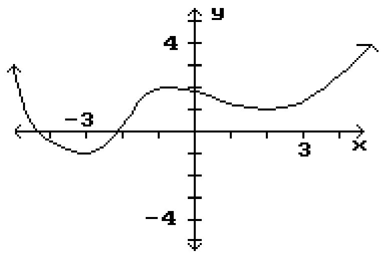
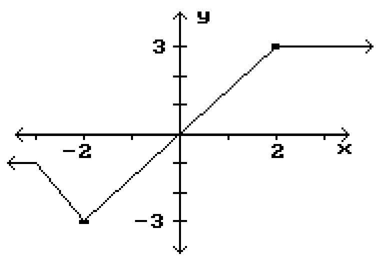
Find the location and value of each relative extremum for the function.

1)



Identify the intervals where the function is changing as requested.

2) Increasing



Find the open interval(s) where the function is changing as requested.

3) Increasing $y = (x^2 - 9)^2$

4) Decreasing $y = \frac{1}{x^2} + 7$

Determine the location of each local extremum of the function.

5) $f(x) = x^3 - 4.5x^2 - 12x - 2$

Determine the coordinates of each local extremum of the function.

6) $f(x) = \frac{x^2}{x^2 + 5}$

Solve each problem.

7) The velocity of a particle (in $\frac{ft}{s}$) is given by $v = t^2 - 5t + 3$, where t is the time (in seconds) for which it has traveled. Find the time at which the velocity is at a minimum.

Evaluate f ''(c) at the point.

8) $f(x) = \frac{x^2 + 2}{3x^2 - 1}$, $c = 0$

9) $f(x) = e^{4-x^2}$, $c = 2$

Find the indicated derivative of the function.

10) $f^{(4)}(x)$ of $f(x) = 2x^6 - 4x^4 + 2x^2$

11) $f'''(x)$ of $f(x) = \dfrac{1}{x + 1}$

Solve the problem.

12) Find the velocity function v(t) if $s(t) = -3t^3 + 5t^2 - 9t - 9$.

13) Find the acceleration function a(t) if $s(t) = \dfrac{5}{2t + 3}$.

s is the distance (in ft) traveled in time t (in s) by a particle. Find the velocity and acceleration at the given time.

14) $s = 3t^3 + 4t^2 + 5t + 2$, $t = 1$

Find the coordinates of the point(s) of inflection for the function.

15) $f(x) = x^3 + 9x^2 + 27x + 5$

16) $f(x) = -x^2 - 18x - 79$

Find the open interval(s) where the function is concave upward.

17) $f(x) = x^3 - 3x^2 - 4x + 5$

18) $f(x) = \dfrac{3}{x + 2}$

Find all critical numbers for the function. State whether it leads to a local maximum, a local minimum, or neither.

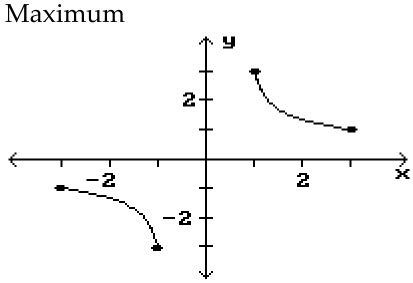
19) $f(x) = -x^3 - 6x^2 - 9x - 1$

The rule of the derivative of a function f is given. Find the location of all local extrema.

20) $f'(x) = (x^2 - 16)(x + 5)$

Find the location of the indicated absolute extrema for the function.

21) Maximum



Find the absolute extremum within the specified domain.

22) Minimum of $f(x) = x^3 - 3x^2$; $[-0.5, 4]$

23) Minimum of $f(x) = \frac{5}{\sqrt{x^2 + 9}}$; $[-3, 2]$

Solve the problem.

24) If the price charged for a bolt is p cents, then x thousand bolts will be sold in a certain hardware store, where $p = 24 - \frac{x}{32}$. How many bolts must be sold to maximize revenue?

25) An architect needs to design a rectangular room with an area of 77 ft^2. What dimensions should she use in order to minimize the perimeter? Round to the nearest hundredth if necessary.

26) A piece of molding 191 cm long is to be cut to form a rectangular picture frame. What dimensions will enclose the largest area?

27) A rectangular field is to be enclosed on four sides with a fence. Fencing costs $2 per foot for two opposite sides, and $5 per foot for the other two sides. Find the dimensions of the field of area 820 ft^2 that would be the cheapest to enclose.

