2.1 Increasing / Decreasing Worksheet

This document was composed and formatted by Annie Bernatchez.

The course material originated from www.jensenmath.ca

1) Use critical numbers and the first derivative test to determine when the function is increasing or decreasing.

a) $f(x) = x^3 + 3x^2 + 1$

b) $f(x) = x^5 - 5x^4 + 100$

c) $f(x) = 3x^4 + 4x^3 - 12x^2$

d) $f(x) = (2x - 1)^2(x^2 - 9)$

2) Suppose that $f(x)$ is a differentiable function with the given derivative. Determine the values of x for which $f(x)$ is increasing and decreasing.

a) $f'(x) = (x - 1)(x + 2)(x + 3)$

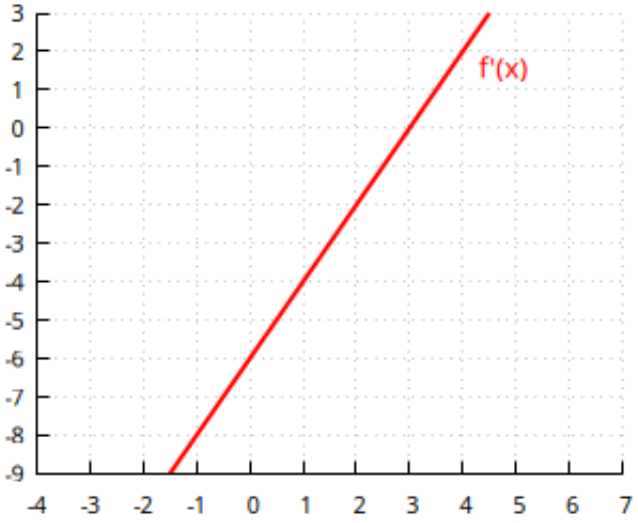
b) $f'(x) = x^2 + 2x - 4$

Copyright © 2026 Annie Bernatchez—All rights reserved.

c) $f'(x) = x^3 + 3x^2 - 4x - 12$

3) Given each graph of $f'(x)$, state the intervals of increase and decrease for the function $f(x)$. Then sketch a possible graph of $f(x)$.

a)

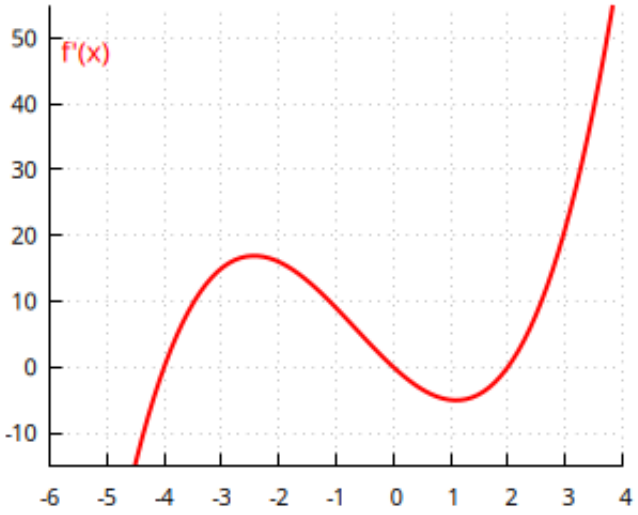


b)



Copyright © 2026 Annie Bernatchez—All rights reserved.

c)



4) Sketch a continuous graph of $f(x)$ given each set of conditions.

a) $f'(x) > 0$ when $x < 3$, $f'(x) < 0$ when $x > 3$, $f(3) = 5$

b) $f'(x) > 0$ when $-1 < x < 3$, $f'(x) < 0$ when $x < -1$ and when $x > 3$, $f(-1) = -\frac{20}{27}$, $f(3) = 4$

c) $f'(x) > 0$ when $x \neq 2$, $f(2) = 1$

Answer Key

1) a) increasing: $x < -2, x > 0$; decreasing: $-2 < x < 0$ b) increasing: $x < 0, x > 4$; decreasing: $0 < x < 4$ c) increasing: $-2 < x < 0, x > 1$; decreasing: $x < -2, 0 < x < 1$ d) increasing: $-2 < x < 0.5, x > 2.25$; decreasing: $x < -2, 0.5 < x < 2.25$

2) a) increasing: $-3 < x < -2, x > 1$; decreasing: $x < -3, -2 < x < 1$ b) increasing: $x < -1 - \sqrt{5}, x > -1 + \sqrt{5}$; decreasing: $-1 - \sqrt{5} < x < -1 + \sqrt{5}$ c) increasing: $-3 < x < -2, x > 2$; decreasing: $x < -3, -2 < x < 2$

3) a) increasing: $x > 3$; decreasing: $x < 3$ b) increasing: $x < -1, x > 2$; decreasing: $-1 < x < 2$ c) increasing:

Copyright © 2026 Annie Bernatchez—All rights reserved.

$-4 < x < 0,\ x > 2$; decreasing: $x < -4,\ 0 < x < 2$

Copyright © 2026 Annie Bernatchez—All rights reserved.