

Write your questions
and thoughts here!

1. For the function $f(x) = 2x^3 + 4x^2 + 2x$, use a table to help you organize and draw conclusions.

x	_____
$f'(x)$	_____

x	_____
$f''(x)$	_____

When is f both **concave up** and **decreasing**?

x	_____
$f'(x)$	_____
$f''(x)$	_____

Speeding up or slowing down?

An object is **speeding up** if _____ have the same sign.

An object is **slowing down** if _____ have different signs.

2. A particle is moving along the x -axis with position function $x(t) = \frac{1}{3}t^3 - 4t^2 + 12t$. Find the velocity and acceleration functions. Describe the motion of the particle.

3. For the given function $f(x)$, $f'(x)$ and $f''(x)$ do not change signs. A table of values for $f(x)$ is given in the table below.

x	$f(x)$
0	1
1	2
2	4
3	7

- a. Is $f(x)$ increasing or decreasing?
- b. Is $f(x)$ concave up or concave down?

5.9 Connecting f , f' , and f''

Calculus

Practice

1. A particle's position along the x -axis is measured by $x(t) = \frac{1}{3}t^3 - 3t^2 + 8t + 1$ where $t > 0$. Find the intervals where the particle is speeding up. Find intervals where the particle is slowing down.

-
2. A particle's position along the y -axis is measured by $y(t) = t - 3(t - 4)^{\frac{1}{3}}$ where $t > 0$. Find the intervals where the particle is speeding up. Find intervals where the particle is slowing down.

For each table, selected values of x and $f(x)$ are given. Assume that $f'(x)$ and $f''(x)$ do not change signs. Answer the questions for each table.

3.

x	$f(x)$
4	-5
5	-8
6	-12
7	-17

- Is $f(x)$ increasing or decreasing?
- Is $f(x)$ concave up or concave down?

4.

x	$f(x)$
-3	-2
-2	3
-1	7
0	10

- Is $f(x)$ increasing or decreasing?
- Is $f(x)$ concave up or concave down?

5.

x	$f(x)$
2	3
3	0
4	-2
5	-3

- Is $f(x)$ increasing or decreasing?
- Is $f(x)$ concave up or concave down?

6. Given the function $g(x) = -x^4 + 2x^2 - 1$, find the interval(s) when g is concave up and increasing at the same time.

7. Given the function $h(x) = x^3 - 2x^2 + x$, find the interval(s) when h is concave up and decreasing at the same time.

5.9 Connecting f , f' , and f''

8. **Calculator active problem.** Let h be the function given by $h(t) = 70 - 15 \cos\left(\frac{\pi t}{3}\right) + 5 \sin\left(\frac{\pi t}{4}\right)$ for $0 \leq t \leq 5$. At what value of t is h increasing most rapidly?

- (A) 0.266 (B) 1.343 (C) 2.851 (D) 4.439 (E) 5.000

9.

x	-5	-4	-2	0	3
$f'(x)$	-8	-10	-7	-4	-6

Calculator active problem. Let f be a polynomial function with values of $f'(x)$ at selected values of x given in the table above. Which of the following must be true for $-5 < x < 3$?

- (A) The graph of f has at least two points of inflection.
 (B) The graph of f is concave down.
 (C) f is decreasing.
 (D) f has at least two relative extrema.
 (E) f has no critical points.

10. In the xy -plane, the graph of the twice-differentiable function $y = f(x)$ is concave down on the open interval $(1, 3)$ and is tangent to the line $y = 4x + 3$ at $x = 2$. Which of the following statements must be true about the derivative of f ?

- (A) $f'(x)$ is constant on the interval $(2, 2.1)$.
 (B) $f'(x) > 0$ on the interval $(2, 2.1)$.
 (C) $f'(x) < 0$ on the interval $(2, 2.1)$.
 (D) $f'(x) \geq 4$ on the interval $(2, 2.1)$.
 (E) $f'(x) \leq 4$ on the interval $(2, 2.1)$.