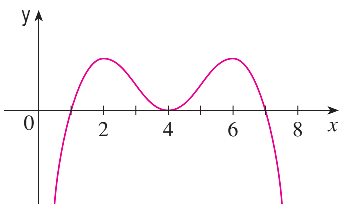
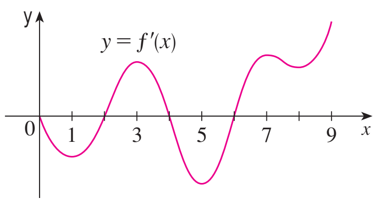
7. In each part state the x-coordinates of the inflection points of f. Give reasons for your answers.
(a) The curve is the graph of f.
(b) The curve is the graph of f'.
(c) The curve is the graph of f''.



8. The graph of the first derivative f' of a function f is shown.
(a) On what intervals is f increasing? Explain.
(b) At what values of x does f have a local maximum or minimum? Explain.
(c) On what intervals is f concave upward or concave downward? Explain.
(d) What are the x-coordinates of the inflection points of f? Why?



9–18
(a) Find the intervals on which f is increasing or decreasing.
(b) Find the local maximum and minimum values of f.
(c) Find the intervals of concavity and the inflection points.

9. $f(x) = 2x^3 + 3x^2 - 36x$

10. $f(x) = 4x^3 + 3x^2 - 6x + 1$

11. $f(x) = x^4 - 2x^2 + 3$

12. $f(x) = \dfrac{x}{x^2 + 1}$

13. $f(x) = \sin x + \cos x, \quad 0 \leqslant x \leqslant 2\pi$

14. $f(x) = \cos^2 x - 2 \sin x, \quad 0 \leqslant x \leqslant 2\pi$

15. $f(x) = e^{2x} + e^{-x}$

16. $f(x) = x^2 \ln x$

17. $f(x) = x^2 - x - \ln x$

18. $f(x) = x^4 e^{-x}$

19–21 Find the local maximum and minimum values of f using both the First and Second Derivative Tests. Which method do you prefer?

19. $f(x) = 1 + 3x^2 - 2x^3$

20. $f(x) = \dfrac{x^2}{x - 1}$

21. $f(x) = \sqrt{x} - \sqrt[4]{x}$

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22. (a) Find the critical numbers of $f(x) = x^4(x - 1)^3$.
(b) What does the Second Derivative Test tell you about the behavior of f at these critical numbers?
(c) What does the First Derivative Test tell you?

23. Suppose f'' is continuous on $(-\infty, \infty)$.
(a) If $f'(2) = 0$ and $f''(2) = -5$, what can you say about f?
(b) If $f'(6) = 0$ and $f''(6) = 0$, what can you say about f?

24–29 Sketch the graph of a function that satisfies all of the given conditions.

24. Vertical asymptote $x = 0$, $\quad f'(x) > 0$ if $x < -2$,
$f'(x) < 0$ if $x > -2$ $(x \neq 0)$,
$f''(x) < 0$ if $x < 0$, $\quad f''(x) > 0$ if $x > 0$

25. $f'(0) = f'(2) = f'(4) = 0$,
$f'(x) > 0$ if $x < 0$ or $2 < x < 4$,
$f'(x) < 0$ if $0 < x < 2$ or $x > 4$,
$f''(x) > 0$ if $1 < x < 3$, $\quad f''(x) < 0$ if $x < 1$ or $x > 3$

26. $f'(1) = f'(-1) = 0$, $\quad f'(x) < 0$ if $|x| < 1$,
$f'(x) > 0$ if $1 < |x| < 2$, $\quad f'(x) = -1$ if $|x| > 2$,
$f''(x) < 0$ if $-2 < x < 0$, $\quad$ inflection point $(0, 1)$

27. $f'(x) > 0$ if $|x| < 2$, $\quad f'(x) < 0$ if $|x| > 2$,
$f'(-2) = 0$, $\quad \lim_{x \to 2} |f'(x)| = \infty$, $\quad f''(x) > 0$ if $x \neq 2$

28. $f'(x) > 0$ if $|x| < 2$, $\quad f'(x) < 0$ if $|x| > 2$,
$f'(2) = 0$, $\quad \lim_{x \to \infty} f(x) = 1$, $\quad f(-x) = -f(x)$,
$f''(x) < 0$ if $0 < x < 3$, $\quad f''(x) > 0$ if $x > 3$

29. $f'(x) < 0$ and $f''(x) < 0$ for all x

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30. Suppose $f(3) = 2$, $f'(3) = \frac{1}{2}$, and $f'(x) > 0$ and $f''(x) < 0$ for all x.
(a) Sketch a possible graph for f.
(b) How many solutions does the equation $f(x) = 0$ have? Why?
(c) Is it possible that $f'(2) = \frac{1}{3}$? Why?

31–32 The graph of the derivative f' of a continuous function f is shown.
(a) On what intervals is f increasing? Decreasing?
(b) At what values of x does f have a local maximum? Local minimum?
(c) On what intervals is f concave upward? Concave downward?
(d) State the x-coordinate(s) of the point(s) of inflection.
(e) Assuming that $f(0) = 0$, sketch a graph of f.

31.