THEOREM: FIRST DERIVATIVE TEST FOR LOCAL EXTREMA			
The following test applies to a continuous fu	nction f(x).		
At a critical point c:			
1. If f' changes sign from positive to negative maximum at c.	e at c (f'>0 for all x <c all="" and="" f'<0="" for="" x="">c), then f has a local</c>		
f' (c) = 0	f' (c) does not exist		
2. If f' changes sign from negative to positive minimum at c.	e at c (f'< cfor all x <c and="" f'=""> 0 for all x>c), then f has a local</c>		
f' (c) = 0	f' (c) does not exist		
3. If f' does not change sign at c (f' has the s	same sign on both sides of c), then f has no local extreme		
	f' (c) does not exist		
f' (c) = 0	1 (c) does not exist		

>	At the left end	ooint a: if f'<0 (f'	>0) for all x> a	, then f has a lo	ocal maximum	(minimum) value at a.
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f' (q) = 0	f' (a) does not exist

> At the right endpoint b: if f'<0 (f'>0) for all x< b, then f has a local minimum (maximum) value at b.

f' (b) = 0	f' (b) does not exist		

Example: Use the first derivative test to identify all local extrema of $y = -x^3 + 12x - 5$

Note: y is a polynomial function that is continuous and differentiable on its entire domain. So the only critical points are those where y has a horizontal tangent.

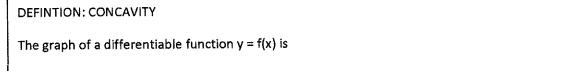
Step 1:Find dy/dx and the points where it is zero.

Step 2: Use these points to split a number line into intervals. Within each interval identify whether the dy/dx is positive or negative.

Step 3: Identify whether the critical points yield a local maximum or minimum.

Step 4. Sketch the graph of y to check your work.

CONCAVITY



- 1. Concave up on an open interval I if y^{\prime} is increasing on I.
- 2. Concave down on an open interval I if y' is decreasing on I.

Examples:

- \succ Concavity Test: The graph of a twice-differentiable function y = f(x) is
 - 1. concave up on any interval where y" > 0
 - 2. concave down on any interval where $y^{\prime\prime} < 0$

Example: Identify intervals on which $y = 2x^3 - x^2 - 5x$ is concave up and concave down.

POINTS OF INFLECTION

DEFINITION: a point where the graph of a function has a tangent line and where the concavity changes, is a point of inflection.

- A point of inflection can be either at the point where the second derivative zero or at the point where the second derivative does not exist.
- Not all points that have a zero second derivative are inflection points.
- An inflection point implies the change in the sign of the second derivative.

Examples:

SECOND DERIVATIVE TEST FOR LOCAL EXTREMA

- 1. If f'(c) = 0 and f''(c) < 0, then f has a local maximum at x = c.
- 2. If f'(c) = 0 and f''(c) > 0, then f has a local minimum at x = c.

Note: this test fails if f''(c) = 0 or when f''(c) fails to exists and the first derivative test must be used instead.

Copy the chart from p 213:						
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