$f'(x) > 0$ if $x < c$; $f'(x) < 0$ if $x > c$; $f''(x) < 0$ if $x < c$; $f''(x) < 0$ if $x > c$

$f'(x) > 0$ if $x < c$; $f'(x) > 0$ if $x > c$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $x > c$

$f'(x) > 0$ if $x < c$; $f'(x) < 0$ if $x > c$; $f''(x) > 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$f'(x) < 0$ if $x < c$; $f'(x) > 0$ if $x > c$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $x > c$

$f'(c) = 0$; $f'(c) = 0$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $x > c$

$f(c) = 0$; $f'(x) > 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$f'(c) = 0$; $f'(c) = 0$; $f''(x) > 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$f(c) = 0$; $f'(x) < 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$f'(c) = 0$; $f'(c) = -1$; $f''(x) < 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$f'(c) = 0$; $f'(c) = \frac{1}{2}$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $x > c$

$f'(c)$ does not exist; $f''(x) > 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$f'(c)$ does not exist; $f''(c)$ does not exist; $f''(x) < 0$ if $x < c$; $f''(x) > 0$ if $x > c$

$\lim_{x \to c} f(x) = +\infty$; $\lim_{x \to c^+} f'(x) = 0$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $x > c$

$\lim_{x \to c} f(x) = +\infty$; $\lim_{x \to c^+} f'(x) = -\infty$; $f''(x) > 0$ if $x < c$; $f''(x) > 0$ if $x > c$

Draw a sketch of the graph of a function f for which $f(x)$, $f'(x)$, and $f''(x)$ exist and are positive for all x.

Draw a sketch of the graph of a function f for which $f(x)$, $f'(x)$, and $f''(x)$ exist and are negative for all x.

If $f(x) = x^5$, show that 0 is a critical number of f but that $f(0)$ is not a relative extremum. Is the origin a point of

$f(c) = 0$; $\lim_{x \to d^-} f'(x) = +\infty$; $\lim_{x \to d^+} f'(x) = +\infty$; $f'(e) = 0$; $f''(x) > 0$ if $x < d$; $f''(x) < 0$ if $x > d$

$f'(c) = 0$; $\lim_{x \to d} f'(x) = -\infty$; $\lim_{x \to d^+} f'(x) = -\infty$; $f'(e) = 0$; $f''(x) < 0$ if $x < d$; $f''(x) > 0$ if $x > d$

$f'(c)$ does not exist; $f'(d) = -1$; $f''(d) = 0$; $f'(e) = 0$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $c < x < d$; $f''(x) > 0$ if $x > d$

$f'(c) = 0$; $f'(d) = -1$; $f''(d) = 0$; $f'(e)$ does not exist; $f''(x) < 0$ if $x < d$; $f''(x) > 0$ if $d < x < e$; $f''(x) < 0$ if $x > e$

$f'(c) = 0$; $f'(d)$ does not exist; $f'(e) = 0$; $f''(e) = 0$; $f''(x) < 0$ if $x < d$; $f''(x) < 0$ if $d < x < e$; $f''(x) > 0$ if $x > e$

$f'(c) = 0$; $f''(c) = 0$; $f'(d)$ does not exist; $f'(e) = 0$; $f''(x) < 0$ if $x < c$; $f''(x) > 0$ if $c < x < d$; $f''(x) > 0$ if $x > d$

Suppose that $\frac{1}{2}\sqrt{2}$ and $-\frac{1}{2}\sqrt{3}$ are critical numbers of a function f and that $f''(x) = x[\![\frac{1}{2}x^2 + 1]\!]$. At each of these numbers, determine if f has a relative extremum, and if so, whether it is a relative maximum or a relative minimum.

In Exercises 31 through 42, draw a portion of the graph of a function f through the points $(c, f(c))$, $(d, f(d))$, and $(e, f(e))$ if the given conditions are satisfied. Also draw a segment of the tangent line at each of these points, if there is a tangent line. Assume that $c < d < e$ and f is continuous on some open interval containing c, d, and e.

31. $f'(c) = 0$; $f'(d) = 1$; $f''(d) = 0$; $f'(e) = 0$; $f''(x) > 0$ if $x < d$; $f''(x) < 0$ if $x > d$
32. $f'(c) = 0$; $f'(d) = -1$; $f''(d) = 0$; $f'(e) = 0$; $f''(x) < 0$ if $x < d$; $f''(x) > 0$ if $x > d$
33. $f'(c) = 0$; $f'(d) = -1$; $f''(d) = 0$; $f'(e) = 0$; $f''(e) = 0$; $f''(x) < 0$ if $x < d$; $f''(x) > 0$ if $d < x < e$; $f''(x) < 0$ if $x > e$
34. $f'(c) = 0$; $f'(d) = 1$; $f''(d) = 0$; $f'(e) = 0$; $f''(e) = 0$; $f''(x) > 0$ if $x < d$; $f''(x) < 0$ if $d < x < e$; $f''(x) > 0$ if $x > e$
35. $f'(c) = 0$; $f''(c) = 0$; $f'(d) = -1$; $f''(d) = 0$; $f'(e) = 0$; $f''(x) > 0$ if $x < c$; $f''(x) < 0$ if $c < x < d$; $f''(x) > 0$ if $x > d$
36. $f'(c) = 0$; $f''(c) = 0$; $f'(d) = 1$; $f''(d) = 0$; $f'(e) = 0$; $f''(x) < 0$ if $x < c$; $f''(x) > 0$ if $c < x < d$; $f''(x) < 0$ if $x > d$