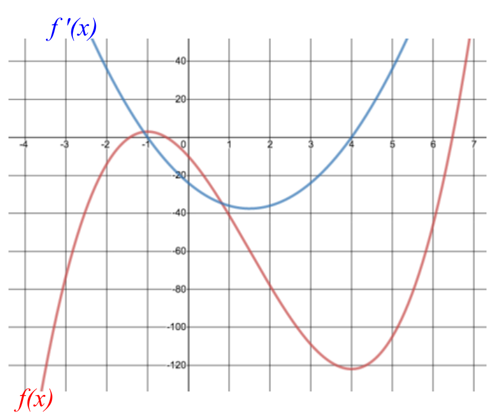
$f(x) = 2x^3 - 9x^2 - 24x - 10$

Critical Numbers: Critical Points:

Sign Chart:

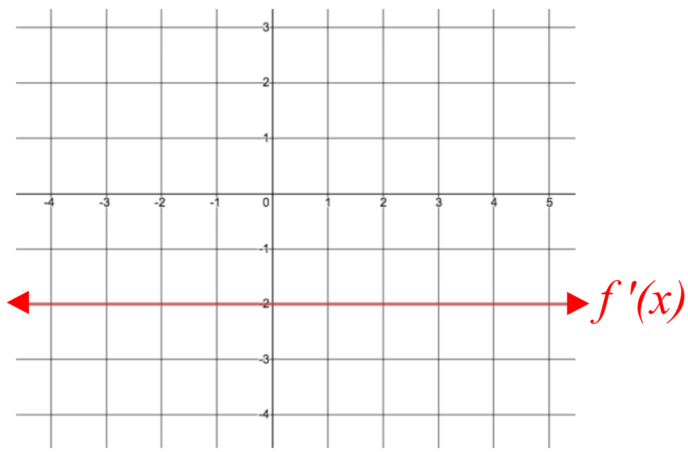
Test value for x			
$f'(x)$			
$f(x)$			

Notice how we could use the graph of the derivative to verify our solution:

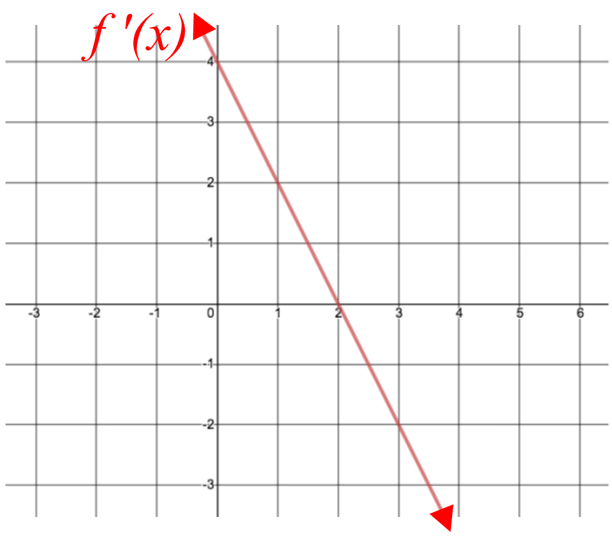


Example 2: For each function, use the graph of $f'(x)$ to sketch a possible function $f(x)$.

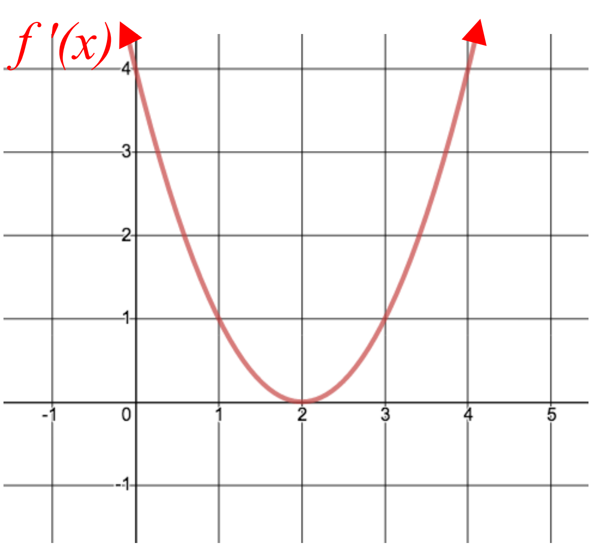
a)



