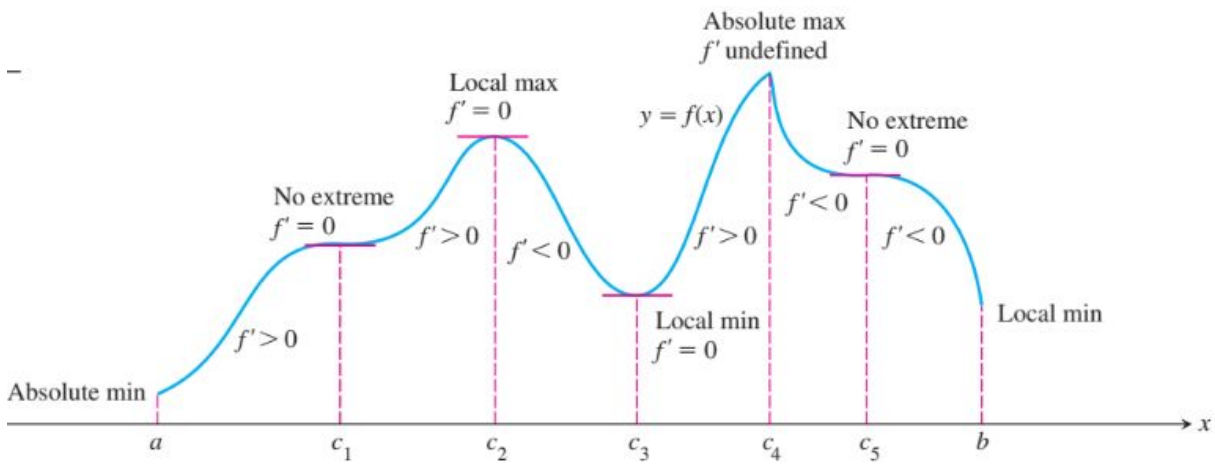
Finding critical points:

Critical points don't immediately imply local extrema!



First Derivative Test	
Max in Interval	
Min in Interval	

Max at Endpoint	
Min at Endpoint	

1. Use the first derivative test to determine the local extreme values of the function, and identify any absolute extrema. Support your answers graphically.
   a. $y = -2x^3 + 6x^2 - 3$
   b. $$y = \begin{cases} 3 - x^2, & x < 0 \\ x^2 + 1, & x \geq 0 \end{cases}$$

Concavity	
Concave Up	
Concave Down	

2. Use the concavity test to determine the intervals on which the graph of the function is (a) concave up and (b) concave down.
   a. $y = -x^4 + 4x^3 - 4x + 1$
   b. $y = e^x, \quad 0 \le x \le 2\pi$

Point of Inflection

3. Find all points of inflection of the function.

a. $y = x^3(4 - x)$

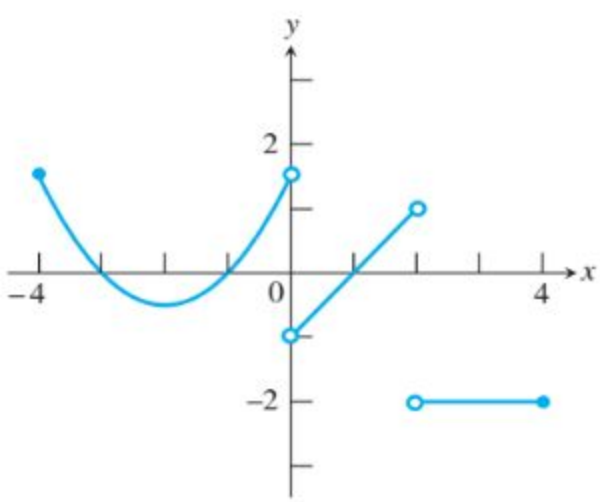
b. $y = \frac{x}{x+1}$

Second Derivative Test	
Max in Interval	
Min in Interval	

4. Find the local extreme values of $f(x) = x^3 - 12x - 5$.

5. Let $f'(x) = 4x^3 - 12x^2$. (a) Identify where the extrema of f occur. (b) Find the intervals on which f is increasing and decreasing. (c) Find where the graph of f is concave up and concave down. (d) Sketch a possible graph of f.

6. A function f is continuous on the interval $[-4, 4]$. The discontinuous function f', with domain $[-4, 0) \cup (0, 2) \cup (2, 4]$, is shown below. (a) Find the x-coordinates of all local extrema and points of inflection of f. (b) Sketch a possible graph of f.



8. Use the graph of the function f' to estimate the intervals on which the function f is (a) increasing or (b) decreasing. Also, (c) estimate the x-coordinates of all local extrema values.