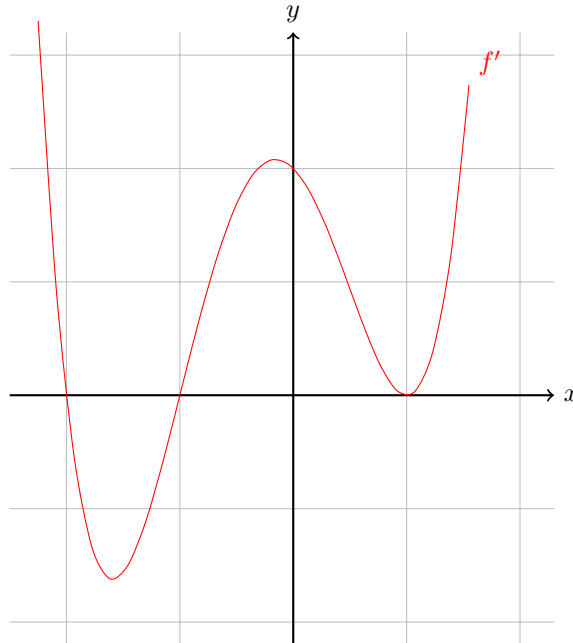

Sections 5.1, 5.2, 5.3



Exercise 1. Given the graph of f' below,

1. Determine over which interval is f increasing? decreasing?
2. What are the critical numbers of f ? Does the function f has local maxima, local minima at the critical numbers.
3. Determine over which interval is f concave upward? concave downward? Find the inflection points.

Exercise 2. Sketch a graph of a continuous function f satisfying the following properties:

1. $f(0) = 0$, $f(3) = -1$, $f'(3) = 0$.
2. $f'(x) < 0$ if $0 < x < 3$; $f'(x) > 0$ if $x > 3$.
3. $f''(x) < 0$ if $x < 1$ and $x > 5$; $f''(x) > 0$ if $1 < x < 5$.
4. $\lim_{x \rightarrow \infty} f(x) = 2$.
5. $f(-x) = f(x)$.

Exercise 3. On which intervals is f increasing? Find the local extrema.

1. $f(x) = x^3 + 3x^2 - 9x + 5$.
2. $f(x) = 2x^3 - 3x^2 + 5$.
3. $f(x) = \frac{(x-2)^2}{x^2+1}$

Exercise 4. Find the critical numbers for the following functions.

1. $f(x) = x^3 + 3x^2 - 9x + 5$
2. $f(x) = |x^2 - 3x + 2|$
3. $f(x) = x^2 \ln(x)$
4. $f(x) = x^{(2/3)}(2x - 5)$
5. $f(x) = x^2 e^{-x^2}$

Exercise 5. Find all absolute and local extrema for the following functions by sketching the graph.

1. $f(x) = \sin x$ for x in $[\pi/4, 5\pi/6]$.
2. $f(x) = \begin{cases} 2x - 1, & \text{for } 0 \leq x < 2 \\ 1 - (x - 3)^2 & \text{for } 2 \leq x \leq 4 \end{cases}$

Exercise 6. Find the absolute maximum and absolute minimum values for the following functions on the given interval.

1. $f(x) = \frac{x^2}{x+4}$ for x in $[-2, 6]$.
2. $f(x) = 2 \sin x + (\cos^2 x)$, for x in $[0, 2\pi]$
3. $f(x) = \sqrt[3]{x^2 - 1}$ for $-2 \leq x \leq 3$

Exercise 7. Sketch the graph of a continuous function on $[0, 5]$ that satisfies

1. f has a maximum at $x = 1$
2. f has a critical number at $x = 2$ but no local maximum
3. f has a local minimum at $x = 3$,
4. f has a local maximum at $x = 4$ and the derivative of f does not exist.
5. f has a minimum at $x = 5$

Exercise 8. Find the intervals where the following functions are concave up and concave down and identify all inflection points.

1. $f(x) = x^4 - 6x^2$
2. $f(x) = (x^2 - 1)^5$
3. $f(x) = x^{(2/3)} \sqrt[3]{x - 1}$

Exercise 9. Let $f(x) = x^5 - 10x^3 + 1$

1. Determine over which interval is f increasing? decreasing?
2. What are the critical numbers of f ? Does the function f has local maxima, local minima at the critical numbers.
3. Determine over which interval is f concave upward? concave downward? Find the inflection points.

Exercise 10. Let f be a 2 times differentiable function such that

x	$f(x)$	$f'(x)$	$f''(x)$
1	3	$f'(x) = 0$	$f''(x) = 4$
4	2	$f'(x) = 0$	$f''(x) = -2$
2	-1	$f'(x) = 0$	$f''(x) = 0$
3	0	$f'(x) DNE$	$f''(x) DNE$

At which critical points of f is there a local extrema? Specify whether they are local maxima or local minima. Illustrate each case by a figure.