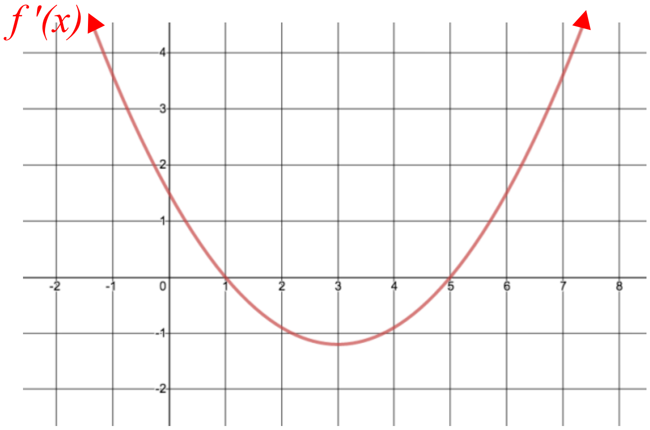
b)



c)

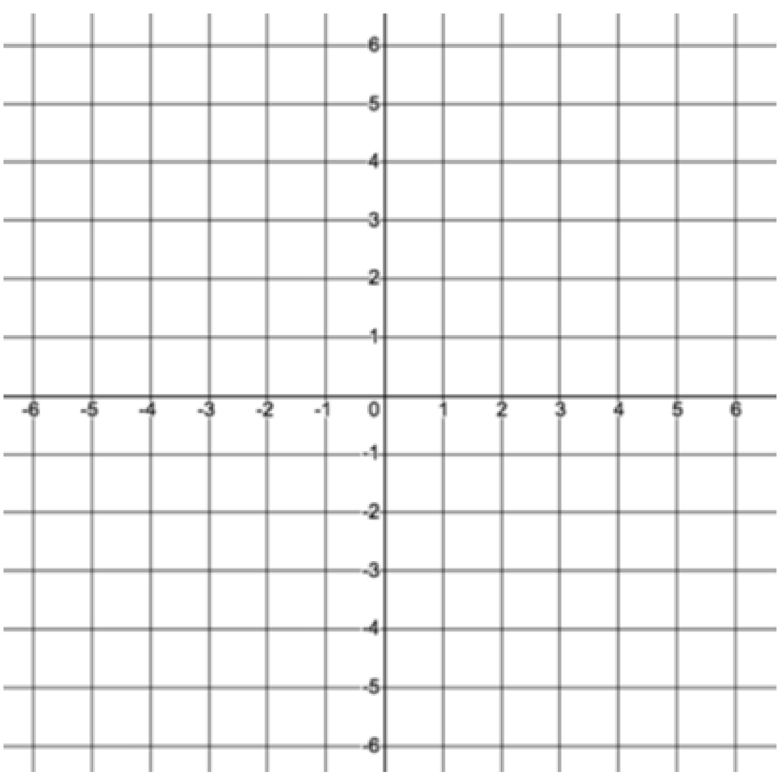


d)

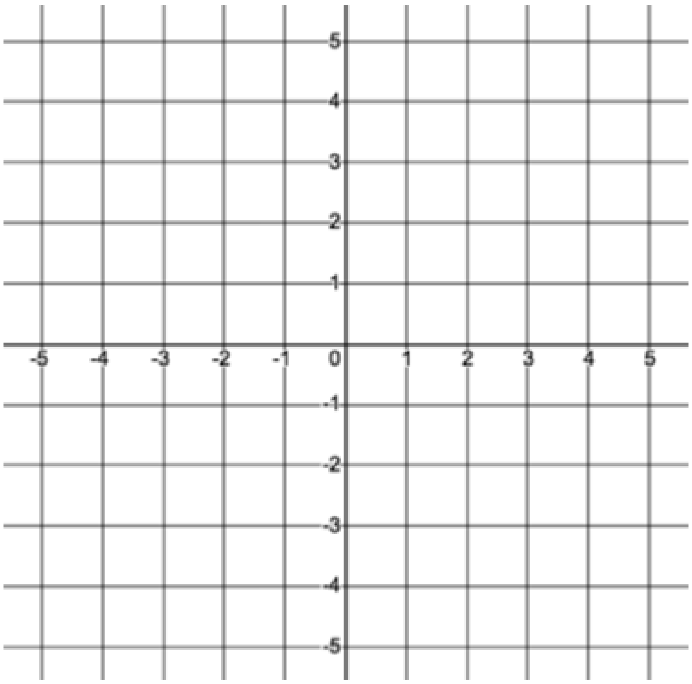


Example 3: Sketch a continuous function for each set of conditions

a) $f'(x) > 0$ when $x < 0$, $f'(x) < 0$ when $x > 0$, $f(0) = 4$



b) $f'(x) > 0$ when $x < -1$ and when $x > 2$, $f'(x) < 0$ when $-1 < x < 2$, $f(0) = 0$



Example 4: The temperature of a person with a certain strain of flu can be approximated by the function $T(d) = -\frac{5}{18}d^2 + \frac{15}{9}d + 37$, where $0 < d < 6$; T represents the person's temperature, in degrees Celsius and d is the number of days after the person first shows symptoms. During what interval will the person's temperature be increasing?