Sketch the graph and show all local extrema and inflection points.

28) $f(x) = 6x^3 + 12x^2 + 6x$

Sketch a graph of a single function that has these properties.

29) (a) defined for all real numbers
(b) increasing on $(-3, -1)$ and $(2, \infty)$
(c) decreasing on $(-\infty, -3)$ and $(-1, 2)$
(d) concave upward on $(-\infty, -2)$ and $(1, \infty)$
(e) concave downward on $(-2, 1)$
(f) $f'(-3) = f'(-1) = f'(2) = 0$
(g) inflection point at $(-2, 0)$ and $(1, 1)$

Sketch the graph. Show all local extrema, point(s) of inflection, x– and y–intercept(s), and all asymptotes.

30) $f(x) = \frac{x + 1}{x}$

Find the partial derivative.

31) Let $z = f(x,y) = 5x^2 - 15xy + 7y^3$. Find $\frac{\partial z}{\partial x}$.

32) Find $g_y(3, 4)$ when $g(x,y) = xe^{xy}$.

Find the partial derivative as requested.

33) $f_x(2, 3)$ if $f(x,y) = \dfrac{3x^2}{2y}$

Find the second–order partial derivative.

34) Find f_{xx} when $f(x,y) = 8x^3y - 7y^2 + 2x$.

35) Find f_{yy} when $f(x,y) = 8x^3y - 7y^2 + 2x$.

36) Find $\dfrac{\partial^2 z}{\partial x\, \partial y}$ when $z = \ln|2x + 9y|$.

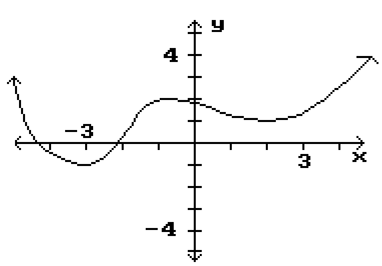
Solve the problem.

37) Suppose that the manufacturing cost of a precision instrument is approximated by $C(x,y) = 10x^2 + 5y^2 - 5xy$, where x is the cost of materials and y is the cost of labor. Find $C_y(2, 6)$.

Find values of x and y such that both $f_x(x,y) = 0$ and $f_y(x,y) = 0$.

38) $f(x,y) = 3x^2 + 3y^2 - 6x - 6y + 2$

1) (−3,−1), (−1,2), (2,1)
2) (−2, 2)
3) (3, ∞) and (−3, 0)
4) (0, ∞)
5) Local maximum at −1; local minimum at 4
6) Local minimum at (0, 0)
7) 2.5 s
8) f''(0) = −14
9) f''(2) = 14
10) $f^{(4)}(x) = 720x^2 - 96$
11) $f'''(x) = -6(x + 1)^{-4}$
12) $v(t) = -9t^2 + 10t - 9$
13) $\frac{40}{(2t + 3)^3}$
14) v = 22 ft/s, a = 26 ft/s^2
15) (−3, −22)
16) There are no points of inflection.
17) (1, ∞)
18) (−2, ∞)
19) Local maximum at −1; local minimum at −3
20) Local maximum at −4; local minima at −5 and 4
21) (1, 3)
22) (2, −4)
23) $(-3, \frac{5\sqrt{2}}{6})$
24) 384 thousand bolts
25) 8.77 ft x 8.77 ft ($\sqrt{77}$ft x $\sqrt{77}$ft)
26) 47.75 cm x 47.75 cm ($\frac{191}{4}$ cm x $\frac{191}{4}$ cm)
27) 45.3 ft @ $2 by 18.1 ft @ $5 ($5\sqrt{82}$ ft @ $2 by $2\sqrt{82}$ ft @ $5)
28) x−intercepts: −1, 0
y−intercept: 0
Local maximum: (−1, 0)
Local minimum: $(-\frac{1}{3}, -\frac{8}{9})$
Inflection point: $(-\frac{2}{3}, -\frac{4}{9})$
29)



30) x–intercept: -1 V.A.: $x = 0$
y–intercept: none H.A.: $y = 1$

Local extrema: none
Inflection points: none

Decreasing on $(-\infty, 0)$ & $(0, \infty)$
Concave up on $(0, \infty)$
Concave down on $(-\infty, 0)$

31) $10x - 15y$
32) $9e^{12}$
33) 2
34) $48xy$
35) -14
36) $\dfrac{-18}{(2x + 9y)^2}$
37) 50
38) $x = 1$, $y = 1$